၂၀၂၂ ခုနှစ်၊ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုရ

ပါရဂူကျမ်း

သုတေသနလုပ်ငန်း အစီရင်ခံစာများ

2022 Calendar Year, Myanmar Academy of Arts and Science Award Winning

Doctoral Dissertation

Research Reports

၂၀၂၅ ခုနှစ်၊ ဩဂုတ်လ

2025, August

၂၀၂၂ ခုနှစ်၊ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုရ ပါရဂူကျမ်း

သုတေသနလုပ်ငန်း အစီရင်ခံစာများ

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Research Reports

၂၀၂၅ ခုနှစ်၊ သြဂုတ်လ

2025, August

စာစဉ်အမှတ် - ၄၉

ပထမအကြိမ်ပုံနှိပ်ခြင်း

၂၀၂၅ ခုနှစ်၊ သြဂုတ်လ

အုပ်ရေ ၁၅၀

ပညာရေးဝန်ကြီးဌာန မူပိုင်ဖြစ်သည်။

ထုတ်ဝေသူ ဒေါက်တာ မောင်ကျော်(ဝဝ၃၂၂)၊ ဒုတိယဥက္ကဋ္ဌ
မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့

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တက္ကသိုလ်နယ်မြေ၊ တက္ကသိုလ်များပုံနှိပ်တိုက်တွင်
မန်နေဂျာ- ဦးတင်စိုး(၀၀၁၇၁)က ပုံနှိပ်သည်။

မာတိကာ

အမှာစာ

ပညာရေးသည် လူမှုစီးပွားဘဝကို မြှင့်တင်ပေး ရုံသာမက၊ ပြည်တွင်း ငြိမ်းချမ်းရေးမှသည် နိုင်ငံတော်၏ စီးပွားရေးနှင့် အမျိုးသား စည်းလုံးညီညွတ်ရေးကို ဖွံ့ဖြိုးတိုးတက်စေရာတွင် အဓိက အခန်းကဏ္ဍမှ ပါဝင်နေပါသည်။

မြန်မာနိုင်ငံ၏ ပညာရေးအဆင့်အတန်းကို နိုင်ငံတော်က အာဆီယံ ဒေသတွင်း နိုင်ငံများ၏ အဆင့်အတန်းမှသည် ကမ္ဘာ့ဖွံ့ဖြိုးပြီးနိုင်ငံကြီးများ၏ အဆင့်အတန်းကို မီသည်အထိ မြှင့်တင်ပေးသွားရန် ရည်မှန်းထားပါသည်။ ပညာရေးဝန်ကြီးဌာနအနေဖြင့် ဤရည်မှန်းချက် အထမြောက်စေရေးအတွက် အမျိုးသားပညာရေး မဟာဗျူဟာ စီမံကိန်း (၂၀၂၁-၂၀၃၀)ကို ရေးဆွဲချမှတ်၍ အကောင်အထည်ဖော် ဆောင်ရွက်လျက် ရှိပါသည်။

အမျိုးသားပညာရေးဥပဒေကို ပြင်ဆင်သည့်ဥပဒေ (၂၀၁၅)၊ စာမျက်နှာ (၁၃)၊ ပုဒ်မ(၂၈)တွင် သုတေသန ဆောင်ရွက်မှုနှင့်စပ်လျဉ်း၍ အဆင့်မြင့်ပညာ သင်ကြားပို့ချနေသော တက္ကသိုလ်ကောလိပ်များအား သုတေသနနှင့် ပညာရပ်ဖွံ့ဖြိုးမှုကို ဦးစားပေး ဆောင်ရွက်ရမည်ဟု ပြဋ္ဌာန်းထားပါသည်။

နိုင်ငံတော်အစိုးရက မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ကို ၁၉၉၉ ခုနှစ်၊ ဩဂုတ်လ (၁၆)ရက်နေ့တွင် ဖွဲ့စည်းပေးခဲ့ပါသည်။ ဤပညာရှင်အဖွဲ့အနေဖြင့် ပညာရေးနှင့် နီးနွယ်သော -

(က) သင်ကြားရေးနှင့်သင်ယူရေး၊

(ခ) သုတေသန လုပ်ငန်းလမ်းညွှန်မှု ပေးရေး၊

(ဂ) ပညာပြန့်ပွားရေးနှင့်ပညာဖြန့်ဖြူးရေး၊

(ဃ) ပညာရှင်များ ပြုစုပျိုးထောင်ရေး

ဟူသော လုပ်ငန်းကြီးလေးမျိုးကို ပညာရေးကဏ္ဍ၏ လိုအပ်ချက်များအရ ဦးစားပေးအစီအစဉ်အတိုင်း ပြည်တွင်း ပြည်ပ ပညာရှင်များနှင့် ပူးပေါင်း၍ ဆောင်ရွက်လျက်ရှိပါသည်။

ပညာရှင်အဖွဲ့ကို စတင် ဖွဲ့စည်းချိန် ၁၉၉၉ ခုနှစ်မှစတင်၍ သုတေသနစာတမ်းဖတ်ပွဲများကို နှစ်စဉ် ကျင်းပ ပေးနိုင်ခဲ့ပါသည်။ ၂၀၀၅ ခုနှစ် ပဉ္စမအကြိမ် သုတေသနစာတမ်းဖတ်ပွဲမှ အစပြု၍ **အကောင်းဆုံး သုတေသနစာတမ်းဆု(Best Paper Award)**ကို ချီးမြှင့်ခဲ့ရာ၊ တစ်နှစ်ထက် တစ်နှစ် ဆုရစာတမ်းများ၏ အရေအတွက် ပိုမို၍တိုးပွားလာခဲ့ပါသည်။ ၂၀၂၄ ခုနှစ် (၂၃) ကြိမ်မြောက် ဝိဇ္ဇာနှင့်သိပ္ပံ သုတေသနညီလာခံ၌ အကောင်းဆုံး သုတေသနစာတမ်းဆုကို**(၅၁) ဆု၊ ပထမဆု (၁၅) ဆု၊ ဒုတိယဆု (၁၀)ဆု၊ တတိယဆု (၅)ဆု၊ ဂုဏ်ပြုစု (၂၁) ဆု** စာတမ်းရှင် စုစုပေါင်း (၅၁)ဦး အား ချီးမြှင့်နိုင်ခဲ့ပါသည်။

သုတေသနလုပ်ငန်းများပေါ် အခြေခံ၍ ပါရဂူကျမ်းပြုစုခဲ့သော ပညာရှင်များအနက် ထူးချွန်သူများအား ရွေးချယ်၍ **မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု** (Academy Award) ကို ချီးမြှင့်ရန် ပညာရှင်အဖွဲ့အနေဖြင့် ကြိုးပမ်းခဲ့ပါသည်။ ၂၀၂၂ ပြည့်နှစ်တွင် ပါရဂူဘွဲ့ရရှိခဲ့သူ စုစုပေါင်း (၁၅)ဦး ယှဉ်ပြိုင်ခဲ့ရာ (၈) ဦး ပညာရှင်အဖွဲ့ဆု ရရှိခဲ့ကြပါသည်။ ဘာသာရပ်တိုင်း၌ ပညာရှင်အဖွဲ့ဆု၏ အရေအတွက်နှင့်အတူ ဆုငွေ၏ပမာဏကိုလည်း တိုးမြှင့်ပေးအပ်သွားရန်ပညာရှင်အဖွဲ့က ကြိုးစားနေပါသည်။ ပညာရှင်အဖွဲ့ဆု အစပျိုးချိန်တွင် ပညာရှင်အဖွဲ့၊ ထွန်းဖောင်ဒေးရှင်း၊ သီရိမွန် ဖောင်ဒေးရှင်း၊ ကမ္ဘောဇဘဏ်တို့၏ လှူဒါန်းငွေဖြင့် ဆုများကိုချီးမြှင့်ခဲ့ပါသည်။

ယခုအခါ (က) မြန်မာနိုင်ငံစာစစ်အဖွဲ့ဥက္ကဋ္ဌ(ငြိမ်း) ဦးမောင်မောင်စိန်နှင့်ဇနီး ဒေါ်ခင်မာမာတို့က ရန်ကုန် တက္ကသိုလ် ပါမောက္ခချုပ် ဆရာကြီး ဒေါက်တာထင်အောင် အထိမ်းအမှတ်အဖြစ် လှူဒါန်းငွေ၊

(ခ) ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ ဆရာကြီး ဦးဝီလျံပေါ အထိမ်းအမှတ်အဖြစ် လျှုဒါန်းငွေ၊

(ဂ) ရန်ကုန်တက္ကသိုလ် မြန်မာစာဌာနမှ မြန်မာစာဌာန တည်ထောင်ခဲ့သည့် (၇၅) နှစ်ပြည့် အထိမ်းအမှတ်အဖြစ် လှူဒါန်းငွေနှင့်

(ဃ) ဆရာမကြီး ဒေါ်ခင်သိန်း၊ ပါမောက္ခ(ငြိမ်း)၊ အရှေ့တိုင်းပညာဌာနမှ ရန်ကုန်တက္ကသိုလ် ပါမောက္ခချုပ် ဆရာကြီး ဦးဖေမောင်တင် အထိမ်းအမှတ် အဖြစ် လှူဒါန်းငွေ

များကို ဘဏ်တွင်ပဒေသာပင်အဖြစ် အပ်နှံကာတိုးပွားလာသည့် ဘဏ်အတိုးငွေများဖြင့် ဆုငွေကိုချီးမြှင့်လျက် ရှိပါသည်။

ထိုလှူဒါန်းငွေများအပြင် သုတေသနစာတမ်းဆုနှင့် ပညာရှင်အဖွဲ့ဆုအတွက် ၂၀၁၆ ခုနှစ်၊ (၁၆)ကြိမ်မြောက် သုတေသနစာတမ်းဖတ်ပွဲမှ အစပြု၍ ပညာရေးဝန်ကြီးဌာနမှ ဆုငွေများကို ထုတ်ပေးနေပါသည်။

တက္ကသိုလ်၊ ကောလိပ်များမှ ဆရာဆရာမများ၏ စွမ်းဆောင်ရည်သည် တစ်ဦးချင်း၏ ပညာအရည်အချင်းနှင့်အတူ မိမိတတ်ကျွမ်းသော ဘာသာရပ်၌ မိမိဆောင်ရွက်ခဲ့သော သုတေသနလုပ်ငန်းများမှ ရရှိထားသည့် အတွေ့အကြုံများ အပေါ်တွင်လည်း အများအပြား မူတည်နေပါသည်။

(၂၃) ကြိမ်မြောက် သုတေသနညီလာခံတွင် ၂၀၂၂ ပြက္ခဒိန်နှစ်အတွက် မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု ရရှိခဲ့သည့် သုတေသနလုပ်ငန်း အစီရင်ခံစာများမှာ အောက်ပါအတိုင်း ဖြစ်ပါသည် -

(က) သိပ္ပံပညာရပ်

- **ဓာတုဗေဒ ဘာသာရပ်**

  Preparation, Characterization and Application of Carboxymethyl Cellulose-Polyvinyl Alcohol Composite Film

- **ဘူမိဗေဒ ဘာသာရပ်**

  Assessment and Analysis of Landslides in Mawchi Mine Area, Pasawng Township, Bawlakhe District, Kayah State, Myanmar

(ခ) လူမှုရေးပညာရပ်

- **ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှု ဘာသာရပ်**

  The Development of a Pedagogic Facilitating Model in Promoting Primary Students' Critical Thinking Skills

- **ပညာရေးစိတ်ပညာ ဘာသာရပ်**

  The Impact of Metacognitive Awareness on English Reading Comprehension Ability of High School Students

- **သင်ရိုးညွှန်းတမ်းနှင့်သင်ပြနည်း ဘာသာရပ်**

  Integrating Collaborative Learning Techniques and Concept Mapping in Teaching Physics

- **ဝါဏိဇ္ဇဗေဒ ဘာသာရပ်**

  The Effect of Social Media Marketing on Brand Equity of Myanmar Cosmetics

- **အသုံးချစာရင်းအင်း ဘာသာရပ်**

  Estimation of Rate of Returns on Investment in Education in Myanmar

- **ဝါဏိဇ္ဇဗေဒ ဘာသာရပ်**

  Influence of Social Marketing on Behaviour Changes of Diabetic Patients

ပါရဂူကျမ်းဆိုင်ရာ သုတေသနပြုစုသူများ အပါအဝင် တက္ကသိုလ် ဆရာ၊ ဆရာမများနှင့် အများပြည်သူတို့ လေ့လာခွင့် ရရှိစေရန် ရည်ရွယ်၍ ဤစာအုပ်ကို ပုံနှိပ်ထုတ်ဝေ ဖြန့်ချိခြင်း ဖြစ်ပါသည်။

ဒေါက်တာသက်လွင်

ဥက္ကဋ္ဌ

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့

FOREWORD

Education not only improves socio-economic lives of all ethnic groups in enhancing the country's economy, national unity, peace and tranquility.

The Primary aim of the government is to raise the level of Myanmar education from the current level of the ASEAN member countries to those of the world's developed countries. The Ministry of Education has been implementing the National Education Strategic Plan 2021-2030 to achieve this goal.

The National Education Law had been amended in 2015; On page 13, Section 28 of this law stipulates that research and academic development projects must be given priority by universities and colleges offering various courses.

In 1999, the government constituted the Myanmar Academy of Arts and Science on August 16, academics at Higher Education Institutions were entrusted with the following tasks –

(a) teaching and learning,

(b) providing research guidance,

(c) Imparting core subject and disseminating knowledge, and

(d) Nurturing Scholars.

According to the needs of the education sector, these tasks are being carried out in cooperation with both local as well as overseas experts according to priorities adopted in the strategic plan.

Since the establishment of the academy in 1999, research conferences have been held every year. Beginning with the fifth research conference in 2005, the Best Paper Award was awarded. The number of award-winning papers has increased year by year, in 2023 a total of 51 authors received the best paper award.

Based on the research activities, the academy tried to confer **Myanmar Academy of Arts and Science Award** (Academy Award) to outstanding scholars who had submitted doctoral theses. In 2022, out of a total of 15 scholars who had earned their doctorate degrees, received the academy award. Our academy is trying to increase the amount of prize money in every subject. At the time of the initiation of the award, prizes were awarded with donations from Thiri Mon Foundation, Htun Foundation, Kanbawza Bank and other donors viz.

(a) Retired President of the Board of Examinations U Maung Maung Sein and his spouse donated money in commemoration of Sayagyi Dr Htin Aung, Rector of Rangoon University

(b) Yangon University of Economics donated money in commemoration of Sayagyi Saw William Paw

(c) Department of Myanmar, University of Yangon, donated money in commemoration of its 75th anniversary, and

(d) Sayamagyi Daw Khin Thein, Retired Professor of the Department of Oriental Studies, University of Yangon donated money in commemoration of Sayagyi U Pe Maung Tin

In addition to those donations, for the Best Paper Award and the Academy Award in 2016. Starting from the 16th Research Conference, the Ministry of Education has been providing funds for conferring awards.

The performance of academics viz. faculty staff members at higher education institutions depends to a large extent on the individual's educational qualifications as well as the experience gained from the research activities carried out in the subject of his/her choice.

The research reports that won Academy Award for the 2022 calendar year at the 23rd Research Conference were given below –

This book is being printed and distributed with the objective of enriching the knowledge of post graduate students in particular and the public in general.

The best research report of doctoral theses for the year 2022 are:

(a) Physical Sciences

- **Chemistry**

  Preparation, Characterization and Application of Carboxymethyl Cellulose-Polyvinyl Alcohol Composite Film

- **Geology**

  Assessment and Analysis of Landslides in Mawchi Mine Area, Pasawng Township, Bawlakhe District, Kayah State, Myanmar

(b) Social Science

- **Educational Theory and Management**

  The Development of a Pedagogic Facilitating Model in Promoting Primary Students' Critical Thinking Skills

- **Educational Psychology**

  The Impact of Metacognitive Awareness on English Reading Comprehension Ability of High School Students

- **Curriculum and Methodology**

  Integrating Collaborative Learning Techniques and Concept Mapping in Teaching Physics

- **Commerce**

  The Effect of Social Media Marketing on Brand Equity of Myanmar Cosmetics

- **Apply Statistics**

  Estimation of Rate of Returns on Investment in Education in Myanmar

- **Commerce**

  Influence of Social Marketing on Behaviour Changes of Diabetic Patients

The Myanmar Academy of Arts and Science is delighted to publish this book for the benefit of the Contestants concerned, the academicians in the universities and colleges as well as the general public.

Dr Thet Lwin
President
Myanmar Academy of Arts and Science

၂၀၂၂ ခုနှစ်၊ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု နှင့် နှီးနွယ်သော ပါရဂူကျမ်းနှင့်သုတေသနလုပ်ငန်းအစီရင်ခံစာ ရွေးချယ်မှု

- ရည်ရွယ်ချက်
- ဆုပေးအပ်ချီးမြှင့်မှု
- စံသတ်မှတ်ချက်
- ရွေးချယ်ရေးအဖွဲ့ ဖွဲ့စည်းခြင်း
- ဆုချီးမြှင့်ခြင်း

၁။ ။ ၂၀၂၂ ခုနှစ်၊ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုနှင့် နှီးနွယ်သော ပါရဂူကျမ်း သုတေသနလုပ်ငန်း အစီရင်ခံစာ ရွေးချယ်မှု

ရည်ရွယ်ချက်

၁။ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့၊ အခြေခံစည်းမျဉ်းများ အခန်း(၂)၊ အပိုဒ် (၃) တွင်ပါရှိသည့် ရည်ရွယ်ချက် (၅)ရပ်အနက် –

(၁) နိုင်ငံတော်ကို အကျိုးပြုမည့် သုတေသနလုပ်ငန်းများ ဆောင်ရွက်ရန်နှင့်

(၂) နိုင်ငံတော်ကိုအကျိုးပြုမည့် ဝိဇ္ဇာသိပ္ပံပညာရှင်များ မွေးထုတ်နိုင်ရေးအတွက် စီမံဆောင်ရွက်ရန်၊

တို့ပါရှိပါသည်။

ဆုပေးအပ်ချီးမြှင့်မှု

၂။ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အမှုဆောင်အဖွဲ့၏ စတုတ္ထလုပ်ငန်းအဖွဲ့ဖြစ်သော ပညာရှင်ပြုစု ပျိုးထောင်ရေးအဖွဲ့က ချမှတ်ထားသည့် လုပ်ငန်းစဉ် (၁၄)ရပ်အနက်၊ လုပ်ငန်းစဉ် (၄)တွင် ဝိဇ္ဇာနှင့်သိပ္ပံ ပညာရပ်ဆိုင်ရာ ကျမ်းများ၊ စာအုပ်များအနက်မှ အကောင်းဆုံးကို **"ဝိဇ္ဇာနှင့်သိပ္ပံဘာသာ စာပေဆု"** ချီးမြှင့်ရန် ပါရှိပါသည်။ အဆိုပါဆုကို မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု အနေဖြင့် ထိုက်တန်စွာ ပေးအပ်ချီးမြှင့်ရန် ရည်ရွယ်ခြင်း ဖြစ်ပါသည်။

စံသတ်မှတ်ချက်

၃။ "**မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု**" ရွေးချယ်ရေးအတွက် ယေဘုယျ သတ်မှတ်ထားသော စံများမှာ အောက်ပါအတိုင်းဖြစ်ပါသည်-

(က) ပြည်ထောင်စုသမ္မတ မြန်မာနိုင်ငံတော်၊ ပညာရေးဝန်ကြီးဌာနအောက်ရှိ တက္ကသိုလ်များတွင် သတ်မှတ်ထားသည့်ခုနှစ်အတွင်း တင်သွင်း လက်ခံခဲ့သော ပါရဂူကျမ်း ဖြစ်ရမည်။

(ခ) နိုင်ငံတော်နှင့်လူမျိုးအတွက် အသိဉာဏ် တိုးတက်စေရန်(သို့မဟုတ်) အသိဉာဏ်ကို အသုံးချ နိုင်စေရန် (သို့မဟုတ်) သက်ဆိုင်ရာ ဘာသာရပ် ဖွံ့ဖြိုးတိုးတက်စေရန် ထူးခြားစွာ အကျိုးပြုစေ နိုင်သည့် ပါရဂူကျမ်းဖြစ်ရမည်။

(ဂ) **"မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင် အဖွဲ့ဆု"** အတွက် မိမိ၏ပါရဂူကျမ်းကို အခြေခံ၍ စာမျက်နှာ (၂၀-၃၀) ခန့်ရှိ သုတေသနလုပ်ငန်း အစီရင်ခံစာ (Research Report) ပြုစု ရေးသားတင်သွင်း ရမည်။

(ဃ) မူပိုင်ကိစ္စနှင့်စပ်လျဉ်း၍ ရှင်းရှင်းလင်းလင်း ရှိစေရမည်။

(င) ၂၀၂၂ ခုနှစ်အတွင်း ပညာရေးဝန်ကြီးဌာန အောက်ရှိ တက္ကသိုလ်များတွင် ထုတ်ပြန်သော **ပါရဂူကျမ်း အောင်စာရင်းတွင်** ပါရှိကြောင်း **သက်ဆိုင်ရာ ပါရဂူဘွဲ့ ရယူခဲ့သည့် တက္ကသိုလ်၏ မော်ကွန်းထိန်းထံ**မှ ထောက်ခံချက် ပါရှိရမည်။

ရွေးချယ်ရေးအဖွဲ့ ဖွဲ့စည်းခြင်း

၄။ **"မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု"** ရွေးချယ်ရေးအဖွဲ့များကို အကဲဖြတ်နိုင်မည့် ပညာရှင်များဖြင့် ဖွဲ့စည်း၍ ရွေးချယ်ခြင်းဖြစ်ပါသည်။

၅။ သုတေသနလုပ်ငန်းအစီရင်ခံစာကို အောက်ဖော်ပြပါ မူ (၅)ရပ်အပေါ်တွင် အခြေခံ၍ အကဲဖြတ် ရွေးချယ်ပါသည်-

(က) သုတေသနလုပ်ငန်းသည် နိုင်ငံတော်အတွက် မည်၍ မည်မျှအကျိုးပြုခြင်း (Contribution to the National Interest)

(ခ) သုတေသနလုပ်ငန်းသည် ပင်ကို ဖြစ်ခြင်း (Originality)

(ဂ) သုတေသနလုပ်ငန်းကို စနစ်တကျ/သိပ္ပံနည်းကျ ဆောင်ရွက်ထားခြင်း (Systematic/ Scientific Approach)

(ဃ) သုတေသနလုပ်ငန်းသည် ဘာသာရပ်အတွက် မည်သည့်အတိုင်းအတာအထိ အကျိုးပြုနိုင်ခြင်း (Contribution to the Subject)

(င) သုတေသနအစီရင်ခံစာ ဖတ်ကြား တင်ပြပုံ စနစ်ကျနခြင်း (Presentation, Format and Style)

ဆုချီးမြှင့်ခြင်း

၆။ "မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု" ချီးမြှင့်ပေးအပ်ရာတွင် -

(က) အဆိုပြုလာသော ဝိဇ္ဇာဘာသာရပ်ဆိုင်ရာ ပါရဂူကျမ်းများအနက်၊ အကောင်းဆုံး ဝိဇ္ဇာပညာရပ် ပါရဂူကျမ်းနှင့် သုတေသနလုပ်ငန်းအစီရင်ခံစာ ပြုစုသောပုဂ္ဂိုလ်အား ပညာရှင်အဖွဲ့၏ ဆုကို **ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု (ဝိဇ္ဇာပညာရပ်)** ဟူ၍ လည်းကောင်း၊

(ခ) အဆိုပြုလာသော သိပ္ပံဘာသာရပ်ဆိုင်ရာ ပါရဂူကျမ်းများအနက်၊ အကောင်းဆုံး သိပ္ပံပညာရပ် ပါရဂူကျမ်းနှင့် သုတေသနလုပ်ငန်း အစီရင်ခံစာ ပြုစုသောပုဂ္ဂိုလ်အား ပညာရှင်အဖွဲ့၏ဆုကို **ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု (သိပ္ပံပညာရပ်)**ဟူ၍ လည်းကောင်း၊

(ဂ) အဆိုပြုလာသော လူမှုရေး (စီးပွါးရေးပညာ၊ သင်ပြမှု/သင်ယူမှုပညာ၊ ဥပဒေပညာ၊ ဘာသာ စကားစသည့်) ဘာသာရပ်ဆိုင်ရာ ပါရဂူကျမ်းများအနက်၊ အကောင်းဆုံး လူမှုရေးပညာရပ် ပါရဂူကျမ်းနှင့် သုတေသနလုပ်ငန်းအစီရင်ခံစာ ပြုစုသောပုဂ္ဂိုလ်အား ပညာရှင်အဖွဲ့၏ဆုကို **ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု (လူမှုရေးပညာရပ်)**ဟူ၍ လည်းကောင်း၊

ဆု (၃)မျိုး ခွဲခြား၍ ချီးမြှင့် ပေးအပ်ခြင်း ဖြစ်ပါသည်။

မှတ်ချက် ။ ဆု တစ်ဆုစီအတွက် အကောင်းဆုံးဟု ယူဆထားသော ပါရဂူကျမ်း အကယ်၍ မရှိပါက ထိုဆုအတွက် ချီးမြှင့်မည် မဟုတ်ပါ။

၇။ ၂၀၂၂ ခုနှစ်၊ (၁၇)ကြိမ်မြောက် "**မြန်မာနိုင်ငံဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင် အဖွဲ့ဆု"**အတွက် ပြိုင်ပွဲဝင်သည့် ပါရဂူဘွဲ့ရပညာရှင် စုစုပေါင်း (၁၅)ဦး ရှိခဲ့ရာ၊ အောက်ဖော်ပြပါ (၈) ဦးတို့သည် **"မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင် အဖွဲ့ဆု"** ကို -

(၁) **သိပ္ပံပညာရပ်**မှ ဓာတုဗေဒ ဘာသာရပ်တွင် ဒေါက်တာထက်ထက်သန်းစိန်၊ ဘူမိဗေဒ ဘာသာရပ်တွင် ဒေါက်တာဇော်ဇော်သိန်း တို့က လည်းကောင်း၊

(၂) **လူမှုရေးပညာရပ်**မှ ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှု ဘာသာရပ်တွင် ဒေါက်တာအိအိဖြိုး၊ ပညာရေးစိတ်ပညာ ဘာသာရပ်တွင် ဒေါက်တာဝင့်ဝါဝါထွန်း၊ သင်ရိုးညွှန်းတမ်းနှင့်သင်ပြနည်း ဘာသာရပ်

တွင် ဒေါက်တာနန်းယဉ်ယဉ်မိုး၊ ဝါဏိဇ္ဇဗေဒဘာသာရပ်တွင် ဒေါက်တာချိုမာလွင်နှင့် ဒေါက်တာဟိန်းလတ်၊ အသုံးချစာရင်းအင်းပညာ ဘာသာရပ်တွင် ဒေါက်တာခင်မို့မို့တို့က လည်းကောင်း၊ အသီးသီး ရရှိကြပါသည်။

၈။ အဆိုပါ **"မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု"** ချီးမြှင့်ရာ၌ ပါရဂူကျမ်းနှင့် သုတေသနလုပ်ငန်းအစီရင်ခံစာများအပေါ်တွင် အခြေပြု၍ အရွေးချယ်ခံရသည့်အကြောင်းရင်းတို့ကို အောက်တွင် အကျဉ်းချုပ်၍ ဖော်ပြထားပါသည်-

(၈-၁) သိပ္ပံ ပညာရပ် (၁) - **ဓာတုဗေဒဘာသာရပ်**
ဒေါက်တာထက်ထက်သန်းစိန်
ကထိက၊ ဓာတုဗေဒဌာန၊
ရန်ကုန်တက္ကသိုလ်

ကျမ်းခေါင်းစဉ် - Preparation, Characterization and Application of Carboxymethyl Cellulose-Polyvinyl Alcohol Composite Film

(က) **သိပ္ပံပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာထက်ထက်သန်းစိန်**သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်တက္ကသိုလ်မှ **ဓာတုဗေဒဘာသာရပ်** ဖြင့် ပါရဂူဘွဲ့ရရှိခဲ့သူ ဖြစ်ပါသည်။

(ခ) ဒေါက်တာထက်ထက်သန်းစိန်၏ သုတေသနသည် -

- Carboxymethyl Cellulose-Polyvinyl Alcohol Composite တစ်သားတည်း ဖြစ်သော ဖလင်ပြားကို ဓာတ်ခွဲခန်း၌ ပြုလုပ်ခြင်း၊ အရည်အသွေးကို တိုင်းတာစစ်ဆေးခြင်းနှင့် ၎င်းဖလင်ပြားကိုသုံး၍ မီးလောင်ဒဏ်ရာရသည့် ကိုယ်ရေပြားကို ဆေးဝါးဖြင့် ကုသရာတွင် အလားအလာရှိကြောင်း ဖော်ပြထားသည်ကို တွေ့ရှိရသည်။ တစ်သားတည်းဖြစ်သည့် ဖလင်ပြားကို ပြုလုပ်ရာတွင် ရိုးရှင်းသော နည်းစဉ်များကို သုံးထားကြောင်းနှင့် ကိုယ်ရေပြားမီးလောင်ဒဏ်ကို ကုရာတွင် မိုက်ခရိုပိုး (Microbial)၏ အန္တရာယ်မှကာကွယ်နိုင်မှုရှိ မရှိစမ်းသပ်ထားချက်အရ လည်းကောင်း၊ ဓာတ်ခွဲခန်း သုံးကြွက်ငယ်များဖြင့် စမ်းသပ်ရာတွင်လည်းကောင်း၊ SC-3 နှင့် SC PCA-4 composite တို့သည် ထိရောက်မှုရှိကြောင်း တွေ့ရှိချက်

တို့ကြောင့် **သိပ္ပံပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင် အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်း ဖြစ်ပါသည်။

(စ-၂) သိပ္ပံ ပညာရပ်(၂) - **ဘူမိဗေဒ ဘာသာရပ်**

ဒေါက်တာဇော်ဇော်သိန်း

လက်ထောက်ဘူမိဗေဒအရာရှိ

မြန်မာနိုင်ငံ သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင် ထိန်းသိမ်းရေး ဝန်ကြီးဌာန

ကျမ်းခေါင်းစဉ် - **Assessment and Analysis of Landslides in Mawchi Mine Area, Pasawng Township, Bawlakhe District, Kayah State, Myanmar**

(က) သိပ္ပံပညာရပ်တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာဇော်ဇော်သိန်း** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်တက္ကသိုလ်မှ **ဘူမိဗေဒဘာသာရပ်** ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူ ဖြစ်ပါသည်။

(ခ) ဒေါက်တာဇော်ဇော်သိန်း၏ သုတေသနသည် –

- မော်ချီးသတ္တုတွင်း၏ Slope Stability ကုန်းမြေအနိမ့်အမြင့်အရ တည်ငြိမ်မှုကို ဆန်းစစ်ထားကြောင်း၊
- သတ္ထုတူးဖော်ရာတွင် မြေအောက်ထိ နက်လာလေလေ Slope stability ၏ အခြေအနေကို သတိပြုရမည်ဖြစ်ကြောင်း၊
- အန္တရာယ်ကင်းစွာဖြင့် သတ္ထုတူးဖော်နိုင်ရန် Slope Stability ကို ဂရုပြုလုပ်ဆောင်ရမည့် သိပ္ပံနည်းကျ ဖော်ထုတ်ထားသည့် အချက်အလက်များကြောင့် သတ္ထုတွင်းတူးဖော်သည့်လုပ်ငန်းများအတွက် အကျိုးပြုသည့် သုတေသနဖြစ်ကြောင်း တွေ့ရှိရခြင်း

တို့ကြောင့် **သိပ္ပံပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်း ဖြစ်ပါသည်။

(စ-၃) လူမှုရေး ပညာရပ်(၁) - **ပညာရေးသဘောတရားနှင့်စီမံခန့်ခွဲမှု ဘာသာရပ်**

ဒေါက်တာအိအိဖြိုး

ကထိက၊ ပညာရေးသဘောတရားနှင့်စီမံခန့်ခွဲမှု ဌာန

ရန်ကုန်ပညာရေးတက္ကသိုလ်

ကျမ်းခေါင်းစဉ် - **The Development of a Pedagogic Facilitating Model in Promoting Primary Students' Critical Thinking Skills**

(က) **လူမှုရေးပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာအိအိဖြိုး** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်ပညာရေးတက္ကသိုလ်မှ **ပညာရေးသဘောတရားနှင့်စီမံခန့်ခွဲမှု ဘာသာရပ်**ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူဖြစ်ပါသည်။

(ခ) ဒေါက်တာအိအိဖြိုး၏ သုတေသနသည် –

- ပညာရေးဖွံ့ဖြိုးတိုးတက်မှု လုပ်ဆောင်မည့် ဆရာ ဆရာမများ၏ စွမ်းရည်မြှင့်တင်ရာတွင် အထောက်အကူပြုခြင်း၊ မူလတန်း ဆရာ ဆရာမတို့၏ သင်ကြားရေးဆိုင်ရာ

အရည်အသွေး တိုးတက်ကောင်းမွန်ရန် ၎င်းတို့အား စွမ်းအင်မြှင့်တင်လုပ်ပိုင်ခွင့် ပေးနိုင်မည့် သင်ကြားနည်းပုံစံဖြစ်ခြင်း၊ ကျောင်းသားတို့၏ ထိုးထွင်းစဉ်းစားသည့် ကျွမ်းကျင်မှု (Critical Thinking Skills) ဟူသော Concept တစ်ခုကို ဘာသာရပ် နှင့်ချိတ်ဆက်၍ သုတေသနပြု လုပ်ထားခြင်း

တို့ကြောင့် **လူမှုရေးပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်းဖြစ်ပါသည်။

(၈-၄) လူမှုရေး ပညာရပ် (၂) - **ပညာရေးစိတ်ပညာ ဘာသာရပ်**
ဒေါက်တာဝင့်ဝါဝါထွန်း
လက်ထောက်ကထိက၊ ပညာရေးစိတ်ပညာဌာန
ရန်ကုန်ပညာရေးတက္ကသိုလ်

ကျမ်းခေါင်းစဉ် - **The Impact of Metacognitive Awareness on English Reading Comprehension Ability of High School Students**

(က) **လူမှုရေးပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာဝင့်ဝါဝါထွန်း** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်ပညာရေးတက္ကသိုလ်မှ **ပညာရေးစိတ်ပညာဘာသာရပ်**ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူဖြစ်ပါသည်။

(ခ) ဒေါက်တာဝင့်ဝါဝါထွန်း၏ သုတေသနသည် –

- ဆရာအတတ်ပညာ၏ သင်ကြား/သင်ယူမှုဖြစ်စဉ်ကို တိုက်ရိုက်အကျိုးပြုခြင်း၊ ပညာရေးစိတ်ပညာဘာသာရပ်အတွက် အကျိုးပြုခြင်း၊ Training Programme ၏ အကျိုးသက်ရောက်မှုရှိခြင်း တွေ့ရှိရခြင်း

တို့ကြောင့် **လူမှုရေးပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်း ဖြစ်ပါသည်။

(၈-၅) လူမှုရေး ပညာရပ် (၃) - **သင်ရိုးညွှန်းတမ်းနှင့်သင်ပြနည်း ဘာသာရပ်**
ဒေါက်တာနန်းယဉ်ယဉ်မိုး
ကျောင်းအုပ်ကြီး၊ အမှတ်(၈) အခြေခံပညာအလယ်တန်းကျောင်း
မြောက်ဥက္ကလာပမြို့နယ်

ကျမ်းခေါင်းစဉ် - **Integrating Collaborative Learning Techniques and Concept Mapping in Teaching Physics**

(က) **လူမှုရေးပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာနန်းယဉ်ယဉ်မိုး** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်ပညာရေးတက္ကသိုလ်မှ **သင်ရိုးညွှန်းတမ်းနှင့်သင်ပြနည်း ဘာသာရပ်** ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူဖြစ်ပါသည်။

(ခ) ဒေါက်တာနန်းယဉ်ယဉ်မိုး၏ သုတေသနသည် –

- အခြေခံပညာ သိပ္ပံသင်ယူသူ ကျောင်းသား ကျောင်းသူများ၏ Students' Achievement in Physics တွင် အသုံးပြုနိုင်သော Model တစ်ခုကို ဖော်ထုတ်တင်ပြ

ထားခြင်း၊ ပညာရေးကိုပံ့ပိုးပေးနိုင်ခြင်း၊ သင်ယူသူဗဟိုပြု သင်ယူမှုပုံစံတွင် Collaboration ပူးပေါင်းဆောင်ရွက်မှုနှင့် Concept mapping သဘောတရားပြမြေပုံ သဘောတရားများကို ပေါင်းစပ်၍ အဆင့်သုံးဆင့် (Planning, instructional maneuver and evaluation) ကို အသစ်တီထွင် ဖန်တီးထားခြင်းနှင့် ၂၁ ရာစု ကျွမ်းကျင်မှုများ ဖွံ့ဖြိုးလာစေရန် သင်ယူသူဗဟိုပြု သင်ယူမှုပုံစံကို အသုံးပြု သင်ကြားရာတွင် အထောက်အကူပြုခြင်း၊ ဘာသာရပ်အတွက်များစွာအထောက်အကူ ပြုခြင်း

တို့ကြောင့် **လူမှုရေးပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်းဖြစ်ပါသည်။

(၈-ဖ) လူမှုရေး ပညာရပ်(၄) - **ဝါဏိဇ္ဇဗေဒ ဘာသာရပ်**
ဒေါက်တာချိုမာလွင်
တွဲဖက်ပါမောက္ခ
ရန်ကုန်အဝေးသင်တက္ကသိုလ်

ကျမ်းခေါင်းစဉ် - **The Effect of Social Media Marketing on Brand Equity of Myanmar Cosmetics**

(က) **လူမှုရေးပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာချိုမာလွင်** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ **ဝါဏိဇ္ဇဗေဒ ဘာသာရပ်** ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူဖြစ်ပါသည်။

(ခ) ဒေါက်တာချိုမာလွင်၏ သုတေသနသည် –

- နည်းပညာမြင့်မားသော နိုင်ငံခြားအလှကုန်များနှင့် ယှဉ်ပြိုင်နေရသော ပြည်တွင်း အလှကုန်လုပ်ငန်းများ ရပ်တည်ရှင်သန်နိုင်ရေးအတွက် အကြံပေးမှုများမှတစ်ဆင့် တိုင်းပြည်၏ အသေးစား၊ အလတ်စား စီးပွားရေးလုပ်ငန်းများ ဖွံ့ဖြိုးတိုးတက်ရေး၊ ပို့ကုန်အစားထိုးလုပ်ငန်းများ တိုးတက်ရေးအတွက် အထောက်အကူပြုသော သုတေသနကျမ်းဖြစ်ခြင်း၊ ပြည်တွင်းထုတ်လုပ်မှုကို တိုးတက်ပြီး၊ တိုင်းပြည်ဝင်ငွေကို ပါ မြှင့်တင်စေနိုင်ခြင်း၊
- လက်တွေ့နယ်ပယ်တွင် အသစ်ပြုလုပ်မှုကို အဓိကထားသော စာတမ်းတစ်ခုဖြစ် ပါသည်။ ထိရောက်သော social media marketing activities များကို အသုံးပြု ခြင်းဖြင့် စားသုံးသူများ၏ ဝယ်ယူလိုမှုနှင့်အခြားသော အကျိုးသက်ရောက်မှုများရှိ ခြင်း၊ အလှကုန်လုပ်ငန်းများသာမက အခြားသော ကုန်ပစ္စည်းများအတွက်လည်း လေ့လာသင့်သော ကျမ်းစာတစ်စောင်ဖြစ်ခြင်း၊
- သီအိုရီပိုင်းဆိုင်ရာ ကိုးကားမှုခိုင်မာပြီး၊ လက်တွေ့ပိုင်းတွင် သိပ္ပံနည်းကျသုတေသန နည်းလမ်းများဖြင့် အသုံးပြုကာ ပြည်တွင်းလုပ်ငန်းများအတွက် အထောက်အကူပြု အကြံပေးချက်များကြောင့် တိုင်းပြည်၏အသေးစား၊ အလတ်စားလုပ်ငန်းများ ဖွံ့ဖြိုးမှု အတွက် များစွာအထောက်အကူပြုခြင်း၊

တို့ကြောင့် **လူမှုရေးပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်းဖြစ်ပါသည်။

(၈-၇) လူမှုရေး ပညာရပ်(၅) - **အသုံးချစာရင်းအင်းပညာ ဘာသာရပ်**

ဒေါက်တာခင်မို့မို့

တွဲဖက်ပါမောက္ခ

ရန်ကုန်စီးပွားရေးတက္ကသိုလ်

ကျမ်းခေါင်းစဉ် - **Estimation of Rate of Returns on Investment in Education in Myanmar**

(က) **လူမှုရေးပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာခင်မို့မို့** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ **အသုံးချစာရင်းအင်းပညာ ဘာသာရပ်**ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူ ဖြစ်ပါသည်။

(ခ) ဒေါက်တာခင်မို့မို့၏ သုတေသနသည် –

- နိုင်ငံ့အကျိုးပြု စာတမ်းဖြစ်ပြီး ပညာရေးတွင် ရင်းနှီးမြှုပ်နှံခြင်းဖြင့် ရရှိမည့်အကျိုး ရလာဒ်ကို တွေ့ရခြင်း၊
- ပညာရေးတွင် ရင်းနှီးမြှုပ်နှံခြင်းဖြင့် အကျိုးရလာဒ်ကို Statistical Model သုံး၍ လေ့လာမှုပြုလုပ်ထားခြင်း၊

တို့ကြောင့် **လူမှုရေးပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်းဖြစ်ပါသည်။

(၈-၈) လူမှုရေး ပညာရပ်(၆) - **ဝါဏိဇ္ဇဗေဒ ဘာသာရပ်**

ဒေါက်တာဟိန်းလတ်

ကထိက

ရန်ကုန်အဝေးသင်တက္ကသိုလ်

ကျမ်းခေါင်းစဉ် - **Influence of Social Marketing on Behaviour Changes of Diabetic Patients**

(က) **လူမှုရေးပညာရပ်**တွင် ပညာရှင်အဖွဲ့ဆုရသူ **ဒေါက်တာဟိန်းလတ်** သည် ၂၀၂၂ ခုနှစ်တွင် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ **ဝါဏိဇ္ဇဗေဒ ဘာသာရပ်** ဖြင့် ပါရဂူဘွဲ့ ရရှိခဲ့သူဖြစ်ပါသည်။

(ခ) ဒေါက်တာဟိန်းလတ်၏ သုတေသနသည် –

- မြန်မာနိုင်ငံရှိ ဆီးချိုဝေဒနာသည်များအတွက် social marketing ဆိုင်ရာ သုတေသန နယ်ပယ်တွင် ကနဦး လေ့လာသောစာတမ်းဖြစ်ခြင်း၊
- Quantitative & qualitative သုတေသန နည်းလမ်းနှစ်ရပ်ကို အသုံးပြုထားခြင်း နမူနာကောက်ယူမှု၊ တွက်ချက် သုံးသပ်တင်ပြမှုများမှာ သိပ္ပံနည်းကျ နည်းလမ်းများ ကို အသုံးပြုထားခြင်း အထူးသဖြင့် ဆီးချိုဝေဒနာရှင်များအား စစ်တမ်းကောက်ယူ ရာတွင် နည်းစနစ်ကျနခြင်း၊ အချက်အလက်များအား သုံးသပ်ရာတွင် သရုပ်ဖော်

စာရင်းအင်းပညာ၊ ကောက်ချက်ချ စာရင်းအင်း ပညာများအား မှန်ကန်စွာ ထည့်သွင်းအသုံးချခြင်းဖြင့် သုတေသန ရလဒ်များကို တင်ပြထားခြင်း၊

- ပြည်သူ့ကျန်းမာရေးအတွက် အထောက်အကူပြု အကြံပေးချက်များအား ထည့်သွင်းထားသောကြောင့် ပြည်သူ့ကျန်းမာရေးကဏ္ဍအတွက် အထောက်အကူပြုခြင်း၊

တို့ကြောင့် **လူမှုရေးပညာရပ်ဆိုင်ရာ** မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ရွေးချယ်ခဲ့ခြင်းဖြစ်ပါသည်။

၂၀၂၂ ခုနှစ်အတွက်
မြန်မာနိုင်ငံဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုရ
ပါရဂူကျမ်းနှင့် သုတေသနလုပ်ငန်းအစီရင်ခံစာများ

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုရ
နှင့်ပါရဂူကျမ်း သုတေသနလုပ်ငန်း အစီရင်ခံစာများ
သိပ္ပံပညာရပ်

PREPARATION, CHARACTERIZATION AND APPLICATION OF CARBOXYMETHYL CELLULOSE-POLYVINYL ALCOHOL COMPOSITE FILM

PREPARATION, CHARACTERIZATION AND APPLICATION OF CARBOXYMETHYL CELLULOSE-POLYVINYL ALCOHOL COMPOSITE FILM

Htet Htet Than Sein*

Abstract

This work deals with the competence of carboxymethyl cellulose-polyvinyl alcohol-citric acid-aloe vera based composite film for burn treatment in wound dressing application. Firstly, cellulose was prepared from the two plant sources of pineapple leaf fiber and sugarcane bagasse by chemical method. Pineapple leaf fiber, sugarcane bagasse, treated samples and prepared celluloses were characterized by XRD, FT IR, and SEM techniques. Then, pineapple carboxymethyl cellulose (PCMC) and sugarcane carboxymethyl cellulose (SCMC) were prepared by using various concentrations of sodium hydroxide (10, 20, 30, and 40 % w/v) and sodium monochloroacetate with two prepared cellulose samples. The degree of substitution of PCMC and SCMC were determined by quantitative analysis. The prepared PCMC and SCMC were characterized by XRD, FT IR and SEM and their physicochemical properties (solubility in water and pH) were determined. Their molecular weights were investigated by viscometric method. The molecular weight of SCMC is greater than PCMC. Therefore, SCMC was selected for preparing composite. Various concentrations of SCMC (1, 1.5, 2, and 2.5 %, w/v) films (SC-1 to SC-4) and polyvinyl alcohol (PVA) (1, 2, 3, 4, and 5 %, w/v) films (P-1 to P-5) were prepared separately. Based on the optimum concentration of 2 % SCMC and 4 % PVA, the different volume ratios of SCMC and PVA (20 : 80, 40 : 60, 60 : 40, 80 : 20 v/v) were used to prepare SCMC-PVA composite films and are denoted as SCP -1 to SCP-4, respectively. The different amounts of citric acid (0.18, 0.36 and 0.54 g) as a cross linker were added to the selected sample (SCP-2) and were denoted as SCPC-1 to SCPC-3. Among them, SCPC-3 was selected as the composite film. Aloe-Vera solutions as an antimicrobial agent (5, 10, 15 and 20 mL) were added to SCPC-3 sample and are noted as SCPCA-1 to SCPCA-4. According to the mechanical properties, SC-3, P-4, SCP-2, SCPC-3, and SCPCA-4 were selected for biomedical application and characterized by FT IR and SEM techniques. The antimicrobial activities of SC-3, P-4, SCPCA-1 to SCPCA-4 films were evaluated by agar well diffusion method. Among them, SC-3, SCPC-3, SCPCA-3 and SCPCA-4 samples were also applied for burn wound healing. It was found that, the SC-3 and SCPCA-4 were completely healed within 21 days. According to the histopathological results, SCPCA-4 is the best for burn wound healing.

Keywords: pineapple leaf fiber, sugarcane bagasse, carboxymethyl cellulose, composite film, antimicrobial activities, burn wound healing, histopathological

Introduction

Cellulose is an organic compound with the formula $(C_6H_{10}O_5)_n$, a polysaccharide consisting of a linear chain of several hundred to many thousands of β(1⟶4) linked D-glucose unit (Lavanya *et al.,* 2011). Lignin and hemicellulose are amorphous in structure while cellulose is semicrystalline (Yang et al., 2007). Plant fibers are mainly composed of cellulose, hemicellulose and lignin (Moran *et al.,* 2008). There are many plant fibers available which has potential to be applied in industries as raw materials such as pineapple leaf, coir, abaca, sisal, cotton, jute, bamboo, banana, hemp and talipot. Among them pineapple leaf fibers (PALF) is one of the waste materials in agriculture sector. PALF constitute holocellulose (70-80 %), lignin (5-12 %) and ash (1,1 %) (Yougesh and Hari, 2017). Sugarcane bagasse (SCB) is an abundant agro-industrial waste and a fibrous residue (Kumar *et al.,* 2014). It contains 40-50 % cellulose, 25-35 % hemicellulose and 18-24 % lignin (Wulandari *et al.,* 2016).

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Cellulose must be converted into its derivatives. One of the most common derivatives is carboxymethyl cellulose (CMC). CMC is manmade modified cellulose, a linear, long chain, water soluble and anionic polysaccharide (Mondal *et al.,* 2015). PVA composites, such as PVA gels are used in different biomedical fields, such as in the manufacturing of contact lenses, artificial heart surgery, drug delivery systems and wound dressings because of its highly favorable properties, such as biocompatibility, nontoxicity, non-carcinogenic, swelling properties, and bioadhesive characteristics (Gazz *et al.,* 2015). Citric acid (CA) is very well used as a promising crosslinking agent due to biocompatible and economical properties. In addition, CA has powerful antimicrobial properties (Siregar *et al.,* 2019). Carbohydrates derived from some of the plants (such as *Aloe*) exhibit diverse biological activities. Aloe vera is well known for its antioxidant, anti-inflammatory, antidiabetic, sunburn relief, immune boost, anti-ageing and anticancer properties (Maan, *et al*., 2018).

Composite can be defined as materials that consist of two or more chemically and physically different phases separated by a distinct interface. Composite dressings comprising both synthetic and naturally occurring polymers have also been reported for controlled drug delivery to wound sites (Slaughter *et al*., 2009). Wounds can be classified as closed wound and open wound. Open Wounds includes incisions, lacerations, abrasions, cutting-pricking tool wounds, gunshot wounds, surgical wounds and metabolic wounds (Singh *et al.,* 2013). Generally, excision, incision, burn, dead space, ear and superficial wound model are used to study the wound healing property for animal models. (Kumar *et al.,* 2013). A burn is a type of injury to skin caused by heat, electricity, chemical, light, radiation or friction. Most burn affects only the skin. In case of severe burns deeper tissues like bone, muscle and blood vessels can also be wounded (Singh *et al.,* 2013).

The aim of the research work is to prepare and characterize the carboxymethyl cellulose – polyvinyl alcohol composite film using prepared carboxymethyl cellulose and apply in biomedical application.

Materials and Methods

2.1 Sample Collection

Pineapple leaf was collected from farm of Shaw Pyar Village, Pathein Township, Ayeyarwady Region and sugarcane bagasse from Hledan Market, Yangon Region, in Myanmar. Other requiring chemicals were purchased from chemical store. Distilled water was used as the solvent in all analyses.

2.2 Extraction of Pineapple Leaf Fiber

The pineapple leaf fiber (PALF) from the pineapple leaves can be extracted by manual or mechanical methods. The most common and effective way of the extraction of PALF was the manual method, and it was used in this research work. Firstly, pineapple leaves were washed with water. Then, a plate was used to scratch and remove skin of the leaf from the surface. The fiber was detached after skin removal. After that, the fiber was washed with distilled water and dried in sunlight. Dry fiber was cut into small pieces.

2.2.1 Preparation of cellulose from pineapple leaf fiber

Cellulose was isolated from PALF by steam explosion process along with mild chemical treatment including alkaline extraction, bleaching and acid hydrolysis. PALF were treated with 2 % NaOH (with fiber to liquor ratio of 1:10) in an autoclave and kept under 120 ˚C temperature and 138 kPa pressure for a period of one hour. Pressure was then released immediately. The fibers were removed from the autoclave and washed in distilled water until the alkaline solution was completely removed from the fiber.

The steam exploded fibers were bleached using a mixture solution of 0.65 M NaOH and 1.30 M glacial CH_3COOH, mixed with 12 % NaClO solution in 1:3 ratios. The bleaching was repeated six times. After that, the bleached fiber was treated with 11% $H_2C_2O_4$ acid in an autoclave at 120 ˚C temperature and 138 kPa pressure. The pressure was then released immediately. The autoclave was again set to reach 138 kPa and the fiber were kept under that pressure for 15 min. The pressure was released and the process repeated eight times.

The fiber was then taken out and washed until the fiber were free from acid. The processed cellulose fiber was suspended in distilled water and kept stirring with a mechanical stirrer for about 4 h until the fibrils were dispersed uniformly. Finally, the cellulose fiber was sonicated for 30 min at room temperature. The fiber was then filtered using a filter paper and dried in an oven at 60 ˚C.

2.3 Preparation of Sugarcane Bagasse Powder

Sugarcane bagasse was firstly washed with distilled water to remove remaining sugar components and impurities. The sugarcane bagasse was dried in an incubator at 60 ˚C. The dried sugarcane bagasse was ground and screened to get the dried sugarcane bagasse powder.

2.3.1 Preparation of cellulose from sugarcane bagasse

The powder of sugarcane bagasse was refluxed with 150 mL of 17.5 % sodium hydroxide for 3 h with constant stirring at 45 °C to remove hemicellulose. The residue of this process was washed with distilled water until reach a neutral pH. The neutral residue was bleached with 12 % NaOCl for 6 h with constant stirring at 45 °C to remove the lignin. The residue was also washed with distilled water until a neutral pH and it was dried at room temperature for 2-3 days. The bleached sugarcane bagasse was hydrolyzed with sulphuric acid 10 % v/v with a ratio of bleached sugarcane bagasse to sulphuric acid 1:25 at 40 ˚C for 10 min. The hydrolysis process was quenched by adding 10-fold excess distilled water (250 mL) to the reaction mixture. A colloidal suspension which produced was centrifuged at 6500 rpm for 30 min. Then, it was dialyzed for 5 days to neutralize and eliminate the sulphate ions. The neutral colloidal suspension was sonicated for 30 min to homogenize the generated cellulose sugarcane bagasse.

2.4 Preparation of Carboxymethyl Cellulose via Prepared Cellulose from Pineapple Leaf Fiber and Sugarcane Bagasse

Carboxymethyl cellulose was prepared from cellulose according to the procedure. First of all, 5 g of cellulose powder was weighed and added to 150 mL of isopropanol with continuous stirring for an hour. Then, 15 mL of (10 %, 20 %, 30 % and 40 % w/v) NaOH was added dropwise into the mixture and further stirred for an hour at room temperature. The carboxymethylation was started when 6 g of MCA was added with continuous stirring for another 1.5 h. The mixture was covered with aluminum foil and placed into the hot air oven at 60 ºC for 3.5 h.

The slurry was subsequently soaked in 100 mL of methanol for overnight. On the next day, the slurry was neutralized with 90 % of acetic acid to pH 7 and then filtered. The final roduct was washed for three times by soaking in 50 mL of ethanol for 10 min to remove undesirable by-products, and then it was washed again with 100 mL of absolute methanol for the last time. The obtained CMC from cellulose pineapple leaf fibre (CPALF) was filtered and dried at 60 ºC to constant weight and kept in a dry place.

2.5 Determination of Degree of Substitution (DS) of CMC

Sodium carboxymethyl cellulose was converted to the acid form (H-CMC) by adding an aqueous solution of 6 mL of 6 N HCl per 2 g of the sample, with continued stirring for 30 min. The dispersion was filtered in order to remove the excess acid. The precipitate was washed with a methanol. Then the precipitate was again dispersed in acetone, filtered, dried and ground.

The obtained H-CMC was used for the DS determination. About 0.5 g of the H-CMC sample was dissolved in 20 mL of 0.2 N NaOH and 50 mL of distilled water was also added. The solution was transferred to a 100 mL volumetric flask, which was then filled up to the mark with distilled water. 25 mL of the solution was transferred to an Erlenmeyer flask and diluted by addition of 50–100 mL of bi-distilled water. The excess of NaOH was back-titrated with standard 0.05 N HCl using phenolphthalein as the indicator. The titration was repeated three times and the average value of the HCl volume was used for the calculations. The milli-equivalents of consumed acid per gram of the sample (A) were calculate the following equation.

$$\mathrm{A} = \frac{(\mathrm{BC} - \mathrm{DE})}{\mathrm{F}}$$

Where, A is the milli-equivalents of consumed acid per gram of specimen, B is milliliters of added sodium hydroxide, C is normality of sodium hydroxide, D is milliliters of consumed hydrochloric acid, E is normality of hydrochloric acid and F is specimen grams used. The DS was calculated using equation

$$\mathrm{DS} = \frac{(0.162) * \mathrm{A}}{1 - (0.058 * \mathrm{A})}$$

Where: 162 g/mol is the molar mass of an anhydroglucose unit (AGU), g/mol is the net increase in the mass of an AGU for each carboxymethyl group substituted

2.6 Physicochemical Properties and Characterization of the Prepared Samples

The physicochemical properties of carboxymethyl cellulose (pH, solubility and degree of substitution) and yield percent were determined. The optimize PCMC and SCMC was selected according to the result. The crystallinity index was calculated by using XRD analysis. The structural characterization of celluloses and carboxymethyl cellulose were characterized using FT IR. The morphological structure of prepared samples was characterized by SEM.

X-ray diffraction (XRD) analysis was carried out using Rigaku X-ray Diffractometer, RINI 2000/PC software, Cat. No 9240 J 101, Japan. Copper tube with nickel filter was used. The diffraction pattern was recorded in terms of 2θ in the range of 10-70 °.

FT IR spectrum was recorded in the range of 4000-400 cm^{-1} by using 8400 SHIMADZU, Japan FT IR spectrophotometer.

The scanning electron microscopy (SEM) images were recorded by using JSM-5610 Model SEM, JEOL-Ltd., Japan.

The molecular weight of carboxymethyl cellulose was also determined to select the one kind of CMC for biomedical application.

2.7 Preparation of Pure Films and Composite Films

A series of SCMC solution (1, 1.5, 2 and 2.5 % w/v) and series of PVA solution (1 % to 5 % w/v) were prepared by using various weights percent of sample was dissolved in 100 mL of distilled water under constant stirring at 60 ˚C for 1 h to obtained a clear solution. The solutions were poured onto the melamine plate and dried in incubator at 60 ˚C for 3 days. The prepared films were designated as (SC-1 to SC - 4) and (P-1 to P-5).

The (SCMC-PVA) composite film was prepared by using SC-3 (2 % w/v of SCMC) and P-4 (4 % w/v of PVA) various ratio of (20 : 80, 40: 60, 60 : 40, 80 : 20 v/v) as the same procedure of SCMC and PVA film. The resulting films was designated as SCP-1 to SCP-4. Among them, SCP – 2 (40 : 60) was selected to add the various ratio of cross linker citric acid (0.18, 0.36 and 0.54 g) and these films were designated as SCPC-1 to SCPC-3. And then, aloe vera (5, 10, 15 and 20 mL) was added to selected SCPC-3 (40 : 60 : 0.54) as the antimicrobial agent. All the of films were prepared above the same procedure. The resulting aloe vera films were designated as SCPCA-1 to SCPCA-4.

In the preparation of composite films, the optimized film was selected according to the determination of mechanical properties (thickness, tensile strength, percent of elongation at break and tear strength).

2.8 Determination of Physicochemical Properties and Characterization of Selected Pure Films and Composite Film

The selected sample solution (SC-3, P-4, SCP-2, SCPC-3. SCPCA-1, SCPCA-2, SCPCA-3 and SCPCA-4) were measured the pH value by using pH meter (Jenway 4330, Lab quip, England). The viscosity (cPs) was also measured by using viscometer with BM viscometer. The equilibrium degree of swelling of the prepared films were also determined after immersion in water at various time intervals. The selected films were characterized by FT IR and SEM analysis.

2.9 Screening of Antimicrobial Activity by Agar Well Diffusion Method

The samples (SC-3, P-4, SCPCA-1, SCPCA-2, SCPCA-3, SCPCA-4) were tested with *Bacillus pumilus*, *Bacillus subitilis*, *Candida ablicans*, *Escherichia coli*, *Malasseia furfur*, *Micrococcus luteus*, *Staphylococcus aureus*, *Pseudomonas fluorescens* species to investigate the nature of antimicrobial activity.

Antimicrobial activities by using agar well method. Cork borer was used to make the wells (8 mm in diameter) in the autoclaved basal antimicrobial test medium. The sample was put in the agar well. After 24-48 h of incubation, the clear zones were measured. Therefore, the diameter of clear zones has observed as potent activity shown by respective strain. Clear zones surrounding the test wells indicated the presence of antimicrobial activities which inhibit the growth of the test organisms selectively. The results are shown in Table 2 and Figure 13.

2.10 Biomedical Application of Selected Films

The prepared (SC-3, SCPC-3, SCPCA-3 and SCPCA-4) were utilized in treatment of burn wound of Wister rat skin (*in vivo*).

2.10.1 Animal experiment

A total 6 male Wistar rats strain (weight between 250 g to 300 g) were used which were purchased from Laboratory Animal Services Division, Department of Medical Research (DMR). Making the burn wounds and treatment of these wounds were carried out at this department.

Each rat was anaesthetized by injection of ketamine HCl and xylazine (anaesthesia) allowed for 30-45 s. Then the ringer solution was induced to resist the heat effect. The hair from dorsal side of albino Wister rat was shaved. A 100 g cylindrical stainless-steel rod (1 cm diameter) heated to 100 ˚C in boiling water with an insulated rubber handle was used for the infliction of burns. Temperature was monitored using a thermocouple. Burn infliction was limited to the lion. The skin was pulled upwards away from the underlying viscera, creating a flat surface. The rod was located on its own weight for 20 s on each rat. The average wound size was 1 cm in diameter. This is a simple method for creating burn wound in a rat burn model. The skin with fresh burn wound was taken from one of the six Wistar rats to study the histopathological finding.

The burn area was disinfected using methylated alcohol. Those wounded animals of 6 Wistar rats were divided into six group. The group A used as negative control (without treatment), group B was dressed with sufre tulle (standard drug). For the group C, D, E and F, the burns were dressed by SC-3, SCPC-3, SCPCA-3 and SCPCA-4 respectively.

After making burn wound and treatment the six groups of rats were kept in separate polycarbonated plastic cages and were fed with DMR pellet food and water *ad libitum*. The skin of the fresh burn wound was cut from the rest one Wistar rat to investigate the histopathological finding. All animals in cages showed good general health condition throughout the study, as assessed by their weight gain. The progress of burn wounds of each rat were recorded by taking photographs after 3, 7, 10, 14, 17, 21 and 30 days. The resultant photographs and wound size data are shown in Figures 14 are the progress of treated burn skin on each days. Dressing was changed every day before cleaning the wound to remove dead skin.

Figure 2.1 Photographs for making the burn wound on wistar albino rat model (a) injected the ketamine HCl & xylazine and ringer solution, (b) fleeced the blade, (c) heated the iron stick at 100 ˚C, (d) touch the skin for 20 s with the iron stick and (e) burn wound on rat skin

2.10.2 Histopathological finding

The skin lesions samples were obtained by necropsy was fixed with formalin 10 % for routine histopathological processing. Hematoxylin and eosin (H & E) stained and evaluated blinded manner by two observers using a light microscope with specific image analysis software

from Olympus. For the morphological evaluation of skin lesions, a collagen fiver, inflammatory cell, blood vessel and granulation tissue of skin tissues were examined under a microscope by the pathologist.

The photographs of histopathological finding on epidermis and dermis of control and treated skins on days 30 after burn are illustrated in Figures 15. The descriptions of histopathological finding report of burn wound healing in rat's skin are described in Table 3.

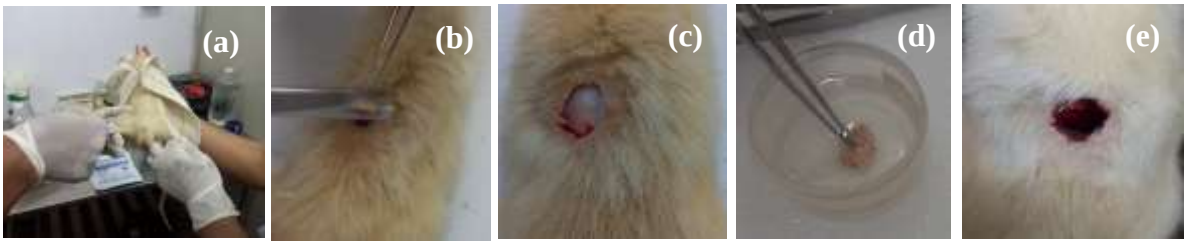

Figure 2.2 Histopathological examination of wistar albino rat model for biomedical application (a) injected the ketamine HCl and xylazine, (b) sampling skin tissue of burn wound area, (c) after taking burn wound area, (d) fixation with formaldehyde for histopathological after 30 days, and (e) treatment again with betadine

Results and Discussion

3.1 Characterization of Prepared Cellulose Using Pineapple Leaf Fiber and Sugarcane Bagasse

The prepared cellulose using pineapple leaf fiber and sugar bagasse was characterized by modern techniques such as XRD, FT IR and SEM analyses.

3.2 XRD Analysis

XRD diffraction analysis is a special technique for measuring and calculation the crystallinity index of polymers. The crystallinity index percent (C_I) was calculated using the following equation, by measuring the peak height of the crystalline region (I_{002}) and the amorphous region (I_{am}).

$$C_I(\%) = \frac{I_{002} - I_{am}}{I_{002}} \times 100\%$$

In figures 3.1 (a), (b) and (c), the XRD diffractograms of the raw pineapple leaf fiber, alkali treated pineapple leaf fiber, and cellulose pineapple leaf fiber. The crystallinity index percent of all pineapple leaf sample are 68.86, 75.12 and 89.05 %. The XRD diffractograms of the raw sugarcane bagasse, alkali treated bagasse, and cellulose sugarcane bagasse are shown in Figures 3.2 (a), (b) and (c). The crystallinity index percent of all sugarcane bagasse sample are 42.5, 65.28 and 72.15 %. In both samples, the highest crystallinity index was achieved after acid hydrolysis because the amorphous content of the samples was hydrolyzed and the hemicellulose and lignin content were reduced, leaving a larger semi-crystalline cellulose fraction.

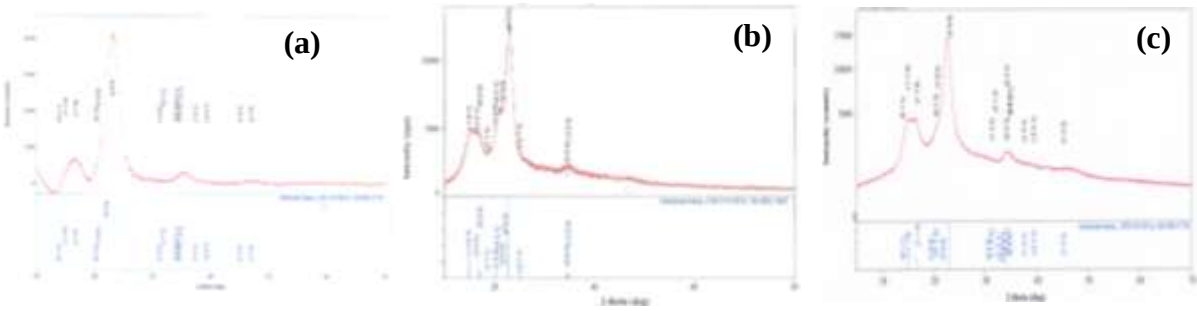

Figure 3.1 XRD diffractograms of (a) raw pineapple leaf fiber, (b) alkali treated pineapple leaf fiber and (c) cellulose pineapple leaf fiber

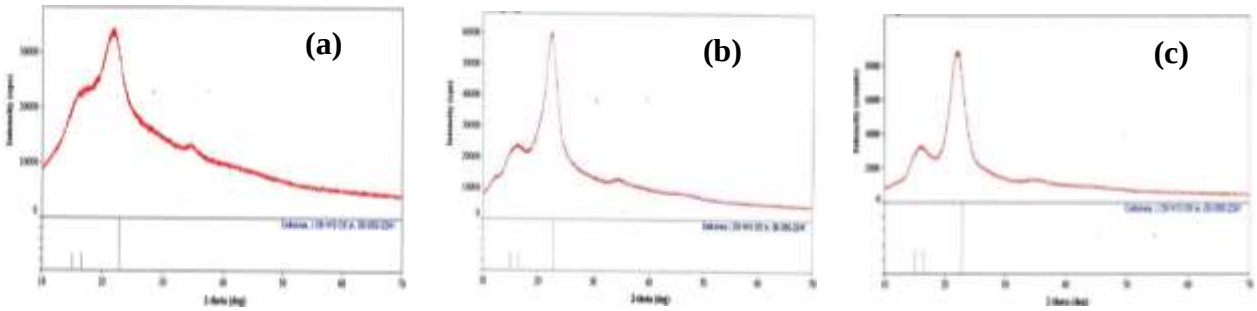

Figure 3.2 XRD diffractograms of (a) raw sugarcane bagasse, (b) alkali treated sugarcane bagasse and (c) cellulose sugarcane bagasse

3.3 FT IR Analysis

The FT IR spectra of raw pineapple leaf fiber, alkali treated pineapple leaf fiber, and cellulose pineapple leaf fiber are shown in Figures 3.3 (a), (b) and (c) and the FT IR spectra of raw sugarcane bagasse, alkali treated sugarcane bagasse, and cellulose sugarcane bagasse are shown in Figures 3.4 (a), (b) and (c).

The strong band at 3431, 3338, and 3334 cm^{-1} of raw pineapple leaf fiber, bleached pineapple leaf fiber, and cellulose pineapple leaf fiber, respectively, they were attributed to the stretching of OH groups. For all samples of pineapple leaf fiber, the absorption peak at around 2899 cm^{-1} was attributed to the CH stretching vibration. According to the FT IR spectrum, there are several peaks in the raw samples which is not found in the spectrum of isolated cellulose of both samples. 1729 cm^{-1} (C=O stretching vibration of carboxylic groups of hemicellulose and lignin), 1514 cm^{-1} (C=C stretching vibration of the aromatic ring in lignin) and 1244 cm^{-1} (C-O stretching vibration of the aryl group in lignin), which were observed in the raw pineapple leaf fiber. This peak disappeared after chemical treatment due to the removal of hemicellulose, lignin and other impurities.

The peaks at 1730, 1587, and 1248 cm^{-1} were observed in raw sugarcane bagasse. The absorption peak of 1730 cm^{-1} is derived from C=O stretching vibration of carboxylic groups of hemicellulose and lignin. C-O stretching vibration of the aryl group in lignin and C=C stretching vibration of the aromatic ring in lignin were found at peaks of 1548 and 1587 cm^{-1}. These peaks were not found in cellulose sugarcane bagasse. The absorption peaks at around 3329 cm^{-1} and 2899 cm^{-1} were derived from OH and CH stretching vibration groups of raw sugarcane bagasse, bleached sugarcane bagasse, and cellulose sugarcane bagasse.

In both samples, the spectral bands of around 1428 cm^{-1}, 1426 cm^{-1}, and 897 cm^{-1} show significant cellulose content. The OH group water absorption peak at around wavenumber 1644 cm^{-1} appears in all samples and it is the cellulose components.

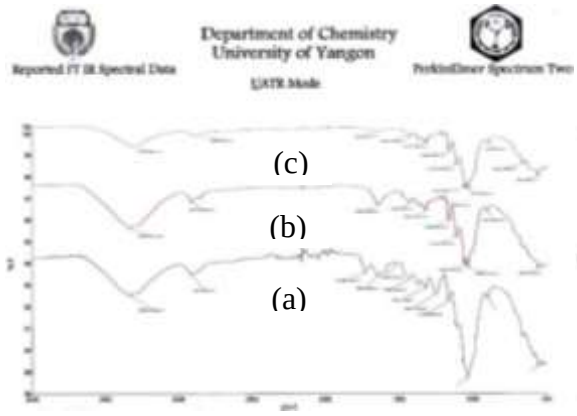

Figure 3.3 FT IR spectra of
(a) raw pineapple leaf fiber
(b) alkali treated pineapple leaf fiber and
(c) cellulose pineapple leaf fiber

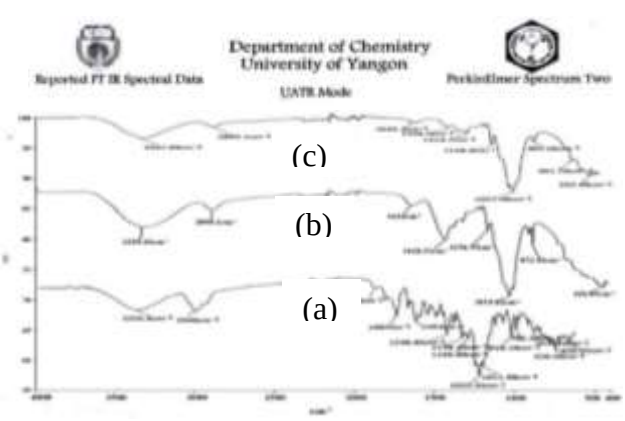

Figure 3.4 FT IR spectra of
(a) raw sugarcane bagasse
(b) alkali treated sugarcane bagasse and
(c) cellulose sugarcane bagasse

3.4 SEM Analysis

In order to further investigate the structural changes in the samples, SEM micrographs of the raw pineapple leaf fiber, alkali treated pineapple leaf fiber, and cellulose pineapple leaf fiber are shown in Figures 3.5 (a), (b) and (c). According to the SEM micrographs, the surface morphology of all samples has a fibrous nature. The raw pineapple leaf fiber was found to be aggregated and microfibrils are still bound to one another due to the presence of lignin and hemicellulose components. After bleaching treatment, the bond between lignin and hemicellulose had been broken due to the removal of the amorphous content in the microfibril bundle. The cellulose pineapple leaf fiber image shows a reduction in fiber size. The cellulose pineapple fiber size is much smaller than the other samples before treatments. This explanation is also supported by XRD crystallinity index data.

The SEM micrographs of the raw sugarcane bagasse, alkali treated sugarcane bagasse, and cellulose sugarcane bagasse are shown in Figures 3.6 (a), (b) and (c). The diameter of the original SCB was much bigger than that of the chemical treatment sample. On treatment with alkali, the hemicellulose is hydrolyzed and becomes water soluble. On subsequent treatment with the bleaching agent, the lignin is removed through complex formation. Finally, the sulphuric acid hydrolysis usually cleaves the remaining amorphous regions of the cellulose.

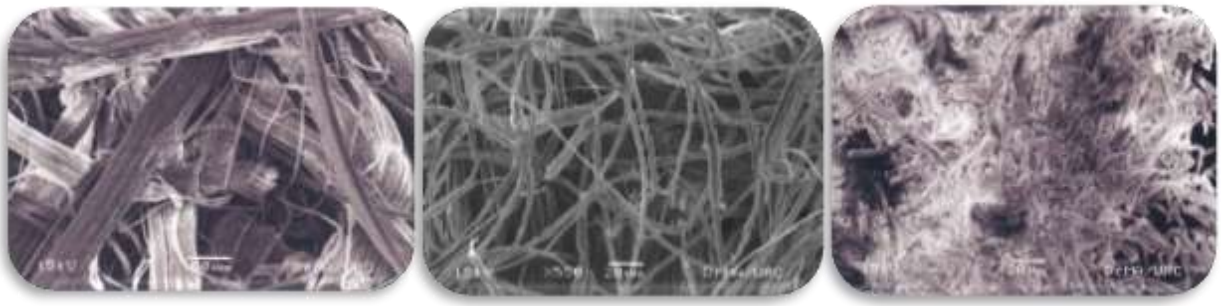

Figure 3.5 SEM micrographs of (a) raw pineapple leaf fiber, (b) alkali treated pineapple leaf fiber and (c) cellulose pineapple leaf fiber

Figure 3.6 SEM micrographs of (a) raw sugarcane bagasse, (b) alkali treated sugarcane bagasse and (c) cellulose sugarcane bagasse

3.5 Preparation of Carboxymethyl Cellulose (CMC) from Isolated Cellulose and Determination of Their Physicochemical Properties

The alkalization-etherification process was used in the preparation of carboxymethyl cellulose (CMC) from both isolated cellulose and isopropyl alcohol medium. To find the optimum CMC, the preparation of CMC was carried out using various concentrations of NaOH (10 %, 20 %, 30 % and 40 % w/v) at the alkalization step.

The degree of substitution of PCMCs and SCMCs obtained from using various concentrations of NaOH was determined by the back titration method. In both samples, the degree of substitution and yield percent of CMC increased with an increase in the concentration of NaOH from 10 % to 40 % and attained a maximum degree of substitution and yield percent at 30 % NaOH concentration. Above 30 % NaOH, the degree of substitution and yield percent decreased. In addition, the highest solubility of water can be seen at 30 % NaOH – CMC. From these results, 30 % NaOH - CMC was selected as the optimum CMC. According to the standard procedure, the pH range of CMC should be 6.0 – 8.5. So, CMC was considered pure. A precipitation test confirmed the distinction of CMC because precipitate appeared during the test. The obtained results for various NaOH concentrations of PCMC and SCMC are presented in Table 3.1.

Table 3.1 Physicochemical Properties of PCMC and SCMC Obtained from Using Various Concentrations of NaOH

Sample	Yield (%)	Solubility in Water	pH	Degree of Substitution
10 % NaOH-PCMC	133	Slightly soluble	6.64	2.1019
20 % NaOH-PCMC	158	Slightly soluble	6.70	2.1103
30 % NaOH- PCMC	182	Soluble	7.14	2.1303
40 % NaOH-PCMC	165	Slightly soluble	6.77	2.0705
10 % NaOH-SCMC	107	Slightly soluble	7.10	2.1973
20 % NaOH -SCMC	120	Slightly soluble	7.21	2.2013
30 % NaOH-SCMC	140	Soluble	7.45	2.2103
40 % NaOH-SCMC	123	Slightly soluble	7.82	2.1443

3.6 Characterization of Prepared Carboxymethyl Cellulose

The XRD diffractograms of PCMC and SCMC are presented in Figure 3.7 (a) and (b). The crystallinity index (C_I) of CMC decreased by approximately 40 % when the cellulose was converted to carboxymethyl cellulose. The C_I values of PCMC and SCMC are 54.40 % and 55.78 %. The decrease in crystallinity during the alkalization and etherification processes of cellulose was due to the cleavage of hydrogen bonds, and this also resulted in the extending of the distance between cellulose molecules. Therefore, all the characteristic cellulose peaks had disappeared and been transformed into an amorphous phase.

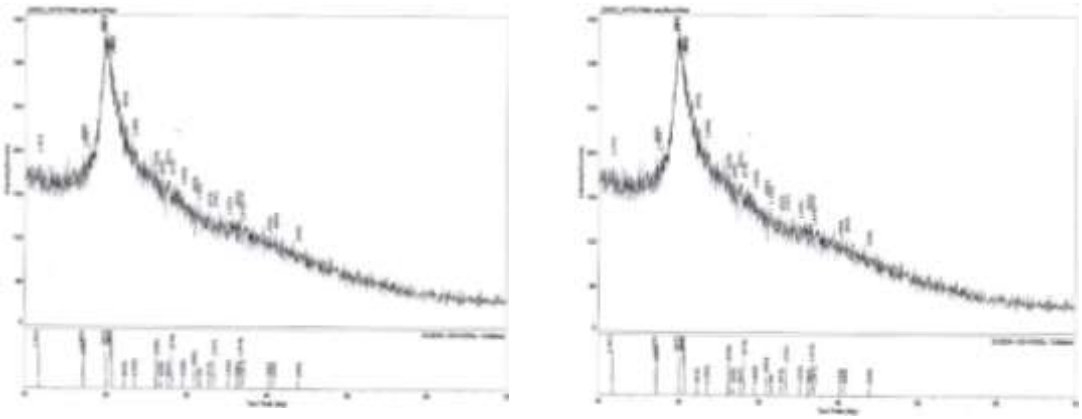

Figure 3.7 XRD diffractograms of (a) PCMC and (b) SCMC

In FT IR analysis, the peak area of PCMC and SCMC was less than the area of the peak that appeared for cellulose, confirming the decrease in hydrogen bonding. The spectra of PCMC and SCMC are shown in Figures 3.8 (a) and (b). The FT IR spectra of both CMC was found to contain not only the main characteristic bands of cellulose but also new and strong absorption bands at around 1590 cm^{-1}, which is associated with the stretching vibration of acetyl and carboxymethyl groups. This observation confirmed that the sodium monochloroacetate used for the etherification process led to the substitution of carboxyl group replace in OH group of cellulose. The FT IR spectra of prepared PCMC and SCMC were almost similar.

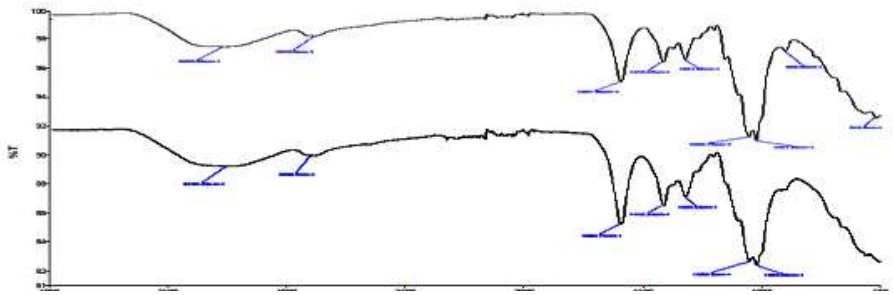

Figure 3.8 FT IR spectra of (a) PCMC and (b) SCMC

SEM analysis was performed on the prepared PCMC and SCMC. The SEM micrographs are shown in Figure 3.9 (a) and (b). In both samples, the surface morphology of prepared CMC can be clearly seen that the obtained products have rod like structure and their surfaces are more extended than the cellulose. It had long and narrow strand characteristics. This image clearly shows that the conversion of cellulose to CMC leads to changes in its ribbon shape.

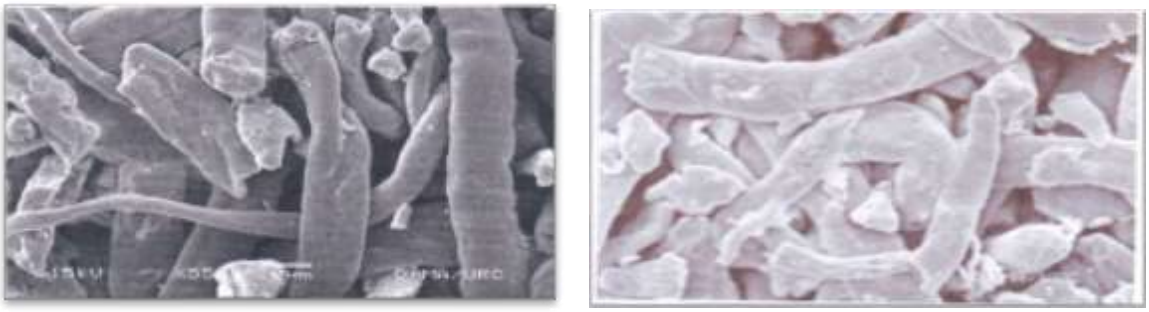

Figure 3.9 SEM micrographs of (a) PCMC and (b) SCMC

3.7 Viscosity Measurement and Determination of Molecular Weight of PCMC and SCMC

The viscosities of prepared PCMC and SCMC were measured using an Ostwald viscometer. The obtained molecular weight of SCMC (181.05 kg mol^{-1}) was higher than PCMC (52.565 kg mol^{-1}) because SCMC not only had more degree of substitution than PCMC but it also had more viscosity. The molecular weight of polymer increases, mechanical properties generally increases. So, SCMC was selected for preparing the composite films.

3.8 Mechanical Properties of Pure Film and Composite Film

The mechanical properties such as thickness, tensile strength, elongation at break (%) and tear strength are important parameters that reveal the nature of films. The thickness of pure SC films was approximately 0.1 mm. Tensile strength, elongation at break, and tear strength ranged between 15.2 MPa to 33.5 MPa, 5.6 % to 31.0 % and 30.0 kN/m to 85.1 kN/m, respectively. For an ideal wound dressing material, wound dressing film must have high elongation at break and tensile strength, with low tear strength, providing that wound dressing is required to be durable and stress-resistant for its application and handling purposes. SC-3 (2 % SCMC w/v) film exhibited a significantly higher percentage of tensile strength (33.5 MPa) and elongation at break (31.0 %) and lower tear strength (30.0 kN/m) than other films. According to the mechanical properties, SC-3 film was chosen as the optimum composition for the preparation of composite film.

The thickness of pure P films was approximately 0.20 mm. Tensile strength, elongation at break and tear strength varied from 19.8 MPa to 30.0 MPa, 258 % to 345 % and 54.0 kN/m to

74.7 kN/m, respectively. The maximum mechanical properties of P-4 flim were found to be 30.0 MPa (tensile strength), 345 % (elongation at break) and 61.6 kN/m (tear strength), respectively. It was found that the P-4 film had higher elongation at break and tear strength than that of SC-3 films. It can be concluded that, according to the mechanical properties of the variation of PVA films, P-4 film is the best for flexible film.

To prepare the various SCP composite films, the 2%-SCMC solution and 4 %-PVA solution are mixed volume by volume, (20 : 80, 40 : 60, 60 : 40, and 80 : 20 v/v). The thickness of SCP composite films was approximately 0.19 mm. In the different SCP composite films results found that the higher the volume of SCMC, the lower the mechanical properties. In the results, SCP-2 (SCMC : PVA – 40 : 60 v/v) composite film was found to have tensile strength (23.3 MPa), elongation at break (225 %) and tear strength (145 kN/m). Therefore, SCP-2 composite film is the best for the preparation of biodegradable films due to its highest elongation at break.

When the added the 0.54 g of citric acid SCP-2 composite solution, these composite film is harder than other films and it has better water resistance. It has tensile strength (14.2 MPa), elongation at break (503 %) and tear strength (35.6 kN/m). This film is designated as SCPC-3 film and it was selected to be applied in the biomedical application. And then, SCPCA-4 composite film was prepared by using 2% SCMC 40 mL, 4 % PVA 60 mL, 0.54 g citric acid and aloe vera 20 mL. It was found to have a tensile strength of 4.2 MPa, an elongation at break of 85 % and a tear strength of 28.4 kN/m. In this research work, SCPCA-4 was collected to be used in biomedical applications because aloe-vera has antimicrobial activity for the treatment of burn wound healing.

3.9 Characterization of Selected Pure Films and Composite Films

The FT IR spectra of SC-3 film, P-4 film and SCP-2, SCPC-1 to SCPC-3, and SCPCA-4 composite films are described in Figure 3.10 and 3.11. When compared with all films, the SCPC-3 and SCPCA-4 significantly decrease the bandwidth at OH stretching. With increasing concentration of CA, there has been an increase in the height peak at 1725 cm^{-1} which corresponds to ester C=O stretching vibration. The principal band of citric acid is at 1725 cm^{-1}. It was occurring because of the chemical reaction with citric acid to form an ester bond. Since this peak is negligible in other films with no citric acid, and the peak height was increased depending on the concentration of CA, it suggests cross-linking.

The SEM imcrograph of SC-3, P-4, SCP-2, SCPC-3, and SCPCA-4 films are shown in Figures 3.12 (a) to (e). It indicated that pure SC-3 and P-4 film, SCP-2, SCPC-3, and SCPCA-4 composite film have different surface morphologies.

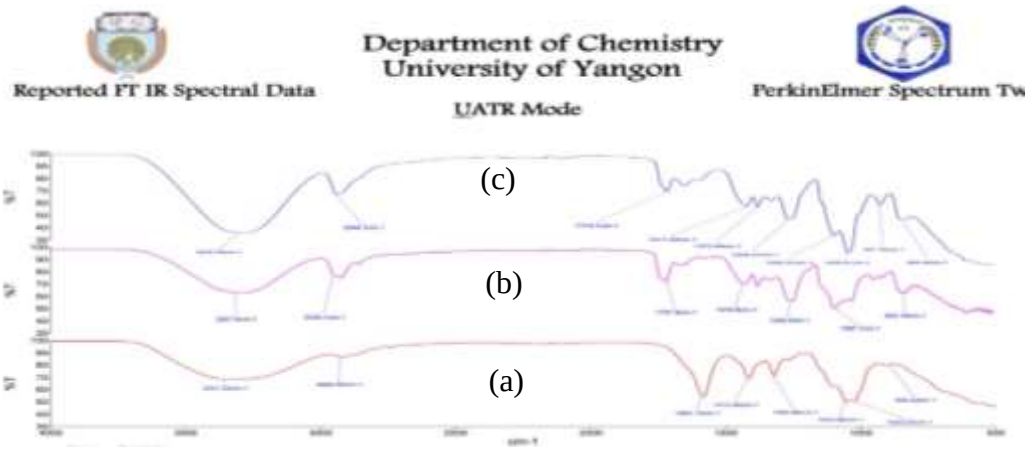

Figure 3.10 FT IR spectra of (a) SC-3, (b) P-4 and (c) SCP-2 films

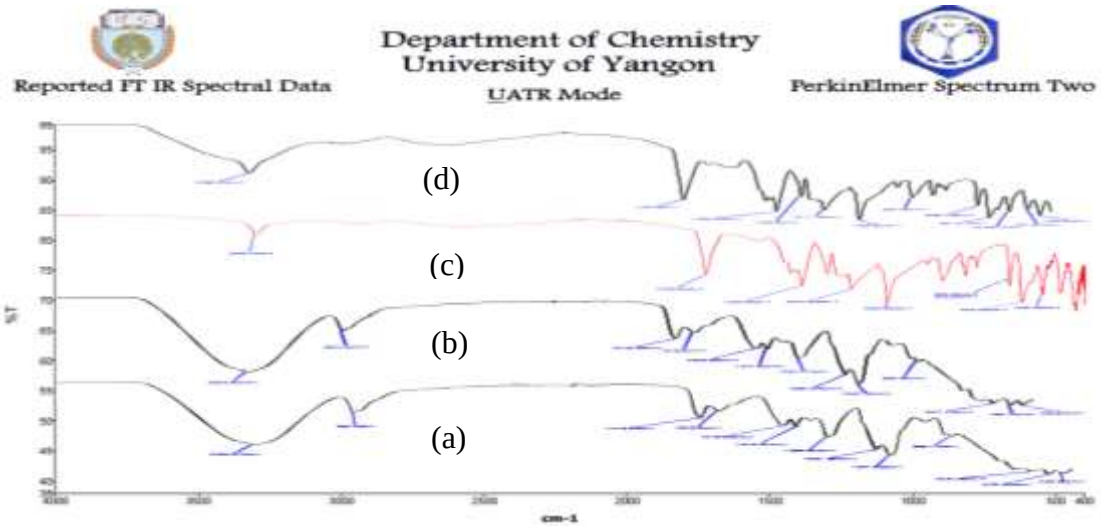

Figure 3.11 FT IR spectra of (a) SCPC-1, (b) SCPC-2, (c) SCPC-3 and (d) SCPCA-4 films

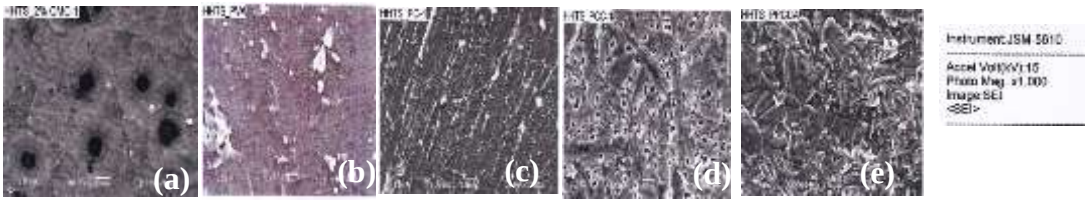

Figure 3.12 SEM micrographs of (a) SC-3 film, (b) P-4 film, (c) SCP-2 composite film, (d) SCPC-3 composite film and (e) SCPCA-4 composite film

3.10 Antimicrobial Activities of SCPCA Composite Films

Antimicrobial activities of various ratios of AV containing SCMC-PVA-CA composite films is shown in Table 3.2. No inhibition zone was observed in the neat films. It can be observed that the SCPCA composite films were effective against both gram-positive (*Bacillus pumilus, Bacillus subtilis, Candida alibicans, Malasseia-furfur, Micrococcus luteus, Staphylococcus aureus*) and gram-negative (*Escherichia coli, Pseudomonas fluoresens*) organisms. An atimicrobial test of various composite films that were used in the agar medium cultivation is shown in Figure 3.13.

(a) **(b)** **(c)** **(d)** **(e)** **(f)** **(g)** **(h)**

Figure 3.13 Antimicrobial activities of prepared (1) SCPCA-1, (2) SCPCA-2, (3) SCPCA-3, (4) SCPCA-4 (5) SC-3 and (6) P-4 films with (a) *Bacillus pumilus*, (b) *Bacillus subtilis*, (c) *Candida alibicans*, (d) *Escherichia coli*, (e) *Malasseia furfur*, (f) *Micrococcus luteus*, (g) *Staphylococcus aureus* and (h) *Pseudomonas fluoresens*

Table 3.2 Antimicrobial Activities of Prepared SCPCA Composite Films by Agar Well Diffusion Method

No.	Microorganisms	Samples			
		SCPCA-1	CSPCA-2	SCPCA-3	SCPCA-4
1	*Bacillus pumilus*	+	++	++	++
2	*Bacillus subtilis*	++	++	++	++
3	*Candida alibicans*	+	++	++	++
4	*Escherichia coli*	+	++	+++	+++
5	*Malasseia furfur*	+	+	+	+
6	*Micrococcus luteus*	++	+	++	+
7	*Staphylococcus aureus*	++	++	++	++
8	*Pseudomonas fluoresens*	+	+	+	++

Diameter of Agar Well = 10 mm

- = no activity, + = 10 mm ~ 14 mm (Lower activity)

++ = 15 mm ~ 19 mm (Higher activity), +++ = 20 mm and above (Highest activity)

3.11 Wound Size Reduction on Burn Skin in Biomedical Application

Animal experiment were used to investigate the biomedical application of prepared SC−3, SCPC−3, SCPCA−3, and SCPCA−4 composite films. The albino skins of albino wistar rats were treated with sufre tulle, SC−3, SCPC−3, SCPCA−3 and SCPCA−4 composite films. The progress of burn, and the gross appearance of the burn wound with and without treatment is shown in Figures 3.14 for different periods of days (0, 3, 7, 10, 14, 17, 21 and 30). On days 3 and 7, the burn wound area increased initially, and the progress of all the burn skin was slow. Among them, the wound area burned skin treated with SCPCA−4 was found to have a wound size reduction while the others had an increase. On days 14 and 17, the wound size treated with SCPCA−3 was the largest and the wound size treated with SC−3 and SCPCA−4 was the significantly decreased. The crust of SC−3 and SCPCA−4 was sloughed off completely on day 21. In treated SC−3 and SCPCA−4 wound burns, the skin regeneration required 21 days to form complete skin, but other wounds to form complete skin required 30 days. After 30 days, the wound treatment was completely healed, whereas the wound that was not sloughed off still persisted in the SCPC−3. The healing of burn wound sized reduction is presented in Table 3.3.

Figure 3.14 Physical appearances of wistar rat burned skin (a) control and treatment with (b) standard sufre tulle, (c) SC-3 (d) SCPC-3 (e) SCPCA-3 and (f) SCPCA-4 in 30 days observation

Table 3.3 Progress of Burn Wound Healing of Rats During 30 Days Treatment

Day	Wound size (cm)					
	Control	**Sufre tulle**	**SC-3**	**SCPC-3**	**SCPCA-3**	**SCPCA-4**
0	1.0	1.0	1.0	1.0	1.0	1.0
3	1.1	1.0	1.2	1.2	1.4	0.8
7	1.1	1.0	1.0	1.1	1.0	0.6
10	1.0	1.0	0.9	1.1	0.9	0.5
14	0.6	0.4	0.3	0.7	0.9	0.3
17	0.3	0.4	0.1	0.6	0.8	0.1
21	0.2	0.2	0.0	0.5	0.3	0.0
31	0.0	0.0	0.0	0.1	0.0	0.0

3.12 Histopathological Examination of Treated and Control Burned Skin

In the wound healing process, histopathological analysis provides the cellular and tissue level interpretation. Because the physical appearance changes of skin on visual inspection are insufficient to determine the efficacy of treated drugs, histopathological finding was performed.

Wound skin tissue samples of control, sufre tulle, and treated with SC-3, SCPC-3, SCPCA-3 and SCPCA-4 are presented in Figures 3.15 for the epidermis and dermis. The histopathological reports of burn wound healing in rat's skin are shown in Table 3.4.

Epidermis

Dermis

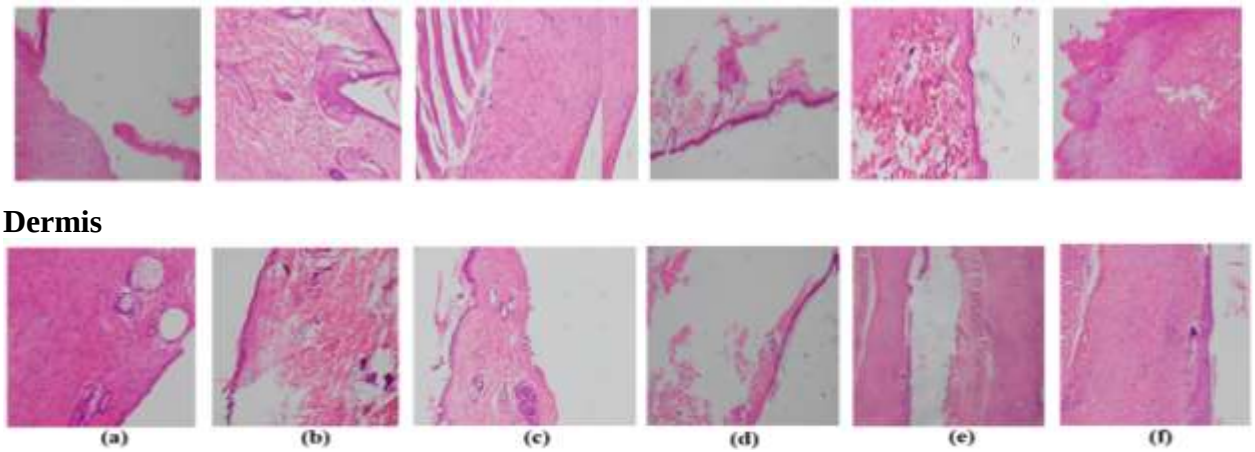

Figure 3.15 Hematoxylin and eosin stained section of biopsies for the morphological evaluation of skin lesions of (a) negative control, (b) standard sufre tulle, (c) SC-3, (d) SCPC-3, (e) SCPCA-3 and (f) SCPCA-4 (after day 30) in epidermis and dermis

Table 3.4 Histopathological Report 30th Days Progressiveness of Burn Wounds in Albino Rat Models Using Treatment with Six Applications

Code No	Epidermis	Dermis	Subcutaneous tissue	Histopathological diagnosis
Negative control	This section showed papillary epidermal outline is thin & composed of squamous epithelium (keratinocytes). Thin Keratin layer is also noted. Loss of some sebaceous and hair follicles are present in epidermal layer. One area of epidermis shows detached in epidermal outline.	Granulation tissue is well formed that is composed of thick layer of fibroblast and collagen tissues. There is absent of inflammatory cells (polymorph and macrophages) in dermis.	Scanty of small blood vessels and muscular layers are also noted.	Wound healing process of rat's skin was continuation and still progress. Appearance of re-epithelialization was nearly normal but vascularization and granulation tissue formation is reduced in this section
Standard drug (Sufre Tulle)	The papillary pattern of epidermal outline is thin and composed of squamous epithelium cells (keratinocytes). Normal keratin layer is also noted. The loss of continuation of epidermal outline is observed. In some areas, Keratin layer is thin and scanty in site of disrupted areas. Some sebaceous glands and hair follicles are lost in epidermal layer.	Granulation tissue consisting of fibroblast and collagen tissues are noted in dermal layer of skin. There is absent of inflammatory cells (polymorph and macrophages) in dermis.	Small blood vessels and part of muscular layer are also noted.	Normal wound healing of rat's skin (Normal degree of re-epithelialization of rat 's skin)
SC- 3	There are well developed papillary squamous epithelium cells (keratinocytes) and thick layer of keratin in epidermis region. There was no interrupted superficial epidermal layer of lesion site. Well- developed sebaceous glands, sweat glands and hair follicles are also seen in this layer.	Granulation tissue is well formed that is composed of thick layer of fibroblast and collagen tissues. There is a group of inflammatory cells (polymorph and macrophages) in dermis that showed a good response for active immune action. Presence of a few developed sebaceous glands, sweat glands and hair follicles are also seen in this layer.	This layer is composed of adequate blood vessels and well-formed fibroblast layers are also noted in dermis and well developed muscular layers are observed in this layer.	Good wound healing in skin of animal model (rat) was observed because of well-developed granulation tissues accompanied with well-developed sebaceous glands and hair follicles in epidermis layer of skin.

Code No	Epidermis	Dermis	Subcutaneous tissue	Histopathological diagnosis
SCPC - 3	Epidermal outline shows no complete continuation of squamous epithelium (keratinocytes) with thin Keratin layer in focal site. There are few amount of papillary squamous epithelium cells (keratinocytes) and thin layer of keratin in some epidermis region. Loss of partial sebaceous glands and hair follicles are also seen in this layer.	Granulation tissue is scanty and because of decreased amount of fibroblast and collagen tissues for good healing. There is absent of inflammatory cells (polymorph and macrophages) in dermis.	Blood vessel formation is decreased and fibroblast layer are also thin and few amounts of muscular layers are also observed in this layer.	Poor wound healing in skin of animal model (rat) was observed because of absence of well- developed granulation tissues in epidermis and dermis layers of skin.
SCPCA - 3	There are partially developed papillary squamous epithelium cells (keratinocytes) and thin layer of keratin in epidermis region. Some amounts of well- developed sebaceous glands and hair follicles are also seen in this layer. Epidermal outline shows complete continuation of squamous epithelium (keratinocytes) with very thin Keratin layer that indicates Keratin development is incomplete.	Partially developed granulation tissues are also observed in this section. It is mainly composed of few fibroblast and more collagen tissues in dermis layer. There is absence of inflammatory cells (polymorph and macrophages) in dermis. Adipose tissues are still present in this layer.	Blood vessels and fibroblast formations are observed in dermis and apart of developed muscular layers are also noted in this layer.	Wound healing is still progress with granulation tissue and developed re-epithelialization of healing process in epidermis .(Good well- developed wound healing process of epidermal lesion)
SCPCA-4	There are completely developed papillary squamous epithelium cells (keratinocytes) and thin layer of keratin in epidermis region. Well developed sebaceous glands and hair follicles are also seen in this layer. Epidermal outline shows complete continuation of squamous epithelium (keratinocytes) with thick Keratin layer.	Granulation tissue is well formed that is composed of thin layer of fibroblast and collagen tissues. There is absent of inflammatory cells (polymorph and macrophages) in dermis.	Normal blood vessels and well formed fibroblast layer are also noted in dermis and well developed muscular layers are observed in this layer.	Good wound healing in skin lesion of rat was observed because presence of well-developed keratinized papillary reaction and granulation tissues accompanied with well-developed sebaceous glands, sweat glands and hair follicles in epidermis and dermis layers of skin. There was absent of epidermal interrupted outline.

Conclusion

In this research work, cellulose was prepared from pineapple leaf fiber and sugarcane bagasse by chemical method. The raw samples and prepared cellulose were characterized by XRD, FT IR, and SEM techniques. From XRD analysis, it was found that the increase in crystallinity index of the prepared cellulose due to the removal of hemicellulose and lignin. FT IR and SEM analyses showed that the amount of lignin and hemicellulose from raw samples were successfully reduced by chemical treatment. Moreover, SEM micrographs of both prepared celluloses showed microfibril structure.

After that, prepared cellulose was successfully converted to carboxymethyl cellulose (CMC) using various concentrations of NaOH in the range of 10 % to 40 % and etherified with sodium monochloroacetate in isopropanol medium. The highest degree of substitution and yield percent results of CMC revealed that the obtained CMC was an optimized CMC. According to the XRD, SEM, and FT IR results, PCMC and SCMC were not significantly different. From the XRD analysis, it was obvious that the cellulose has two apparent diffraction peaks at $2\theta = 16^{\circ}$ and 22°, but both CMCs showed only one diffraction peak at $2\theta = 20^{\circ}$. Thus, the crystallinity index percent of CMCs decreased in comparison with that of cellulose. In FT IR spectra, the main characteristic bands of cellulose, the presence of new and strong absorption bands in both CMC at around 1590 cm^{-1}, which related to the anti-symmetric and symmetric stretching vibration of COO- were observed. SEM images showed the conversion of the cellulose to CMC leads to changes in its rod like structure. Both of them, SCMC was selected for biomedical applications because it had greater molecular weight than that of PCMC and raw samples can be easily collected.

Out of the prepared films SC-3, P-4, SCP-2, SCPC-3 and 3SCPCA-4 were chosen for biomedical applications according to the mechanical properties. The antimicrobial activity of SCPCA composite films and selected films were tested by the agar well diffusion method. According to antimicrobial activity results, SCPCA-3 and SCPCA-4 composite films showed the most potent activity against eight microorganisms. In the burn wound healing process, SC-3, SCPC-3, SCPCA-3, and SCPCA-4 films were used as wound dressing. By visually, the burn wound of rats treated with SC-3 film and SCPCA-4 composite film for 21 days was found to be the significantly healing.

Histopathological findings reported 30 days of progressive improvement of burn wounds in albino rat models using treatment with five samples. The slide of the skin treated with SCPCA-4 composite film showed the best wound healing with completely development re-epithelialization, sebaceous glands, hair follicles of the epidermis and well developed granulation tissues, composed of fibroblast and collagen tissues with the absence of inflammatory cells in the dermis layer. The second best wound healing was the treatment with SC-3 film. From the results of histopathological findings, SCPCA-4 composite film is the most effective and suitable films for the treatment of burn wound.

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ASSESSMENT AND ANALYSIS OF LANDSLIDES IN MAWCHI MINE AREA, PASAWNG TOWNSHIP, BAWLAKHE DISTRICT, KAYAH STATE, MYANMAR

ASSESSMENT AND ANALYSIS OF LANDSLIDES IN MAWCHI MINE AREA, PASAWNG TOWNSHIP, BAWLAKHE DISTRICT, KAYAH STATE, MYANMAR

Zaw Zaw Thein*

Abstract

Mawchi Mine is a world-famous for its tin-tungsten quartz vein system. The Mine is more than a century old and exploited before *World War II*. Successful mining is to extract as much ores as possible in a fail-safe and economical manner. Thoughtful for a joint of mining, along with an increase in operation, the depth of excavating is getting deeper causing slope stability problems and safety issues. Such failure mechanisms are governed by engineering geological conditions of rock mass which are almost always unique to a particular site and possible modes of failure are also varied and complex that phenomenon may cause to landslides. Mostly the field observation was basically recorded in landslides and slope deformations are still hitting the Mawchi Mine area. Landslide calamities are harvested as an actual fragile event in Mine area. Due to repetition of deformations, the Mine area has potential to take landslides and slope failures in future especially in rainy seasons and may cause severe issues to safety of citizen, if there is no action taken. In an effort to prevent from experiencing the hazards of landslide and slope failure, the study enforcing with the aim of the importance on Kinematic Analysis integrated with RMR and SMR to determine and examine the slope stability of Mawchi Mine region. The study has invited someone special in Block Theory assumption that has been encountered at western part of Mawchi hill. This paper presents an overview of all designated critical slope stations were carefully studied and evaluated potential modes of failure and its probability, as well as factors that will bring to bear the zonal stability assessment of the study aera. Results obtained from analysis and interpretation must be treated with recommendation as many slopes instability exist which can be reduced by making sensible, careful and realistic assumptions.

1.Introduction

Myanmar has been continued to face many types of natural disasters, especially in that earthquakes and landslides are major hazards affecting the country. Geologic hazards, landslides, common form of slope instability problems are most significant events and an important issue by reaching to considerable magnitude in Myanmar. Major attraction of landslides is often caused by rainfall-induced sliding in wet season with additional human factors such as negligence of precursors or forewarning signs, incompetence, lack or poor maintenance systems, ignorance of geological inputs, unethical practices and various negative attitudes. To some extent seismicity is regarded as one of the triggering factors. Some prominent hitting records are subtitled as Phakant Jade Mine landslide on frequent *July 2014, November 2015, January, May 2016*, Hakha landslide on *27th July, 2015*, Mawchi Mine landslide on *11th October, 2015*, Popa landslide on *19th October, 2017*. For that reason, scientific and research teams have shown rising interest in the landslide related topics after *2000*. Meanwhile, Mawchi Mine failure was chosen as the case study of researcher.

Mawchi Mine has been a very successful mining operation in the past since British colonial times and also famous for its world-class tin-tungsten quartz vein system, exploited before *World War II* within the Tin Province of Southeast Asia. The most primitive mining of mineral and production of concentrate at the Mawchi Mine dates back to *1913*. In the *1930s*, it was the one of the world's main sources of tungsten supplier, accounting for some *60%* of Burma's total production (*Khin Zaw and Khin Myo Thet, 1983*). In the latter part of mine life, it will be not free

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from worry and strongly reflect the environmental impacts of mining, especially by the improper and uncontrolled mining of the tributors mostly migrant miners coupled with the excessive superincumbent load of miners' tenements on weak ground triggering frequent landslides. Landslide disasters are issues of critical concern due to their socioeconomic significance and the increased production development pressure and population on the Mawchi Mine environment. Actually, some historical landslide events are recorded as fatal landslides. Although there are many literatures describing the ore deposit geology of Mawchi Mine and surrounding area, no obvious meritorious science interests have been studied how landslide hazard is related to mining. In an opinion, considering to probable prices of tin and wolfram, Mawchi Mine is still a worthwhile mining concern because mineral exploration played a vital role in the development of the country. These challenges of Mawchi Mine area have more questions to be addressed to identify and provide preventive measures against those actual causes.

2. Study Area

Mawchi Mine is situated in Pasawng Township, Bawlakhe District, Kayah State, south eastern part of Myanmar. It is bordered by Shan mountains to the north, Thailand's Mae Hong Son province to the east and Kayin State to the south and the west. The Mine itself is located at latitude *18˚49'30"N,* longitude *97˚09'30"E* and is *eleven* miles west of the great Thanlwin River. The salient features around the Mawchi Mine environs are deeply dissected leaving very rugged with north-westerly trend with a nearby maximum elevation of over *1220* meters above mean sea level (*Than Htun et al., 2017*). It constitutes a part of geographical unit known as southern section of the Shan Plateau with the terrain being mountainous and shattered by playing the highest peak in the west and slopes down to the east till the Thanlwin River.

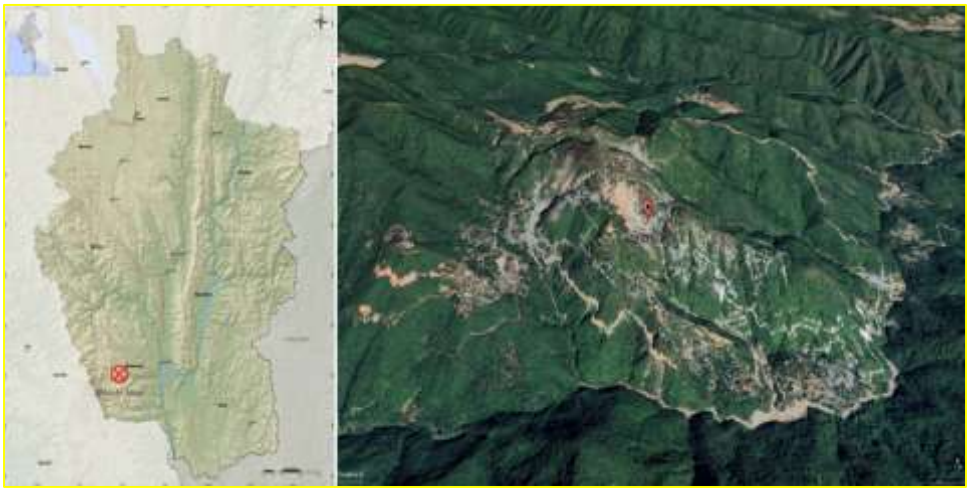


Figure 1. Location and salient feature map of Mawchi Mine area

Mawchi is a lode mine, recognized for granite intrusive related tin mineralization. The sequential mineralization and ore forming process of Mawchi Mine area have been studied by a number of local researchers and foreign geologists through geological time. It lies within the northern section of the Thai-Malay tin-tungsten belt which is located within *40 km* to the west of the Myanmar-Thailand border line. The Thai-Malay tin-tungsten belt extends for some *3500 km* from the Shan State of Myanmar in the north, along the Myanmar-Thailand border into Thailand and Malaysia and along a chain of islands in Indonesia to Belitung Island in the south (*Gardiner et al., 2014*). The limit of the tin-tungsten belt in the territory of Myanmar is about *750* miles.

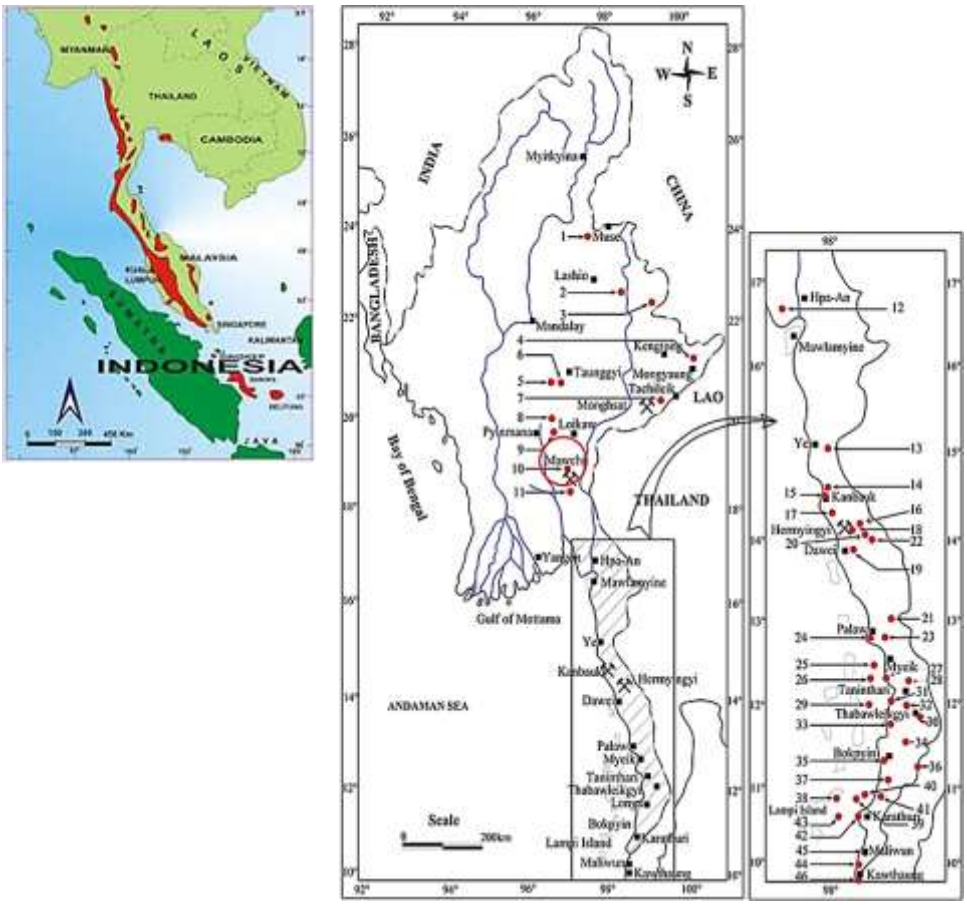


Figure 2. Southeast Asia tin-tungsten belt and tin-tungsten localities in Myanmar (After Tin Aye & Kyaw Nyein 1966; Ye Myint Swe pers. comm. 2012).

Mawchi Mineral Deposit is simply characterized by the presence of Mawchi Group intruded by the granites. Mawchi Group are traversed by the steeply dipping quartz veins which carry values of tin and wolfram with the proper distance being about *1 to 11 km*. Mawchi Group is composed of fine-grained sandstones, grits, calcareous mudstones, shales and limestones which strike northwest-southeast and the dip is steeply to the west. They may correlate with the mainly Carboniferous Mergui Group. As a result of granites intrusion, Mawchi Mine area has a low grade thermal metamorphic small aureole around its body with the metamorphic derivatives of the above sediments such as marbles, quartzites, spotted grits - coarse indurated sandstone, and indurated massive slates (*Hobson,1941*). The granite is a relatively small intrusion of porphyritic biotite granite, up to *500* meters wide and trending northwesterly. The quartz vein system is present both in the granites and the Mawchi meta-sediments that are found near the contact between the granite and the limestone, while some of the quartz veins penetrate the limestone for short distances and some are localized within a granite cupola immediately below a limestone cap. The Quaternary deposits are represented by detritus gravel, boulder-gravel and argillaceous sand formations (*A.Z. Myint et al., 2018*).

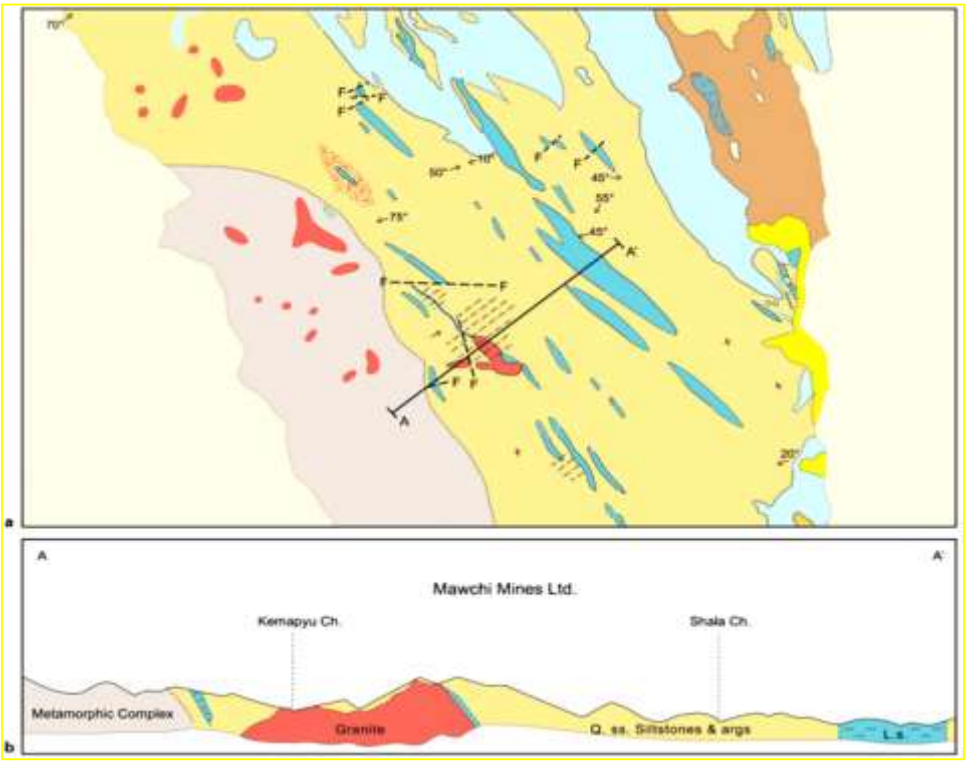


Figure 3. (a) Regional geological map of the Mawchi mine
(b) Cross-section A–A' through the Mawchi granite (from Robb and Arce, 2014).

Development of the Mine has been done by *five* main adits levels and driven along the strike of ore veins with many cross-cuts cutting across the strike of lodes. Mine openings have vertical distance between *30-50* meters. Presently, the majority of known ore veins on uppermost level are worked out (*Aung Zaw Myint et al., 2017*). Slopes are exceptionally steep in the Mine area, presumably because of the erosional-resistant limestone and weathered granite. Hilly relief permits the deposit to be developed by underground drift way method using the adits without expensive driving and labor consuming vertical shaft. However, steep slopes and deep rifts much hampers or impedes the construction of motor roads to connect villages and camps located on the hill slopes, as well as surface buildings and structures near the adit portals. Most of the collapses were occurred in some underground openings due to defective patterns of mining by rapacious extraction of ore in the backs of drives resulted in removing safety pillars. Sometimes, landslides result in dumping and sitting of approaches to the portals of levels.

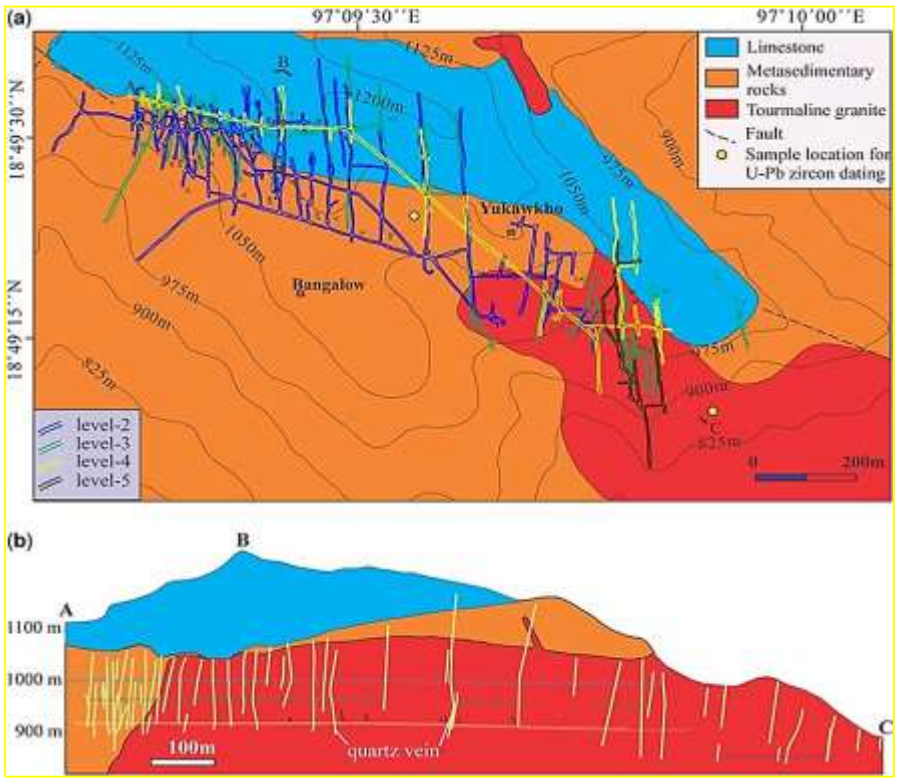


Figure 4. (a) Main adits plan map and (b) Cross sectional view of mineralization style in Mawchi Mine area, (Modified after a Mawchi Mine project map from Aung Zaw Myint *et al*. 2017.)

Landslide is a serious recurring geo-hazard in Mawchi Mine area. According to Mine office and local peoples, fatal events have been chronologically damaged in *July-1985, July-1988, April-2012, October-2015, July-2018*. It may hypothesize that represented in two conditions, both soil and rock failure events. Failure modes and mechanism are not at the same with one another, rock falls associated slope failures and shallow landslide in soil conditions. Shallow landslide has been frequently developed from superficial soil that has been physically relocated by movement from its bedrock source. Two separate times of large rock fall collapsing were happened at the western part of Mawchi hill in *July 1985 and 1988*. Added rock slope failure occurred at *KB-1* worksite eastern part of Mawchi Mine in *2019*. Along the escarpment road section, roadcuts and hard shoulder failures are habitually injured to some retaining structures which connected to Mawchi Mine and Loikaw, capital city of Kayah State.

Figure 5. Two times reported rock fall area in the western part of Mawchi Mine.

Figure 6. Shallow landslide occurrences at Mawchi Hill, October 11, 2015

Figure 7. Rock slope failure event at eastern part of Mawchi Mine, October 25, 2019

Overviewing it comes to finding causes that lead to failure of Mawchi Mine, it is important to include both Mine conditions and geological processes affect rock mass properties or failure mechanisms. The characteristic features of the Mine conditions are its highly dissected topography, favorable drift way method, improper mining, lack of geotechnical input for mine safety and long time consuming on one hand, and highlights the geological processes influence on rock mass properties are structural deformations in lateral extension of the ore-bearing zone and the longitudinal extension of individual veins, wider area of weathered places and disintegration of rocks affected by the tropical climate, soil-like weaken ground by hydrothermal alteration, stresses generated by the granite intrusion, primary jointing and decomposition of granites, rock discontinuities due to the forces exerted by blasting and fissure growth after ore extraction on the other. All this leads to feebly pronounced in frequent landslides with slope instability but they may not pose the same level of hazard. It is needless to say how the valuation which are at most risk.

3.Methodology

The discussion was made on the results of stability analysis using both empirical methods RMR (Geomechanical Classification for Rock Mass Rating) and SMR (Geomechanical Classification for Slopes Mass Rating), as well as the performance of analytical method Kinematic Analysis, are evaluated. It is the most effective methods for evaluating slope stability in the initial planning stage. Not only using these methods can help to avoid excavation on dangerous slopes but also slope-related landslide problems can be predicted and protective measures applied.

Rock Mass Rating (RMR) is a geomechanics classification system originally developed in *1973 by Prof. Z.T. Bieniawski*. It provides a general rating increasing with rock quality from *0 to 100* which low score refer to low rock quality whereas high score means high rock quality. The RMR system consists of *five* basic parameters: Strength of intact rock material, Rock quality designation (RQD), Spacing of discontinuities, Condition of discontinuities and Groundwater condition. In accordance with RQD, it is an index related to the degree of fracturing of core sample. *Palmstrom (1982)* proposed an approximate correlation between RQD and volumetric joint count (*Jv*), number of joints (m^3), which can be used to estimate with the formula ($RQD=115 - 3.3Jv$) when drill core is not available. Where $Jv = \Sigma\, {}^{1}/_{Si}$, S is mean spacing of joints family *i (m).*

Slope Mass Rating (SMR) was proposed by *Manuel R. Romana in 1985* for evaluation of rock slopes stability assessment. The SMR score based on type of slope selected between wedge, planar, and toppling, adjustment factors related to strike & dip of discontinuities and method of excavation as expressed in $SMR = RMR_{basic} + (F1 \times F2 \times F3) + F4$. Where *F1* is an adjustment factor depended on the parallelism between the joint strike (αj) and the slope face strike (αs). *F2* refers to joint dip angle in the planar failure or the plunge of the line of intersection of wedge failure. *F3* reflects the effect of the angle between the slope face dip (βs) and the joint dip (βj) or the plunge of the intersection. *F4* is an adjustment factor that depends on the excavation method. The SMR values range from *0 to 100*. This range has been classified into five different stability classes and the empirically found limit values of SMR associated to the different failure modes. Romana also proposed some guidelines for the use of remedial measures based on SMR.

Table 1. Rock Mass Rating System (Bieniawski, 1989)

Parameter			Range of values						
1	Strength of intact rock material	Point-load strength index	>10MPa	4 – 10MPa	2 – 4MPa	1 – 2MPa	For this low range – uniaxial compressive test is preferred		
		Uniaxial compression strength	>250MPa	100 – 250MPa	50 – 100MPa	25 – 50MPa	5-25 MPa	1-5 MPa	<1 MPa
	Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% - 100%	75% - 90%	50% - 75%	25% - 50%	< 25%		
	Rating		20	17	13	8	3		
3	Spacing of discontinuities		>2m	0.6 – 2m	200 – 600mm	60 – 200mm	<60mm		
	Rating		20	15	10	8	5		
4	Condition of discontinuities (See E)		Very rough surfaces Not continuous No separation Unweathered wall rock	Slightly rough surfaces Separation <1mm Slightly weathered walls	Slightly rough surfaces Separation <1mm Highly weathered walls	Slickensided surfaces or gouge <5mm thick or Separation 1-5mm continuous	Soft gouge >5mm thick or Separation >5mm continuous		
	Rating		30	25	20	10	0		
5	Ground water	Inflow per 10m tunnel length (l/m)	None	<10	10 – 25	25 – 125	>125		
		(Joint water press)/ (major principal σ)	0	<0.1	0.1 – 0.2	0.2 – 0.5	>0.5		
		General conditions	Completely dry	Damp	Wet	Dripping	Flowing		
	Rating		15	10	7	4	0		
B. RATING ADJUSTMENT FOR DISCONTINUITY ORIENTATIONS (See F)									
Strike and dip orientations			Very Favourable	Favourable	Fair	Unfavourable	Very Unfavourable		
Ratings	Tunnels and mines		0	-2	-5	-10	-12		
	Foundations		0	-2	-7	-15	-25		
	Slopes		0	-5	-25	-50	-60		
C. ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS									
Rating			100 ← 81	80 ← 61	60 ← 41	40 ← 21	<21		
Class number			I	II	III	IV	V		
Description			Very good rock	Good rock	Fair rock	Poor rock	Very poor rock		
D. MEANING OF ROCK CLASSES									
Class number			I	II	III	IV	V		
Average stand-up time			20 yrs for 15m span	1 year for 10m span	1 week for 5m span	10 hrs for 2.5m span	30 min for 1m span		
Cohesion of rock mass (kPa)			>400	300 – 400	200 – 300	100 – 200	<100		
Friction angle of rock mass (deg)			>45	35 – 45	25 – 35	15 – 25	<15		
E. GUIDELINES FOR CLASSIFICATION OF DISCONTINUITY CONDITIONS									
Discontinuity length (persistence) Rating			<1m 6	1.3m 4	3 – 10m 2	10 – 20m 1	>20m 0		
Separation (aperture) Rating			None 6	<0.1mm 5	0.1 – 1.0mm 4	1 – 5mm 1	>5mm 0		
Roughness Rating			Very rough 6	Rough 5	Slightly rough 3	Smooth 1	Slickensided 0		
Infilling (gouge) Rating			None 6	Hard filling <5mm 4	Hard filling >5mm 2	Soft filling <5mm 2	Soft filling >5mm 0		
Weathering Rating			Unweathered 6	Slightly weathered 5	Moderately weathered 3	Highly weathered 1	Decomposed 0		

Table 2 Slope Mass Rating System (Romana *et al*. 2003)

Adjustment rating for joints						
Case of failure		Very favorable	Favorable	Normal	Unfavorable	Very unfavorable
P	$\|\alpha j - \alpha s\|$	>30	30-20	20-10	10-5	<5
T	$\|(\alpha j - \alpha s)-180\|$					
P/T	F 1	0.15	0.40	0.70	0.85	1.00
P	$\|\beta j\|$	<20	20-30	30-35	35-45	>45
P	F 2	0.14	0.40	0.70	0.85	1.00
T		1	1	1	1	1
P	$\beta j - \beta s$	>10	10-0	0	0 to-10	<-10
T	$\beta j + \beta s$					
P/T	F 3	0	-6	-25	-50	-60

Adjustment rating methods of excavation of slopes					
Method	Natural	Presplitting	Smooth Blasting	Blasting or Mechanical	Deficient Blasting
F 4	15	10	8	0	-8

Description of SMR classes					
Class	V	IV	III	II	I
SMR	0-20	21-40	41-60	61-80	81-100
Description	Very bad	Bad	Normal	Good	Very good
Stability	Completely unstable	Unstable	Partially stable	Stable	Completely stable
Failures	Big planar of soil like	Planar of big wedges	Some joints of many wedges	Some Blocks	None
Support	Re-excavation	Important / Corrective	Systematic	Occasional	None
Failure Probability	0.9	0.6	0.4	0.2	0

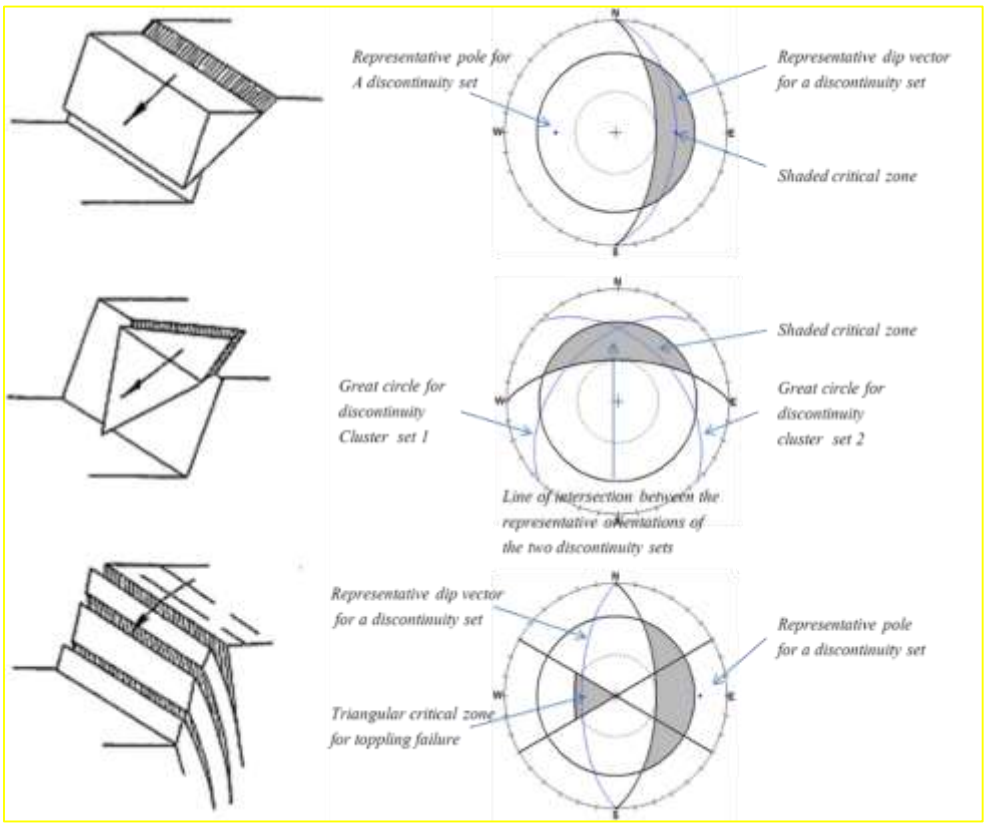


Figure 8. Slope failures and its stereo-net.

Kinematic analysis is based on Markland's test which is described in *Hoek and Bray (1981)*, various modes of rock slope failures that occur due to the presence of unfavorably oriented discontinuities. It is clearly defined by two basic input parameters (dip & dip direction of discontinuity and slope face) for analysis and interpretation through stereographic projections that allow us the three-dimensional orientation data to be represented and analyzed in two dimensions. After collecting important input parameters, the analysis can be done either manually or with software using friction angle, dip & dip directions of slope and discontinuities. Point load testing is used to determine rock strength indexes in geotechnical practice which only comprised of block lump tests. The rainfall data of the research area was obtained from the Department of Meteorology and Hydrology, Yangon Division. The rainfall record in the periods of *1980-2021* for Loikaw Station, *2001-2021* for Bawlakhe Station, and *2020-2021* for Pasawng Station were obtained. The representative spatial arrangement of each station from Mawchi Mine is Loikaw station *149 km*, Bawlakhe station *67.7* km and Paswang station *31* km.

The procedure is based on the primary data analysis. All available data are collected and thoroughly investigated to delineate the problem of landslides area and slope failure sites. The comprehensive slope instability assessment was specially carried out in detailed investigation. The rock samples are collected from the critical areas and then detail measurement of discontinuities were performed. The data are input for RMR and that will be integrated with SMR. The Stereonet *v-11* software is applied to examine the Kinematic analysis of rock mass in critical areas.

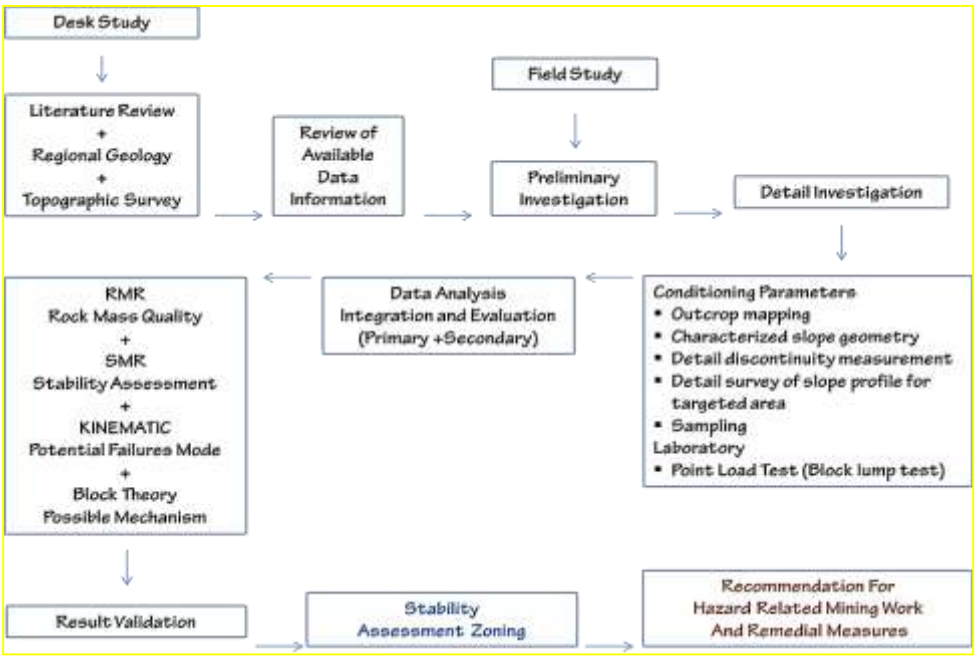


Figure 9. Flow chart of research scheme

4. Stability Assessment on Mine Area

To carry out the study, a total *26* slope stations were carefully studied in Mine area and its related road segment. All stations were selected in the way that they located in the places of geology and physiographic conditions of the exposed rock mass. All intentional cases were examined in regards to rock mass properties and the results were used to assess the stability of slope that was represented in the study area.

In general, the rock mass has been covered by colluvium soil with scanty vegetation. The outcrops are mainly of Mawchi Group only which have steep bedding along with several joint sets. During field investigations it has been observed that argillaceous rocks are more deformed and crushed than the other Mawchi sediments. The structural characters of joints in relation to slope face are such that they form a sequence of way to varying size leading to slope failure.

The study revealed that the entire modes of failure were controlled by structurally the most likely expected slope instability. While the failure pattern is mostly structurally controlled, a number of failures can also be observed due to intense weathering along bedding planes. The rock mass has graded to soil type material at several places and in such zones, failure is governed by mixed modes or possibly circular failure at a later stage.

Degree of weathering plays a significant role in slope stability of study area. For rock containing clay minerals, exchange of ions takes place due to adsorption and absorption of water which swells the rock. The opening of joints aperture has further increased the intensity of weathering by allowing free flow of water to deeper level in the slopes. Staining and alteration on joints indicate chemical alteration along the joint plane. Visual studies of samples from joint planes and outcrop surface were also carried out to estimate degree of alteration. Alteration percentage should be estimated by modal analysis which ranges indicating that joint planes and outcrop surface were undergoing chemical alteration. Chemical alteration of the minerals within the rock mass must be given extra care during extraction and post exploration stage.

Three to four unfavorable discontinuities sets were identified in Mawchi Mine. All discontinuities sets were observed with closed to moderately space with very low to low persistence and apertures were observed to be as closed to moderately wide. Orientations of bedding and joints were measured two or three times in the field, and also recorded the average values of orientation, persistence, aperture, filling, roughness and water conditions. The details of primary field data were taken from all slope stations during field survey.

The probability of slope failure is checked with respect to slope face, as the slope face is not constant, are made to determine a failure type. For each stereographic projection, failure index for planar, wedge and toppling are calculated. Based on the field observation and available data, it is often that wedge and toppling modes are predicted more than plane failures. Therefore, kinematic analysis should be accompanied with additional analysis tools to give more total evaluation of the stability of the Mine area.

4.1 RMR Analysis

In the study area, total RMR value ranges from *41 to 74* which indicating that rock mass under presence of fair to good condition of rock in Mawchi Mine region. Very good condition of rock is not observed in any place of study area. Discontinuity data also showed a wide range of variation in the amount, direction, filling, roughness, persistence, aperture and spacing that are key factors guiding slope stability in rock mass. These values were measured and observed in the field. Dip and strike of rock mass also varied from place to place. In case of strength of rock mass, fragile to very hard condition was noticed. RQD values range from *0% to 89%* poor to good, were obtained by field survey using Jv (volumetric joint count). But some are nearly closed to the excellent condition. This parameter itself is able to demonstrate the present condition of rock mass. Wide variation in RQD is an indication of varying block size and is also responsible for irregular RMR values along the entire study. As the total results, the study area is fall into the proportion by *70%* fair rock and good rock is *30%*. It is favorable for weaken ground.

4.2 SMR Analysis

The SMR score is obtained by subtracting a factor from RMR depending on the joint-slope relationship and adding a factor depending on the method of excavation. On based the field observations and SMR study results concluded that failure modes were controlled by discontinuities then can be categorized into completely stable to completely unstable with probable planar, toppling and wedge failure mode. According to the field investigation performed in the study site, the rock masses of slopes possess four discontinuity sets which three of them are joint sets and one of sets is a bedding set. The results of the study show that all SMR methods can be used for structurally controlled failure of rock slopes (jointed rock mass). SMR values were also calculated which ranges from *7.3 to 80* and failure probability is *0.2 to 0.9*. It indicates that studied rock mass lies under good, stable to very bad, completely unstable class. There is no recorded in very good, completely stable evidence. It will also be convenient to correlate the results obtained from RMR. It was determined that the most probable of rock mass failure was instability. Wedge failure is greater chance of occurrences as compared to other two possible modes of failure in summary.

4.3 Kinematic Analysis

According to the analysis, one station is safe from all possible structurally controlled failure but the other two are clearly involved in all potential. The result shows that wedge failure is mostly in the study area. It is favorable for *19* slope stations. The major cause of wedge failure in the study area is found dip and oblique joints present on bed rock. Secondly, the probable topple failure is found in *12* potential stations at the study area. The possibility of plane failure is *8* stations and less than the above two modes.

Kinematic analysis specifies that there is the probability of almost all types of failures but plane failures are found in a few smaller amounts than other. Both natural and human induced slope failures are favorable in study area. After mode of failure can identify, it can further be used to examine direction of sliding and provide stability condition, which each mode has different condition. Therefore, Mine area has established significant for long-term sustainability.

4.4 Comparison of Stability Analysis

In this study, research focus is interested in instabilities related to mining activity that will be hindered the future cycle of operations of exploitations and may cause considerable threat to mine safety. The whole study uses a combined-attitude methodologically exploited geo-mechanical and kinematical approach to evaluate the effect of the discontinuities network on the mechanical behavior of rock mass in the Mine area and to establish a diagnostic on the stability and on the responses of failures chances. Theoretically, the importance of discontinuity orientation is a natural geologic activity, hence attention should be paid to the proper analysis by using the right tools and techniques so as to avoid turning a profitable mine to a loss.

Kinematic approaches allow failure modes determination on the basis of geometric considerations by neglecting some forces. Stereographic projection makes it possible to highlight the geometrical configurations favorable to a break according to a given mechanism. RMR is used to compute SMR of each slope, indicating that the SMR analyses require RMR and kinematic analysis results. The detailed quantitative consideration of orientation of joint sets and geometry of the slope contributed to such differences in outcomes. The probability of failure and reliability index can give a complement to the calculation so that the result can be interpreted more but they shall not be used as a design value.

Ending results obtained by Kinematic analysis performed indicate that three types of failures (planar, toppling and wedge failure) are possible. The RMR rating is ranging from *41 to 74* and can be categorized as Fair to Good rock. The rating is slightly different in the investigated slopes and it seem to be mutual. The slopes studied have similar RMR because of the corresponding similar lithological and geotechnical characteristics. The SMR rating revealed that the failure probability of slopes was *0.2 to 0.9*. The results say that the stability is low in the slope. However, the similarity of RMR or rock mass quality does not correspond with SMR and its stabilities. This differentiate influenced by the connection between the slope angle and the joint dips on the slope which represented by adjustment factor.

As a foregone conclusion based on these findings, it provides a reliable database that will help professionals and decision-makers to better reason their interventions in the field especially in sites lacking appropriate scientific and technical means. It is conspicuous in comparison table.

Table 3. Summary results of RMR rating for study area

Slope Station	Basic Parameters					Total Rating	Rock Mass	
	Strength Intact Rock	RQD	Joints Spacing	Joints Condition	Joints water		Class	Description
No.1	4	8	8	18	15	53	III,	Fair Rock
No.2	4	0	8	16	15	43	III,	Fair Rock
No.3	7	8	8	21	15	59	III,	Fair Rock
No.4	7	8	8	20	15	58	III,	Fair Rock
No.5	7	13	10	20	15	65	II,	Good Rock
No.6	7	13	10	20	15	65	II,	Good Rock
No.7	7	3	8	20	10	48	III,	Fair Rock
No.8	4	3	8	16	10	41	III,	Fair Rock
No.9	2	3	8	20	10	43	III,	Fair Rock
No.10	12	17	10	20	15	74	II,	Good Rock
No.11	4	3	8	20	10	45	III,	Fair Rock
No.12	7	13	8	20	15	63	II,	Good Rock
No.13	7	13	10	20	15	65	II,	Good Rock
No.14	7	3	8	10	15	53	III,	Fair Rock
No.15	7	8	8	20	15	58	III,	Fair Rock
No.16	7	17	8	10	15	57	III,	Fair Rock
No.17	7	13	10	14	15	59	III,	Fair Rock
No.18	7	13	10	14	15	59	III,	Fair Rock
No.19	4	3	8	16	10	41	III,	Fair Rock
No.20	7	17	10	19	10	63	II,	Good Rock
No.21	7	13	10	14	10	54	III,	Fair Rock
No.22	7	3	8	16	10	44	III,	Fair Rock
No.23	7	13	10	14	15	59	III,	Fair Rock
No.24	7	13	15	12	15	62	II,	Good Rock
No.25	7	13	10	14	15	59	III,	Fair Rock
No.26	7	17	15	12	15	66	II,	Good Rock
Total rock class (%): Class II, Good Rocks (8Nos, 30%), Class III Fair Rocks (18Nos, 70%)								

Table 4. Summary SMR evaluation results for research area

Reference slope station	SMR (Romana,1985)		
	Studied Stability	Potential Failure	
		P/W	T
No.1 (Field Code. 18MC-01)	Bad, Unstable	Yes	No
No.2 (field code. 10MC/01)	Very bad, Completely Unstable	Yes	Yes
No.3 (field code. 10MC/05)	Normal, Partially Stable	No	No
No.4 (field code. 11MC/04)	Good, Stable	No	No
No.5 (field code. 11MC/05)	Good, Stable	No	No
No.6 (field code. 11MC/07)	Good, Stable	No	No
No.7 (field code. 13MC/10)	Bad, Unstable	Yes	No
No.8 (field code. 14MC/01)	Bad, Unstable	Yes	Yes
No.9 (field code. 14MC/02)	Bad, Unstable	Yes	Yes
No.10 (field code. 14MC/ 03)	Good, Stable	No	No
No.11 (field code. 15MC/01)	Normal, partially stable	No	No
No.12 (field code. 15MC/02)	Normal, Partially Stable	No	No
No.13 (field code. 16MC/02)	Bad, Unstable	Yes	Yes
No.14 (field code. 20MC/01)	Bad, Unstable	Yes	Yes
No.15 (field code. 20MC/02)	Bad, Unstable	Yes	No
No.16 (field code. 21MC/01)	Bad, Unstable	Yes	No
No.17 (field code. 21MC/02)	Bad, Unstable	No	Yes
No.18 (field code. 22MC/01)	Bad, Unstable	Yes	Yes
No.19 (field code. 22MC/02)	Very Bad, Completely Unstable	Yes	Yes
No.20 (field code. 23MC/01)	Normal, Partially Stable	No	No
No.21 (field code. 23MC/02)	Bad, Unstable	Yes	Yes
No.22 (field code. 25MC/03)	Bad, Unstable	Yes	Yes
No.23 (field code. 281MC/01)	Bad, Unstable	No	Yes
No.24 (field code. 281-MC/02)	Bad, Unstable	No	Yes
No.25 (field code. 291-MC/08)	Normal, Partially Stable	No	No
No.26 (field code. 62-MC/04)	Normal, Partially Stable	No	No
P-plane, W-wedge, T-topple		13	12

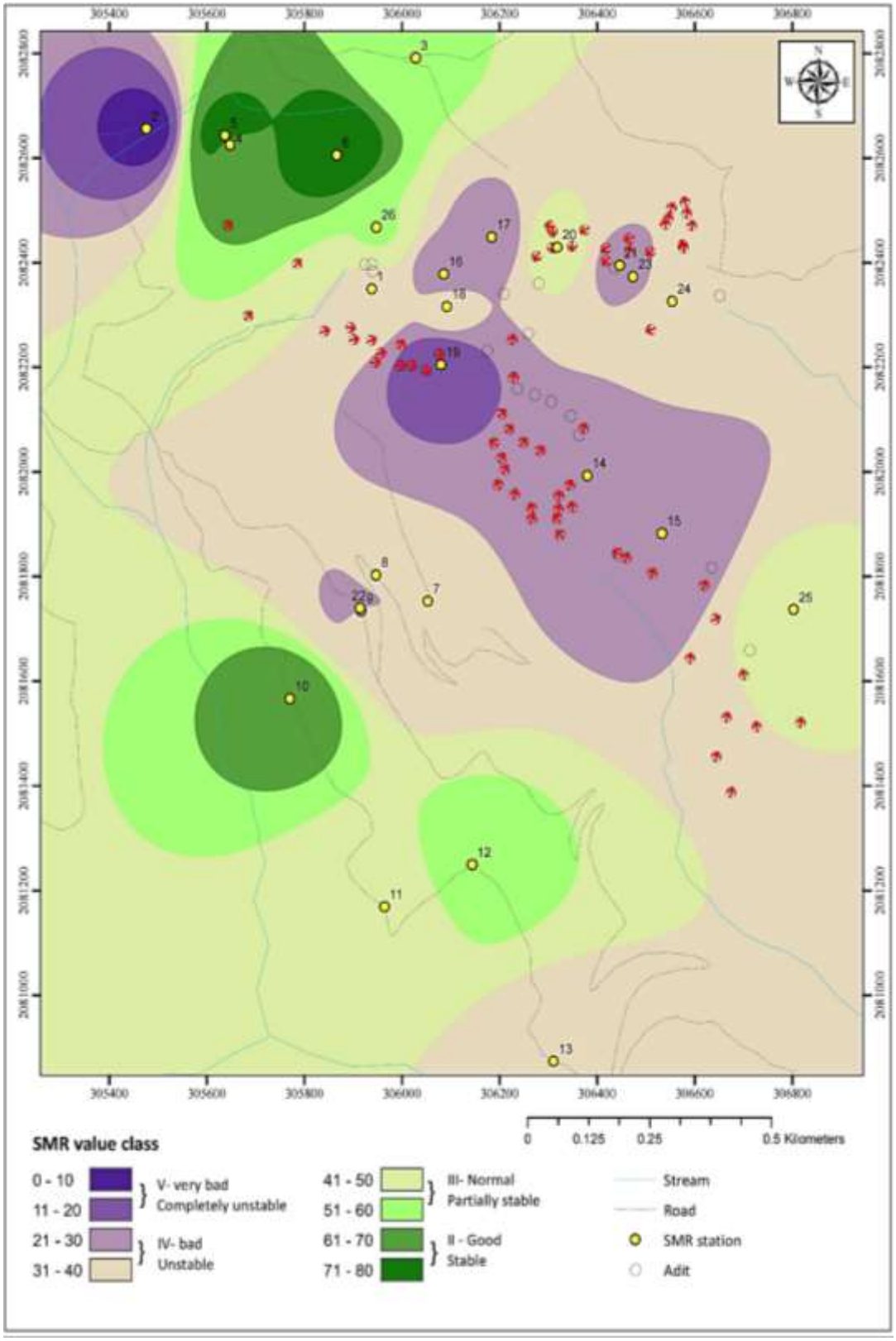
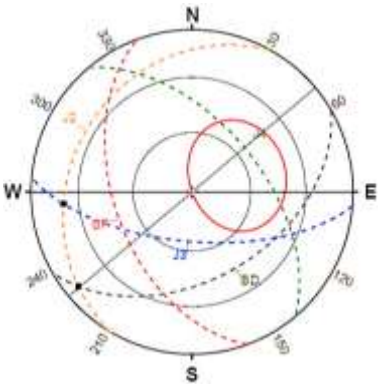


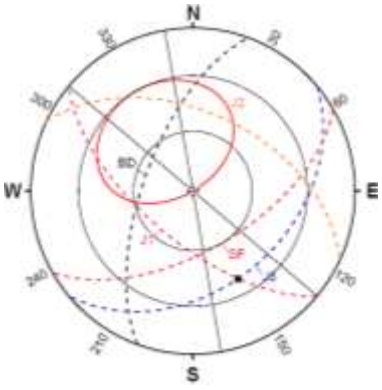
Figure 10. Stability zonation map on SMR values of research area

Table 5 Summary results of kinematic analysis for study area

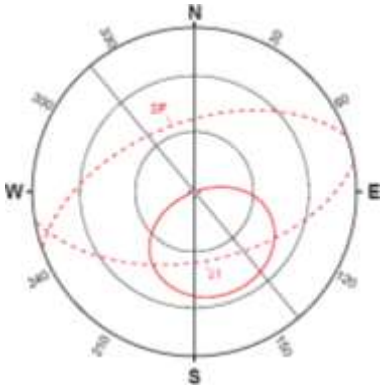
Station	Slope Face	Discontinuity Orientations						Friction Angle	Potential mode of failure and joint sets involved		
		BD	J1	J2	J3	J4	J5	Ø	P	W	T
1	160/50 SW	60/45SE	300/35 NE	210/25 NW	095/65 SW	320/55 NE	-	30	-	J2&J3, J2&BD	J4
2	60/60 SE	200/65 NW	130/65 SW	295/50 NE	50/40 SE	-	-	30	J3DL	J1&J3	-
3	250/55 NW	30/75 SE	80/55 SE	150/45 SW	220/80 NW	310/45 NE	-	30	-	-	J1
4	140/50 SW	345/75 NE	35/40SE	290/65 NE	120/75 SW	260/40 NW	-	30			J2
5	120/50 SW	20/80 SE	145/70SW	355/50 NE	260/40 NW	-	-	40	-	-	-
6	140/60 SW	35/65 SE	120/80 SW	90/60N	60/80 SE	-	-	40		J2&J3	
7	190//70 NW	45/80 SE	135/85 SW	160/35 SW	305/50 NE	190/40 SE	-	30	J4 J2	J2&BD, J4&J2, J1&J4	-
8	145/70SW	20/80 SE	300/ 65NE	160/ 40SW	345/ 70NE	060/ 45SE	-	30	J2	J2&J4, J2&BD	-
9	150/70SW	20/60 SE	280/ 75NE	185/75NW	275/40 NE	110/65SW	-	30	-	J2&J4	-
10	150/70SW	30/80 SE	125/75SW	250/65NW	345/30 NE	120/15SW	-	40	-	-	J3
11	135/70SW	50/40 SE	110/80SW	195/70NW	175/30SW	25/80 SE	-	30	-	J3&BD	-
12	80/70 SE	10/30 SE	40/70 SE	130/60 SW	220/45NW	-	-	40		J1&J2	
13	110/70SW	45/80 SE	150/65SW	40/60 SE	100/35SW	290/ 80NE	-	40	J3	J1&BD, J1&J2, BD&J3 J2&J3	-
14	110/70SW	350/70SW	80/70 SE	320/ 65NE	115/30SW	250/65NW	-	30	-	BD&J1 J1&J2	-
15	120/70SW	195/75NW	320/ 50NE	105/40 SW	250/50NW	080/70 SE	-	30	J2	BD&J2, BD&J4	J1
16	140/70SW	20/55 SE	285/65 NE	080/75 SE	110/85SW	170/50SW	-	30	-	J2&J4	-
17	120/70SW	30/70 SE	250/70NW	300/55 NE	80/60 SE	60/80 SE	-	30	-	J3&J4 J3&BD	J2
18	150/65SW	15/55 SE	170/ 35SW	115/ 75SW	250/75NW	320/60 NE	-	30	J1	J1&J3	J4
19	140/65SW	20/50 SE	290/65 NE	060/50 SE	120/60SW	260/50NW	-	30	J3	-	J1
20	300/70NE	15/75 SE	100/80 SW	320/80 NE	220/65NW	045/70 SE	-	40	-	BD&J3	-
21	330/70NE	20/60 SE	065/45 SE	140/65 SW	120/70SW	300/70 NE	-	30	-	J1&J4, BD&J4	J2/J3
22	140/70SW	40/80 SE	110/65 SW	315/ 50NE	305/ 85NE	220/30NW	-	30	J1	-	J2
23	340/65NE	40/60 SE	280/30 NE	155/ 60SW	320/85 NE	085/55 SE	215/45NW	30		BD&J1	J2
24	310/65NE	50/60 SE	145/ 65SW	220/60NW	170/30SW	085/55 SE	330/65 NE	40	-	-	J1
25	160/60SW	40/80 SE	070/40 SE	310/45 NE	030/85 SE	130/ 65SW	-	30		J1&J3	J2
26	145/65SW	55/60 SE	140/80SW	285/70 NE	070/85 SE	240/55NW	-	40	-	J3&J4	-



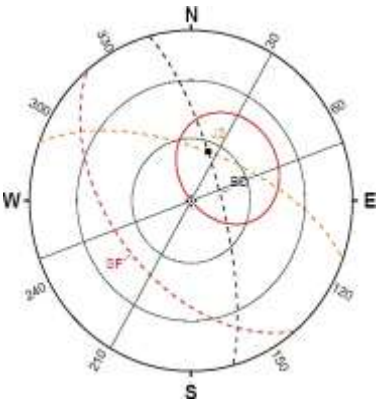
No.1 (18MC-01) 2-Wedge and 1-Topple are possible.



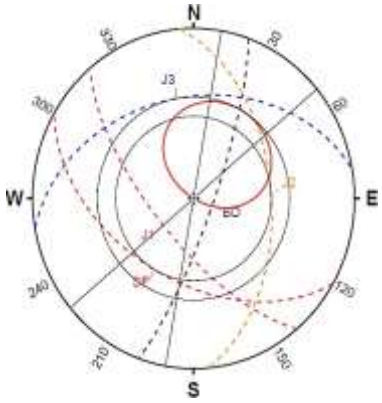
No.2 (10MC-01)1-Wedge and 1-plane are possible



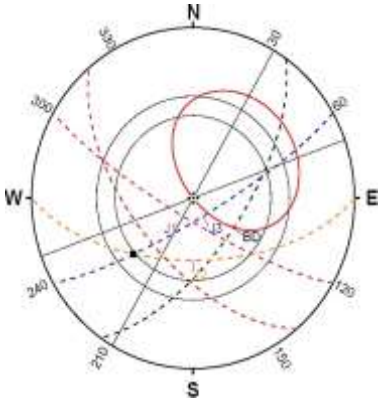
No.3 (10MC-05) Topple failure is possible.



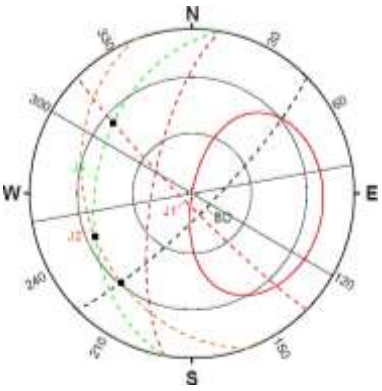
No.4 (11MC-04) Topple failure is possible.



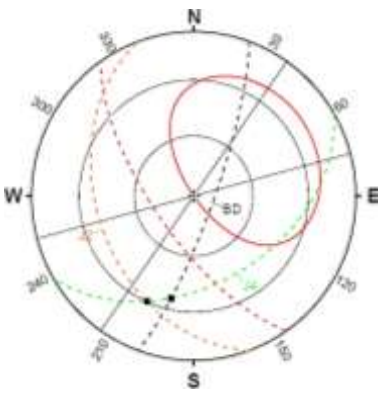
No.5 (10MC-05) Non failure is noted.



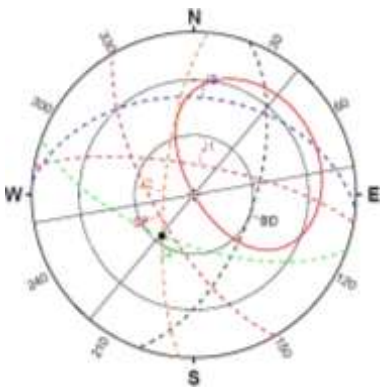
No.6 (11MC-07) Wedge failure is possible



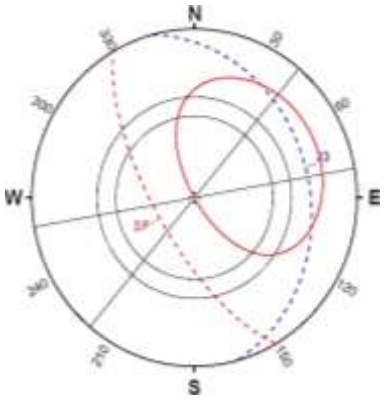
No.7 (13MC-10) 2-plane and 3-wedge are possible



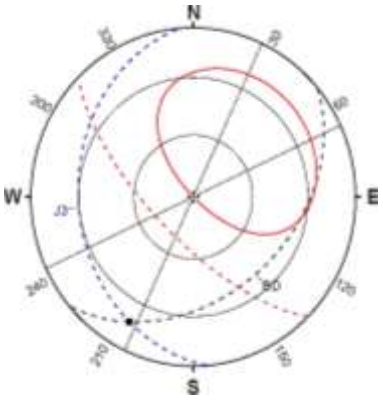
No.8 (14MC-01) A plane and 2-wedge are possible



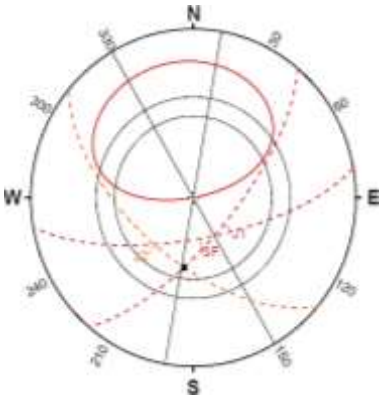
No.9 (14MC-02) A wedge is possible



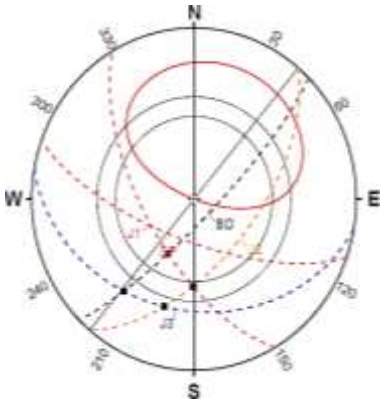
No.10 (14MC-03) A plane and a topple are possible



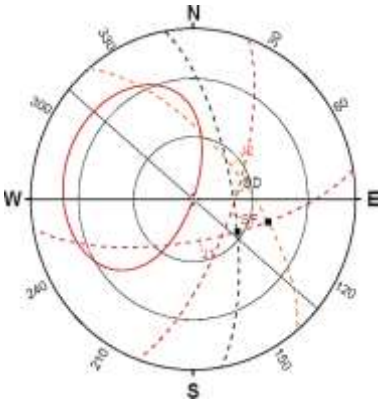
No.11 (15MC-01) A wedge is possible



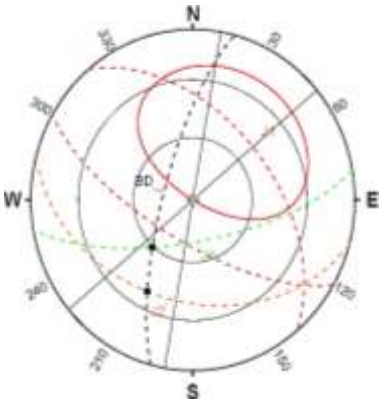
No.12 (12MC-02) A wedge is possible



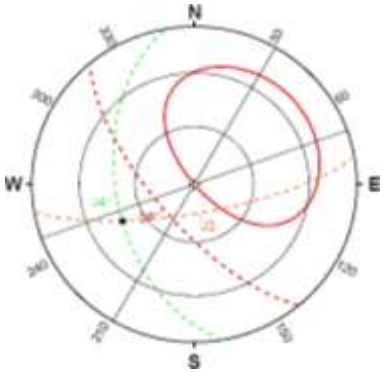
No.13 (16MC-02) A plane and 2-wedge are possible



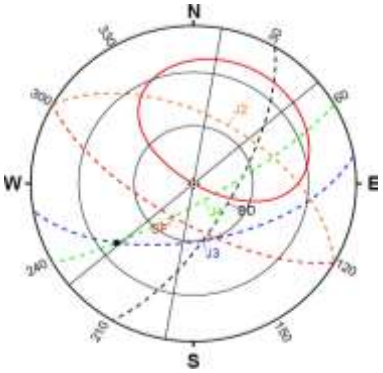
No.14 (20MC-01) 2-wedge are possible



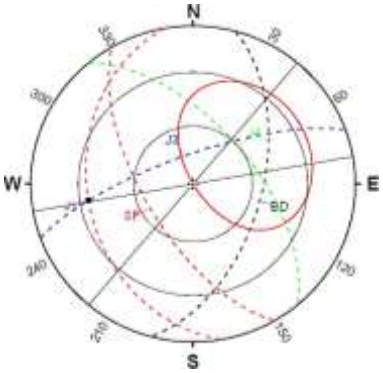
No.15 (20MC-02) All are possibly shown



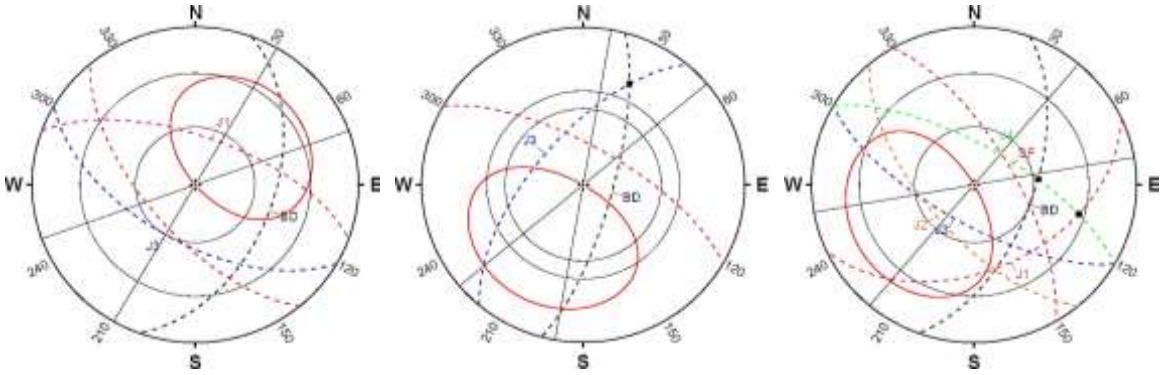
No.16 (21MC-01) A wedge is possible



No.17 (21MC-02) A topple and 2-wedge are possible



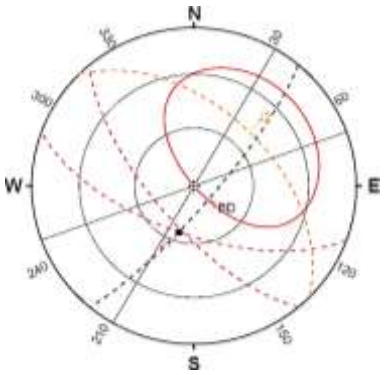
No.18 (22MC-01) All basic modes are possible



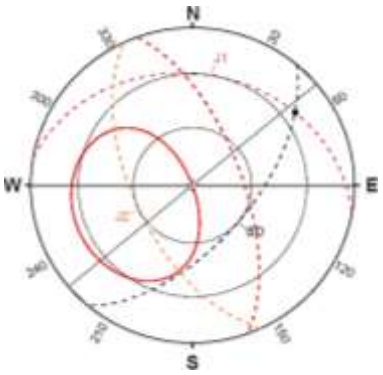
No.19 (22MC-02)
A plane and a topple are

No.20 (23MC-01)
A wedge is possible

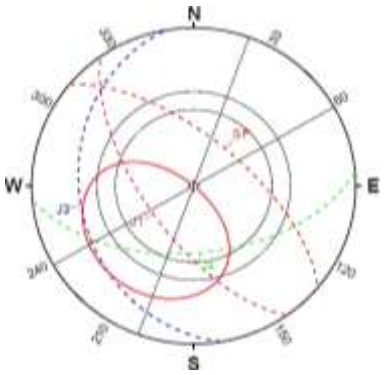
No.21 (23MC-02) A topple
and 2-wedge are possible



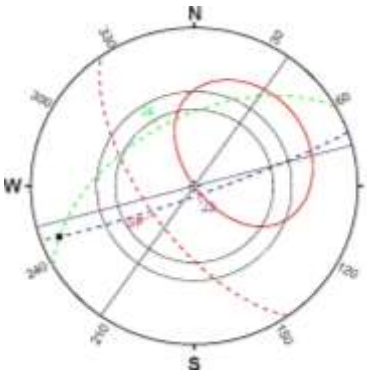
No.22 (25MC-03) A plane
and a topple are possible



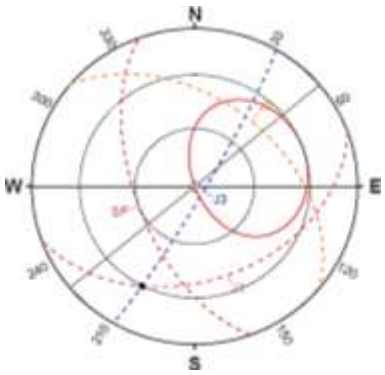
No.23 (28-1MC-01) A topple
and a wedge are possible



No.24 (28-1MC-02)
A topple is possible



No.26 (6-2MC-04)
A wedge is possible



No.25 (29-1MC-08) A plane
and a wedge are possible

Figure 11. ***Calculated all slope stations and its stereo-net interpretations***

Table 6. Comparison analysis of Kinematic, RMR and SMR

No	Slope Station	Kinematic Analysis			RMR (Bieniawski,1989)	SMR (Romana,1985)		
					Rock class and description	Studied Stability	Potential Failure	
		P	W	T			P/W	T
1	18MC-01	No	Yes	Yes	Class III, Fair Rock	Bad, Unstable	Yes	No
2	10MC/01	Yes	Yes	No	Class III, Fair Rock	V-bad, completely unstable	Yes	Yes
3	10MC/05	No	No	Yes	Class III, Fair Rock	Normal, partially stable	No	No
4	11MC/04	No	No	Yes	Class III, Fair Rock	Good, Stable	No	No
5	11MC/05	No	No	No	Class II, Good Rock	Good, Stable	No	No
6	11MC/07	No	Yes	No	Class II, Good Rock	Good, Stable	No	No
7	13MC/10	Yes	Yes	No	Class III, Fair Rock	Bad, Unstable	Yes	No
8	14MC/01	Yes	Yes	No	Class III, Fair Rock	Bad, Unstable	Yes	Yes
9	14MC/02	No	Yes	No	Class III, Fair Rock	Bad, Unstable	Yes	Yes
10	14MC/03	No	No	Yes	Class II, Good Rock	Good, Stable	No	No
11	15MC/01	No	Yes	No	Class III, Fair Rock	Normal, partially stable	No	No
12	15MC/02	No	Yes	No	Class II, Good Rock	Normal, partially stable	No	No
13	16MC/02	Yes	Yes	No	Class II, Good Rock	Bad, Unstable	Yes	Yes
14	20MC/01	No	Yes	No	Class III, Fair Rock	Bad, Unstable	Yes	Yes
15	20MC/02	Yes	Yes	Yes	Class III, Fair Rock	Bad, Unstable	Yes	No
16	21MC/01	No	Yes	No	Class III, Fair Rock	Bad, Unstable	Yes	No
17	21MC/02	No	Yes	No	Class III, Fair Rock	Bad, Unstable	No	Yes
18	22MC/01	Yes	Yes	Yes	Class III, Fair Rock	Bad, Unstable	Yes	Yes
19	22MC/02	Yes	No	Yes	Class III, Fair Rock	V-bad, completely unstable	Yes	Yes
20	23MC/01	No	Yes	No	Class II, Good Rock	Normal, partially stable	No	No
21	23MC/02	No	Yes	Yes	Class III, Fair Rock	Bad, Unstable	Yes	Yes
22	25MC/03	Yes	No	Yes	Class III, Fair Rock	Bad, Unstable	Yes	Yes
23	281MC/01	No	Yes	Yes	Class III, Fair Rock	Bad, Unstable	No	Yes
24	281MC/02	No	No	Yes	Class II, Good Rock	Bad, Unstable	No	Yes
25	291MC/08	No	Yes	Yes	Class III, Fair Rock	Normal, partially stable	No	No
26	62MC/04	No	Yes	No	Class II, Good Rock	Normal, partially stable	No	No
		8	**19**	**12**	**P-plane, W-wedge, T-topple**		**13**	**12**

4.5 Laboratory Point Load Testing

The mechanical properties were determined from the rock samples collected from the vast deposit of Mawchi Group in study area. In this study, twenty Point Load tests were conducted and of those testing and calculation procedures were carried out in accordance with *ISRM (1985)*. It recommends that a minimum of ten tests must be carried out in order for the results to be valid. The Point Load tests were conducted on block cutting specimens which only comprised of block lump tests. This test is usually applied during geo-engineering work and civil engineering projects such as slope stabilization task, tunneling, deep foundation and the design of underground mining support system. The results of the Point load test presented in the mean values of the specimens are *1.8705*. According to *Bieniawski (ISRM 1981)*, this rock can be classified as a low strength rock. It has optimized that there is a strongly satisfactory to the correlation between the result of point load test and both RMR and SMR evaluations for assessing rock strength.

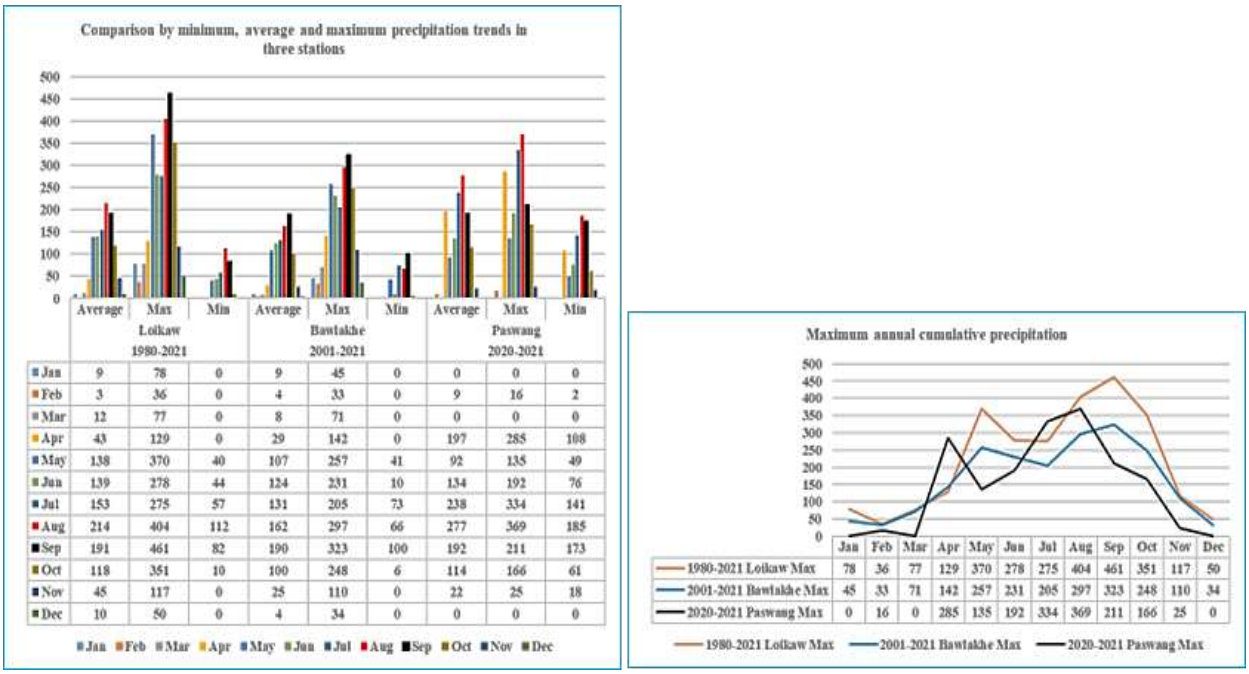
Table 7 Summary results of point load test calculation

No.	Dimension			Applied Load-P (KN)	Minimum Cross-Sectional Area	Equivalent Core Diameter	Size Correction Factor	Uncorrected point load strength	Point load strength
	W (mm)	L (mm)	D (mm)		$A = WD$	$De^2 = 4A/\pi$ $De = \sqrt{\frac{4A}{\pi}}$	$F = (De/50)^{0.45}$	$Is = P/De^2$ (MPa)	$Is_{(50)} = F \times Is$ (MPa)
1	68	50	61	13	4148	72.673	1.183	2.461	2.911
2.	58	52	56	4.6	3248	64.307	1.119	1.112	1.244
3	54	51	56	4.6	3024	62.050	1.102	1.194	1.315
4	52	42	55	4.2	2860	60.344	1.088	1.153	1.254
5	54	54	55	9.7	2970	61.494	1.097	2.565	2.813
6	59	51	53	3.9	3127	63.098	1.110	0.979	1.086
7	54	45	54	4.7	2916	60.932	1.093	1.265	1.382
8	50	58	56	4.2	2800	59.708	1.083	1.178	1.275
9	52	50	53	2.7	2756	59.237	1.079	0.769	0.829
10	54	53	52	4.3	2808	59.793	1.083	1.202	1.301
11	56	53	55	4.2	3080	62.622	1.106	1.070	1.183
12	53	47	54	12.9	2862	60.365	1.112	3.540	3.936
13	56	50	55	4.5	3080	62.622	1.106	1.147	1.268
14	52	53	56	11.9	2912	60.890	1.092	3.209	3.504
15	55	48	51	4.5	2805	59.761	1.083	1.259	1.363
16	51	54	54	8.2	2754	59.215	1.079	2.338	2.522
17	53	53	49	5.3	2597	57.503	1.064	1.602	1.704
18	56	52	56	12	3136	63.189	1.111	3.005	3.338
19	53	53	52	5.7	2756	59.237	1.079	1.624	1.752
20	55	52	54	6.5	2970	61.494	1.097	1.718	1.884
Mean value									1.8705

4.6 Rainfall Analysis

Ideally, the rainfall record should be derived from the particular landslide site. In Mawchi Mine area, the rain gauge station comes with a limited amount; therefore, the nearest rain gauge stations were considered. But the nearest Pasawng Station is the newest and little period in rainfall record. It is about *2 years* life span and *31 km* away from Mawchi Mine. Although the other stations Bawlakhe and Loikaw have entered to acceptable record periods, they missed on the spatial assumption. Based on available rainfall data, the study area is defined by heavy precipitation from *June to September*, moderate precipitation from *April to May* and light precipitation from *February*

to March. The remaining months receives low precipitation as compared to other months. Review on previous collapsing events, it was found that most of the landslides were likely to occur if antecedent rainfall is taken into consideration. Overview on all rain gauges records, it is clear that rain intensity especially in *August and September* is most answerable for soil and rock slope destabilizing. The goal of this suggestion was to raise awareness regarding impacts that increased rain intensity in the future rainy season can have on not only natural slopes, but also mining task and road cuts of study area.



	Loikaw 1980-2021			Bawlakhe 2001-2021			Paswang 2020-2021		
	Average	Max	Min	Average	Max	Min	Average	Max	Min
Jan	9	78	0	9	45	0	0	0	0
Feb	3	36	0	4	33	0	9	16	2
Mar	12	77	0	8	71	0	0	0	0
Apr	43	129	0	29	142	0	197	285	108
May	138	370	40	107	257	41	92	135	49
Jun	139	278	44	124	231	10	134	192	76
Jul	153	275	57	131	205	73	238	334	141
Aug	214	404	112	162	297	66	277	369	185
Sep	191	461	82	190	323	100	192	211	173
Oct	118	351	10	100	248	6	114	166	61
Nov	45	117	0	25	110	0	22	25	18
Dec	10	50	0	4	34	0	0	0	0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980-2021 Loikaw Max	78	36	77	129	370	278	275	404	461	351	117	50
2001-2021 Bawlakhe Max	45	33	71	142	257	231	205	297	323	248	110	34
2020-2021 Paswang Max	0	16	0	285	135	192	334	369	211	166	25	0

Figure 12. Interpretation by rainfall trend of three stations

4.7 Stability Analysis along Mawchi-Aung Chan Thar Road Section

The study is intended by highlighting the preference need to more strengthen the road sections because the roadway is very useful throughout the year owing to its scenic view and connecting link from Mawchi to Loikaw City and surrounding villages. The study comprised *seven* stations which have different lithological as well as geotechnical characteristics. Majority of rock masses selected in the road section consisted of sandstones and argillaceous slate of the Mawchi Group. Most of the cutting have steep to very steep dip angle with a developed system of joints. Determining the sites placing that appear unstable and had a chance of failure were marked and selected for detail studies. Discontinuity data were conducted on selected sites. An added problem is introduced in the form of opening of joint apertures and creation of loose blocks due to improper blasting. The surficial joints have opened up leading to almost negligible shear resistance offered by them allowing the blocks to detach from the slope face very easily. A slight trigger due to vibration or rainfall can lead to detachment of such blocks and can cause series of rock fall activity along the entire stretch. This has also been confirmed during the field visits as several blocks were found on the sides of the roadways mostly on the higher slope section. In road-cuts analysis two completely unstable slope stations are evaluated with plane and wedge failure favorable by kinematic. Four potentially unstable and one completely stable condition are estimated. The most favorable modes are wedge type failure in the road section. Due to hill slope geometry and status of discontinuities, the possibility of wedge failures is found in bigger chance. So, all selected slope

stations of study area including the stations within the Mawchi to Aung Chan Thar Road section is not safe for long-term where the probability of wedge fall will become high.

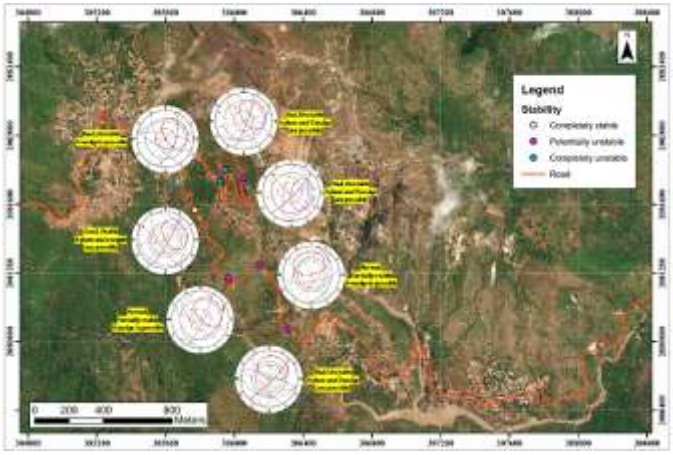


Figure 13. SMR & Kinematic analysis map of Mawchi - Aung Chan Thar Road section

4.8 Analysis on Targeted Slope at Western Part of Mawchi Mine Area

The targeted slope region has been a selected area as the critical issue within the mine and local people. It is located in the western part of Mawchi hill, where two separate times of large rock fall associated slope collapsing were occurred in *July 1985 and 1988*, that consequently caused *21 houses* destroyed, claimed *22 lives*, buildings, road and bridge were demolished. Below the western part of this slope region are the villages of Lokhalo, Lokhalo New Quarter and the *No.3* mining site. If the recurrent slope failure is occurred there, the damages will be great. An important meeting, many people say that it is possible or not and everyone is curious about the collapse of huge limestone boulder on top of the hill as the rock is hardly left over from previous falling events. Therefore, the timely protection of the local people and environment with proper preventive measures is quite imperative.

In the study, targeted area analysis is solved by Block Theory and its probable mode of failure is identified in Kinematic. Key-block theory was introduced by *Goodman and Shi in 1985* for the analyses of instability in rock masses based on geometrical properties and rock block dimensions resulting from the intersection of discontinuities that are assumed to be planar and persistent regardless of the lateral pressures that allow static analyses of rock masses in two-dimensional and three-dimensional spaces.

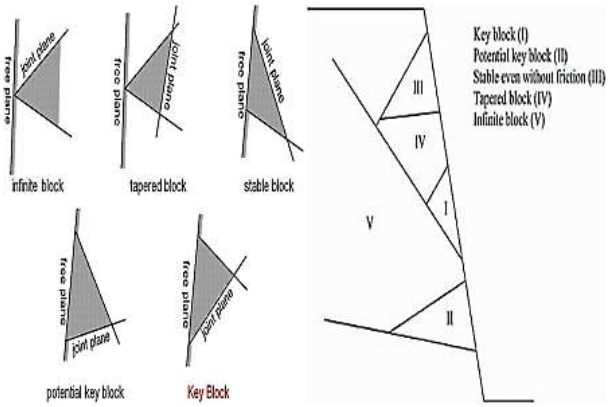


Figure 14 Classification of rock blocks based on Block Theory (Goodman and Shi, 1985)

This theory was assessed by rock block geometrical emplacement which was classified for various block types and different failure conditions that were created by the discontinuity. The block theory classifies blocks in various types as infinite blocks (*V*), tapered blocks (*IV*), stable-even without friction blocks (*III*), potential key blocks (*II*) and key blocks (*I*). In this classification, the '*V*' block is "infinite" and the rest of the blocks are "finite" which have the property of removability.

Firstly, it was performed the geometry of slope by detail surveying and evaluates the potential instability considering the application of the key block theory based on all data measurement of along the slope profile and its surrounding regions. The advantage of the proposed method is quick response for appropriate choices especially for Mawchi Mine in the context of discontinuous rock slope stability analysis. In order to accomplish the task, a detail surveying measurement was made on the created slope profile with the direction of *N 40˚ E* from *3-West* adit mine site to top of the hill by using Ushikata surveying compass. The highest altitude in the slope profiles is about *180 m* and inclination are about *60˚-70˚*. The previous Rock fall direction is *220˚*west.

Identification of slope regions and detail discontinuity surveys were performed for different rock station along the slope profile and its surroundings area. The prominent lithology along the slope profile is medium to thick bedded limestone with *60˚*dip amount which are directed toward *N30˚E*. They are dominantly covered on the top of the hill which can prominently be seen as big rectangular stone. The rock fall from previous case histories seems part of this rock. The middle to lower portion is well exposed by medium to thin bedded fine-grained sandstone with the same dipping direction and amount. First all the measured discontinuities are validated and selected dominant orientation of which are within azimuth direction of *220˚* and *30˚*. The dip amount of those selected discontinuities is presented on the geometric slope profile.

The key block was identified which initiated the first instability of rock falls. It was observed that the small joints in middle portion are firstly commenced and which cause the daylight to second key blocks. The rock fall of second key block again incubates the daylight to upper block of rock. By several times of this way in the middle portion that reach and leads daylight to the bottom of critical discontinuities (east dipping of low angle joint) of the giant rock block at the top. The main controlling discontinuity direction is east direction with *65˚* dip and *80˚* dip amount of west direction joint. Most of the key joints are concerned with low angle dip to east direction. They fall down several times to cause daylight to second key block. By this way, the daylight will reach to the bottom of giant block at the top.

Most of the key joints are found in the middle portion of the slope that induces second key joints to fall. In the actual field condition, rock falls compared with the large size at the top are taken place first in middle portion that incubate the day light to second key joints. By kinematic analysis, the topple nature of failure is mainly happened in this slope instability because the bedding joints are opposite direction of slope face which dip about *220˚*. Kinematic analyses were performed for slopes of two regions in the targeted site using the dominant discontinuity sets and applying the computer program Stereonet *v. 11* by developed by Richard W. Allmendinger © *2020*. The results show that toppling and wedge nature are observed on this slope direction. Note that the reference discontinuity friction angles used for selected two slope station were assumed *30˚* and *40˚* respectively. Using the key block analysis, that is represent bedding joints and one discontinuity set can slide into free space under gravitational loading without any external force unless a proper support system is provided.

In this study, the information, physical and mechanical properties of rock mass fracture data were obtained through field investigations. Failure chance of formation of key blocks from the discontinuity intersections is necessary to develop new procedures for both kinematic and block theory analyses incorporating a probability distribution for discontinuity size of each discontinuity set. Unfortunately, because the rock discontinuities are hidden in the actual rock masses, at present, out of all the discontinuity geometry parameters, the highest uncertainty exists in the estimation of limited discontinuity size. Therefore, incorporation of realistic fixed discontinuity size in kinematic and block theory analyses can be considered as a giant step in improving both these analyses in the future. Note that all the aforementioned conclusions are valid only under the gravitational loading.

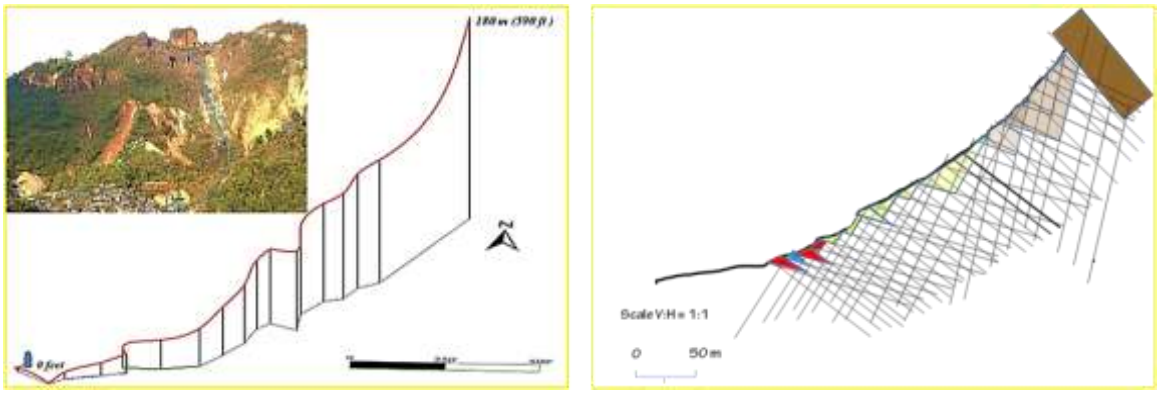


Figure 15 Geometric profile and key block with discontinuities for the mechanism of targeted slope

4.9 Mining Activities Impact on Environment

Removal of the material by underground mining can create environmental problems and safety hazards. Surficial impacts, ground subsidence and slope deformation due to underground mining activities is an old familiar problem. In this study, surficial impacts of Mawchi mine area based on the field surveying are slope failures, ground subsidence and cracks. This consequence could constitute important reference material for future work on the technical assessment of mining related damage. *Ten* surficial crack sites on both soil and rock areas are recorded in study region. Crack sizes, widths and step heights are different from each other.

Open cracks are only formed in limestone formation with the sizes between (*2-3m*) width and (*10-50m*) length. The depth of cracks cannot identify. It is a group of cracks and connected each other by offset, mainly distributed on the top of western part of Mawchi hill. Moreover, the two main adits with many crosscuts are also driving towards these cracks slope where mineralization is formed in the discontinuities as soft filling and the extraction of ore were observed. After extraction of ores from those veins cause loss of filling in discontinuities and become open joints on the slope. Those open joints attract the running water /rain water that affect the stability of the slope. There is considerable close to the previous rock fall site, where large slope failure occurred since *1985 and 1988*. It is indicated that unsafe level for rock fall site.

The rest of sites, tensile and step cracks are mostly formed in soil formations especially in colluvium deposit. The formations of crack sizes are proportional to the magnitudes of the horizontal stretching (tensile) and vertical movement (shear), respectively. The incidence of visible cracking at the study area is dependent on the established deformed region such as the places nearby mining sites, subsidence and past landslides. A few parallel cracks and some step cracks were happened in residence area of mountain village. All these cracks are initial signs of slope

instability and turn into landslide. Therefore, the main factors contributing to serious cracks can respectively be considered as both geometric condition of ore mineralization and its extraction.

In the study area, three subsidence centers named *S-1, S-2 and S-3* are observed. *S-1* and *S-2* were formed in Taung-paw village in *2017*. *S-3* is exited in *13-Gone* hill. Subsidence *S-1* developed rapidly and eventually sank to the depth of *5m* depth in a few days and the *S-2* also developed to the depth of *7m* depth. The diameter of *S-1* is about *30m* and *S-2* is about *25m* in diameter. It is noticed that the rate of deformation slowed down and entered a slow progress in condition. The *S-1* was happened on the sloping ground and *S-2* is formed in flat area, where abundant underground mining work sites about more than *30* work sites (shaft, adit) around its environs are recorded. *S-3* was occurred on slopping ground, near the *13-Gone* old landslide. Its diameter is about *15m*, the depth is *10m* and happened in *2018*. All the three sinking were occurred in overburden soil deposit overlie on sandstone and limestone. It is difficult engineering conditions sourced from underground mining activities constitute very important problems and may occur in the course of time or suddenly and catastrophically. Planning and precautions in such areas is very imperative and has a priority.

Many of slope deformations are occurred in study area. As observed in a total of *15* landslide occurrences of both soil and rock slopes were identified. There are two type of deformations, land-sliding in soil formation and rock slope failure favorable in structurally controlled slopes. Most of it have not been remedied and left unattended. Thus, there must be careful in rainy seasons. If rainfall is major trigger factor, there could be fatal by turning into rainfall induced landslides. Herein, some communities did not leave the former mining sites from old landslide ground for continue to work and live there. Old landslides may be reactivated by striking at any moment, with little notice. In order to protect their home and family, it is important to be prepared. Admitting the true with candidly, the essence of their argument is that life cannot be explained by science.

Figure 16. Some scenes of surficial impact activities in study area

Conclusion

According to the final result, three failure modes such as plane, wedge and topple failures are widely distributed in the mine areas. The geometry of failure on soil shows the underlying rock control of the wedge and plane failure. This indicates that the overburden soft soil upon on rock in which the failure mechanism is greatly controlled by discontinuities. It is quite considerably as in great consuming to failure probability, both natural and human induced slope failures are visible in study area.

The mine area is both unstable and actively failing that comprises surficial crack sites on both soil and rock areas are contributing to seriously stepped and opened nature. All these cracks are initial signs of slope failures. The SMR results show potential mode of failures with respect to different slope faces. The distinctive abilities of the SMR method are to provide recommendation for the slope suggested support systems are presented.

The study area is mostly controlled by geological structures where hydrothermal intrusion was taken place. After extraction of ores from those vertical veins cause loss of filling in discontinuities and become open joints on the slope. Those open joints attract the running water /rain water that affect the stability of the slope. That fact also will reduce rating values of Rock Mass Rating and again decrease Slope Mass Rating. Mention should be made of landslides and slope failures occurring during the rainy season of the year for quite recognizable in July to September. Thus, for a real mining task, attention is suggested to be more paid on the influences of these intervals.

By bearing in mind both classification scheme of RMR and SMR, it was found that currently the whole slope does not appear to be in immediate danger of failing. Although kinematic analysis shows a high potential of wedge and toppling failure, no immediate failures could be observed in the slope surface. However, the analysis does not take into consideration of the engineering properties of several section of the slopes that have exhibited different weathering grade and alteration which could potentially weaken the properties of the slope.

Therefore, steps should be taken in safety mining operations to minimize impacts on all aspects of the environment. Periodic inspections of the mine site, training and review of the mining operations will all lead to a safer work environment.

Acknowledgement

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မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုရ
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THE DEVELOPMENT OF A PEDAGOGIC FACILITATING MODEL IN PROMOTING PRIMARY STUDENTS' CRITICAL THINKING SKILLS

THE DEVELOPMENT OF A PEDAGOGIC FACILITATING MODEL IN PROMOTING PRIMARY STUDENTS' CRITICAL THINKING SKILLS

Ei Ei Phyo[1], Khin Mar Ni[2]

Abstract

The main aim of this study is to develop a pedagogic facilitating model in promoting primary students' critical thinking skills. The specific objectives are 1) to study teachers' knowledge on principles of critical thinking, on understanding learners, and on teaching in promoting primary students' critical thinking skills, 2) to investigate the critical thinking dispositions among primary teachers, 3) to investigate the extent of principals' supports to teachers in promoting primary students' critical thinking skills, 4) to study the extent of professional development practices of primary teachers, and 5) to investigate the practices of teachers in promoting primary students' critical thinking skills. Both quantitative and qualitative research methods were used to collect the required data for this study. There are three phases in this study. In phase I, quantitative study were conducted by using questionnaire survey method. In phase II, qualitative study on teacher's practices in teaching primary students' critical thinking skills was conducted by using observation method and interview method. In phase III, assessing primary students' critical thinking skills was conducted by using critical thinking test. Three hundred and eighteen teachers who are teaching at the primary level participated in this study. The collected data of this study was systematically analyzed. Data analysis included descriptive statistics and independent samples *t* test, One Way of Analysis of Variance (ANOVA) and Multiple Regression. The model for facilitating teachers in promoting primary students' critical thinking skills was proposed. It was also found that academic qualification, knowledge on principles of critical thinking, their analyticity and principal support were the best predictors of teachers' practices in promoting primary students' critical thinking skills. The finding also indicated that the more teacher practiced in teaching critical thinking skills, the more they promoted students' critical thinking skills.

Keywords: Pedagogy, Facilitation, Critical Thinking Skills

Introduction

The unexamined life is not worth living (Socrates, 470-399 BC). Only those with critical thinking can examine their behaviour, work, and life. Everyone also has a responsibility to be critical thinkers in all his civic decisions, such as voting and helping others in civic matters, as this is crucial in maintain a stable democratic society (Paul, 1993). Critical thinking skills are important because they enable students to deal effectively with social, scientific, and practical problems. Therefore, the ability to think critically is one of the most important educational goals. Critical thinking is a widely used term that includes skills in identifying, analyzing, systhesizing, and evaluating information to make informed decisions, and the disposition to apply these skills (Ennis, 1993). To be a worth living, students must be able to think critically.

In the 21st century, many educational systems are responding to the challenge and responsibility of fostering pupils' acquisition of critical thinking skills (Lombardi et.al, 2021). No educational system can ever be better than its teachers (Dr. Khin Zaw, 1993). Richard Paul and Linda Elder (2005) also argued that it is important to note that only when teachers understand the foundations of critical thinking can they effectively teach for it and the simple truth is that teachers are able to foster critical thinking only to the extent that they themselves think critically. Critical

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thinking is the use of the cognitive skills or strategies that increase the probability of a desirable outcome (Halpern, 1996). To enable students to learn to think critically, teachers must learn what intellectual work looks like, how the mind functions when it is intellectually engaged, what it means to take ideas seriously, to take ownership of ideas.

Improving students' critical thinking is not easy. Lauer (2005) highlighted that teachers may find it a challenge to teach critical thinking, as it is difficult to incorporate aspects of critical thinking into their lessons. How to facilitate teachers in promoting primary students' critical thinking skills will be questionable. Therefore, this study will focus on which factors affected on teacher's practices in teaching primary students' critical thinking skills. After studying the factors, the research presents a pedagogic facilitating model in promoting primary students' critical thinking skills that aims to provide a coherent guide to education policy makers, teacher educators, school principals and teachers in cultivating students to become effective learners.

Purpose of the Study

The purpose of this study is to develop a pedagogic facilitating model in promoting primary students' critical thinking skills to accomplish this study, the specific objectives of the study are as follows:

1. To study teachers' knowledge on principles of critical thinking, on understanding learners, and on teaching in promoting primary students' critical thinking skills
2. To investigate the critical thinking dispositions among primary teachers
3. To investigate the extent of principals' supports to teachers in promoting primary students' critical thinking skills
4. To study the extent of professional development practices of primary teachers
5. To investigate the practices of teachers in promoting primary students' critical thinking skills
6. To develop the validated pedagogic facilitating model in primary students' critical thinking skills

Definitions of Key Terms

Pedagogy – Quality teaching practices that facilitate for diverse children their access to knowledge, activities and opportunities to advance their skills in ways to build on previous learning, assist in learning how to learn and provide a strong foundation for future learning in relation to the goals of the curriculum and cultural, community and family values (Farquhar, 2003).

Facilitation – all activities aimed at making it easier to incorporate and manage human factors that affect organizational change management processes on a daily basis (Jacques Sigery & Francois Granier, 2007).

Critical Thinking Skills – the ability of the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information gathered from, or generated by observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Michael Scriven & Richard Paul, 1987).

Review of Related Literature

Critical Thinking Competency Standards and Critical Thinking Assessment

Critical thinking competency standards provide a framework for assessing students' critical thinking abilities. It enables administrators, teachers and faculty at all levels (from elementary through higher education) to determine the extent to which students are reasoning critically within any subject or discipline. These standards include outcome measures useful for teacher assessment, self- assessment, as well as accreditation documentation. These standards include indicators. These indicators identify the extent to which students are using critical thinking as the primary tool for learning. Students who internalize these competency standards will come to see that critical thinking entails effective communication and problem solving skills, a commitment to overcoming one's native egocentric and socio-centric tendencies.

Each critical thinking competency is correlated to specific concepts in critical thinking. Many of competencies in critical thinking overlap so that when teachers foster one competency, they cannot avoid fostering others as well because the concepts in critically thinking are interrelated and function in a dynamic relationship to one another. Critical thinking competencies come it two forms:

1. General competencies applicable to all thinking within all domains, subjects, disciplines and professions. It includes four sections; section one to four.
2. Competencies specific to particular domains, subjects, disciplines and professions. It includes two sections; section five and section six. Section five deals with critical thinking skills essential to study and learn. Section six provides examples of competencies unique to a particular domain of thought (Richard Paul and Linda Elder, 2005).

Critical Thinking Assessment

The Delphi Report also discussed critical thinking issues and goal relevant to education. How are critical thinking skills enhanced in an educative setting? How are critical thinking skills assessed? The main recommendation on critical thinking assessment is that should be reliable and valid. The report states that if critical thinking assessment is carried out appropriately it can be a useful tool in directing educational policy and curriculum formation. Two critical thinking tests that Facione developed using the information obtained from the Delphi group. The first test is a test of critical thinking skills and the second is a measure of critical thinking disposition. In 2000, Facione, and Giancarlo developed the California Critical Thinking Disposition Inventory (CCTDI). This is suitable for use with secondary students, college students and adults. In this inventory, there are seven sub-scales. These sub- scales are truth- seeking, critical thinking self – confidence, systematicity, analyticiy, maturity, open-mindedness and inquisitiveness (Facione *et al.*, 2000).

Richard Paul's Models and Frameworks of Critical Thinking (CT)

Richard Paul has published two major theories of Critical Thinking. The first theory is a model called, Strategy list for Redesigning Lessons and his second theory is a framework, which describes, 'what is essential to CT and what it is to be a critical thinker'.

Paul's Framework has four parts.

Essential to critical thinking

(a) Elements of Reasoning

(b) Standards of CT

(c) Intellectual Abilities

(d) Intellectual traits (CT dispositions)

Essential to BE a critical thinker

Ennis' initial model Strategy list for Redesigning Lessons has 35 strategies. They are broken down into three sections which are affective strategies, cognitive strategies- macro abilities and cognitive strategies – micro abilities. These strategies indicate how critical thinking principles can be transformed into teaching strategies (Paul, R. & Elder, L. 2005).

Methodology

Research Method

Both quantitative and qualitative research methods were used to collect the required data for this study. There were three phases in this study. In phase I, knowledge of teachers on principles of critical thinking, teachers' knowledge on understanding learners and on teaching students' critical thinking skills, critical thinking dispositions of teachers, principals' supports, teachers' professional development and teachers' practices in teaching students' critical thinking skills were studied by using questionnaire survey method. In phase II, qualitative study on teacher's practices in teaching primary students' critical thinking skills was conducted by using observation method, teachers' critical thinking dispositions, difficulties and need for support in promoting primary students' critical thinking skills were studied by using interview method. In phase III, assessing primary students' critical thinking skills was conducted.

Sampling

In phase I, the sample of the study included three hundred and eighteen teachers who teach in primary level from Thegon Township. In Thegon Township, there were 1300 teachers who teach in primary level. In order to get the required sample, the researcher selected the participants by using simple random sampling method. In this study, the design and method were quantitative research design and descriptive survey method. In phase II, the participant teachers were selected by purposive sampling method. For observation study, nine teachers who were teaching upper primary level were chosen based on both mean value of teachers' practices and critical thinking dispositions such as low, average and high. For interview, twenty-five participants who have highest mean value of critical thinking dispositions were selected. In phase III, the researcher selected all students who were taught by teachers who participated in observation study. There were 83 primary students in this study.

Research Instrumentation

For quantitative study, two instruments were used in the proposed study. The first was the researcher- constructed questionnaire and the second was the California Critical Thinking Disposition Inventory. The eight-part researcher constructed questionnaire consisted of

(1) demographic sheet, (2) items for teachers' knowledge on principles of critical thinking, (3) items for teachers' knowledge on understanding learners, (4) items for teachers' knowledge on teaching critical thinking skills, (5) items related to the principals' support, (6) items for the teachers' professional development and (7) items for teachers' practices in teaching critical thinking skills and (8) six open-ended questions. For qualitative study, the observation checklists were consisted with 12 items for physical aspects of classroom environment and general observation, four dimensions with 22 items to investigate teachers' teaching practices in classroom. The semi- structured interview form consists of 12 items to cover building critical thinking dispositions and 3 items to cover teaching critical thinking skills. Primary students' critical thinking test was developed based on the EDUCATE INSIGHT critical thinking skills Grade 3-5. It consisted of five dimensions: analysis, evaluation, inference, induction and deduction and critical thinking attitude. There were 5 items for each dimension and the number of total items for critical thinking skills was 25. There were 5 items for critical thinking attitude.

Procedure

To develop a pedagogic facilitating model in promoting primary students' critical thinking skills, the related literature was analyzed. The instruments were developed based on the literature. For the expert review, the advice and guidance were taken from twenty-three expert educators who have special knowledge and experience in this field. Some items were revised and modified according to their advice. The pilot study was conducted with 40 teachers who taught in primary level from Nyaung Lay Pin Township, Bago Region in the first week of July, 2021. The permission to collect the required data at the selected township was granted by the Department of Basic Education in September 2021. The modified questionnaires were distributed to the selected schools in the first week of October 2021. The participants were given for two weeks to complete the questionnaires. After analyzing the quantitative data, qualitative data were collected from 1st week of December, 2021 until 1st week of January, 2022. In the first week of July, 2021, questionnaires were distributed to Grade 4 students as a pilot study. Then, in the first week of January, 2022, the questionnaires were distributed to the participant students in the selected schools.

Data Analysis and Findings

Phase I: Quantitative Research Findings

Investigating Teachers' Knowledge on Principles of Critical Thinking

Mean percent values were used to compare the knowledge level of teachers on principles of critical thinking. In scoring these items, 2 marks were given for one correct answer. If the participant teacher gives correct answers for 5 out of 10 items, the score will be 10 marks and the average score percent will be 50%. Based on this mean percent value, the variations of knowledge score were categorized into three groups; In-adequate knowledge, Average knowledge and Good knowledge. The level of teachers' knowledge on principles of critical thinking was identified according to the range of average score percent as shown in Table 1.

Table 1. Number and Percentages of the Participant Teachers Showing the Level of Knowledge on Principles of Critical Thinking (N=318)

Variable	No. of Teacher (%)	Remark
Knowledge on Principles of Critical Thinking	58 (18.20%)	In-adequate Knowledge
	179 (56.29%)	Average Knowledge
	81 (25.51%)	Good Knowledge

Scoring range: < 50%= In-adequate Knowledge
50% - 74% = Average Knowledge
≥75%= Good Knowledge

Table 1 showed that majority of the participant teachers (56.29%) had average knowledge, (25.51%) of teacher had good knowledge and only 18.20% of the teachers had in-adequate knowledge on principles of critical thinking. So, it could be assumed that most of the teachers in this research had average level of knowledge on principles of critical thinking.

Investigating Teachers' Knowledge on Understanding Learner

The level of teachers' knowledge on understanding learners was identified according to the range of average score percent as shown in Table 2.

Table 2. Number and Percentages of the Participant Teachers Showing the Level of Knowledge on Understanding Learner (N=318)

Variable	No. of Teachers (%)	Remark
Knowledge on Understanding Learner	49 (15.40%)	In-adequate Knowledge
	195 (61.32%)	Average Knowledge
	74 (22.38%)	Good Knowledge

Scoring range: < 50%= In-adequate Knowledge
50% - 74% = Average Knowledge
≥75%= Good Knowledge

According to Table 2, majority of the participant teacher (61.32%) had average knowledge, (22.38%) of teacher had good knowledge and only 15.40% of the teachers had in-adequate knowledge on understanding learners. Therefore, it could be assumed that most of the teachers in this research had average level of knowledge on understanding learners.

Investigating Teachers' Knowledge on Teaching Students' Critical Thinking Skills

Table 3. Number and Percentages of the Participant Teachers Showing the Level of Knowledge on Teaching Critical Thinking Skills (N=318)

Variable	No. of Teacher (%)	Remark
Knowledge on Teaching Critical Thinking Skill	50 (15.80%)	In-adequate Knowledge
	207(65.09%)	Average Knowledge
	61 (19.18%)	Good Knowledge

Scoring range: < 50%= In-adequate Knowledge
50% - 74% = Average Knowledge
≥75%= Good Knowledge

According to Table 3, majority of the participant teacher (65.09%) had average knowledge, (19.18%) of teacher had good knowledge and only 15.80% of the teachers in this study had in-adequate knowledge on teaching students' critical thinking skills. Therefore, it could be assumed that most of the teachers in this research had average level of knowledge on teaching students' critical thinking skills.

Investigating Critical Thinking Dispositions of Primary Teachers

In this study, the maximum score in each subscale is 60, and a minimum score in each subscale is 10. In scoring for critical thinking dispositions inventory, a score of 30 or less is interpreted as opposition or weakness in the respective subscale, a score of between 31 and 40 is interpreted ambivalence toward the respective subscale, a score between 41 and 50 indicates a positive inclination toward critical thinking disposition, and a score greater than 50 indicates a high inclination or disposition toward the respective subscale (CCTDI Test Manual,2010).

Table 4. Frequencies and Percentage for Critical Thinking Dispositions Inventory (CCTDI) Subscales for Primary Teachers (N=318)

CCDI Subscales	Opposition (or) Weakness (<30)		Ambivalence (31 to40)		Positive (41 to 50)		High (>50)	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*
CTSC	2	0.6	92	28.9	193	60.7	31	9.7
I	2	0.6	119	37.4	194	61.0	3	0.9
TS	0	0.0	66	20.8	209	65.7	43	13.5
S	0	0.0	110	34.6	189	59.4	19	6.0
A	2	0.6	125	39.3	186	58.5	5	1.6
OP	0	0.0	9	2.8	160	50.3	149	46.9
M	3	0.9	61	19.2	237	74.5	17	5.3

Note: CTSC = Critical thinking self- confidence; I= Inquisitiveness; TS= Truth-seeking; S= Systematicity; A= Analyticity ; OP = Open- mindedness ; M= Maturity

Table 5. Frequencies and Percentage for Total Critical Thinking Dispositions Inventory (CCTDI) for Primary Teachers (N=318)

Variable	Negative Inclination towards Critical Thinking (≤ 210)		Ambivalence Inclination towards Critical Thinking (211- 280)		Positive Inclination towards Critical Thinking (>280)	
	f	*%*	*f*	*%*	*f*	*%*
Total CCTDI	0	0	44	13.8	274	86.2

According to Table 5, the percentage of the participants in the study who have ambivalence inclination towards critical thinking was 13.8% (*f* = 44) and the majority of the participants have positive inclination towards critical thinking.

The Extent of Principals' Support in Promoting Primary Students' Critical Thinking Skills

To study the principals' support in promoting primary students' critical thinking skills, the researcher developed 3- point Likert scale questionnaire for principals' support with 7 items. The results will be showed the followings.

Table 6. Number and Percentage of Participant Teachers Showing the Level of Receiving Support of Principals (N= 318)

No.	Variable	Average Mean (SD)	Number of Teachers who		
			Receive a little support	Receive moderate support	Receive adequate support
1.	Supervising the inclusion of Bloom's taxonomy in setting learning goals	2.26 (0.56)	20 (6.3%)	193 (60.7%)	105 (33.0%)
2.	Giving advice in implementing teaching learning process to achieve the learning goals	2.38 (0.62)	24 (7.5%)	146 (45.9%)	148 (46.6%)
3.	Supporting teaching aids	2.61 (0.53)	7 (2.2%)	109 (34.3%)	202 (63.5%)
4.	Observing and providing the necessary guidance	2.39 (0.62)	23 (7.2%)	146 (45.9%)	149 (46.9%)
5.	Creating opportunities to support professional development	2.31 (0.69)	42 (13.2%)	134 (42.1%)	142 (44.7%)
6.	Appreciating teachers' performance	2.22 (0.73)	57 (17.9%)	133 (41.8%)	128 (40.3)
7.	Communicating with teachers well and intimating relationship with teachers	2.83 (0.44)	9 (2.8%)	35 (11.0%)	274 (86.2%)
Principals' Support		**2.43 (0.40)**	**5 (1.6%)**	**131 (41.2%)**	**182 (57.2%)**

Scoring range: 1.00-1.66 = little support;1.67-2.33= moderate support ;2.34-3.00 adequate support

The Extent of Teachers' Professional Development

To study the teachers' professional development, the research developed items for teachers' professional development based on the related literature. There were 6 items in this study. These items were yes or no questions and if the answer was yes, the respondent will continue to answer four- point Likert scales (1= no impact to 4= high impact) and scoring for the performance was 1(not attended) to 5 (high impact).

Table 7. Number and Percentage of Participant Teachers According to Professional Development Practices and Their Perception on Impacts of Doing the Professional Activities (N= 318)

No.	Variable	NO	YES	Level of Impact Perceived by Attended Participants			
				Not at all	Few	Moderate	High
1.	Attending New Curriculum Training	7 (2.2%)	303 (95.3%)	8 (2.5%)	-	88 (27.7%)	207 (65.1%)
2.	Participating in Workshops that make Teaching more Effective	84 (26.4%)	225 (70.8%)	6 (1.9%)	15 (4.7%)	107 (33.6%)	97 (30.5%)
3.	Attending Online Teaching courses	241 (75.8%)	68 (21.4%)	3 (0.9%)	7 (2.2%)	43 (13.5%)	15 (4.7%)
4.	Participating in School-based workplace quality improvement programs (eg. Board Study)	34 (10.7%)	276 (86.8%)	14 (4.4%)	8 (2.5%)	142 (44.7%)	112 (35.2%)
5.	Receiving Mentorship program	182 (57.2%)	128 (40.3%)	10 (3.1%)	6 (1.9%)	61 (19.2%)	51 (16.0%)
6.	Learning subjects and teaching method with instructional books, Video and CD	10 (3.1%)	300 (94.3%)	18 (5.7%)	10 (3.1%)	134 (42.1%)	138 (43.4%)

The Extent of Teachers' Practices in Promoting Primary Students' Critical Thinking Skills

To investigate the extent of teachers' practices in promoting primary students' critical thinking skills, the researcher used the questionnaire. It was consisted of four dimensions: planning and preparation, the classroom environment, instruction and professional responsibilities. the total items for teachers' practices were 58. There items were five-point Likert scales (1= Never to 5=Always).

Table 8. Means and Standard Deviations and Percentages of Teachers' Practices in Promoting Primary Students' Critical Thinking Skills (N= 318)

No.	Variable	Mean	SD	Remark
1.	Planning and Preparation	4.35	0.49	Good
2.	Classroom Environment	4.19	0.48	Moderate
3.	Instruction	4.03	0.03	Moderate
4.	Professional Responsibilities	4.27	0.48	Good
Overall Teachers' Practices		**4.21**	**0.36**	**Moderate**

Scoring range: 1.00 to 1.80 = not at all practiced 1.81 to 2.61= slightly practiced
2.62 to 3.42 = somewhat practiced 3.43 to 4.23 = moderately practiced
4.24 to 5.00 =good practiced

According to the Table 8, the participant teachers in this study moderately practiced in promoting primary students' critical thinking skills.

The Potential Factors Affecting on Teachers' Practices in Promoting Primary Students' Critical Thinking Skills

To investigate how well one variable predicts another variable, series of simple linear regression were conducted in such pairs of variables as their qualification and teachers' practices in promoting primary students' critical thinking skills; knowledge on principles of critical thinking and teachers' practices in promoting primary students' critical thinking skills; teachers' critical thinking self- confidence and teachers' practices; teachers' systematicity and teachers' practices; teachers' analyticity and teachers' practices; the extent of principals' supports and teachers' practices in promoting primary students' critical thinking skills.

Table 9.Mean, Standard Deviations, and Inter-correlations for Teachers' Practices in Promoting Primary Students' Critical Thinking Skills (N=318)

	Variables	M (SD)	1	2	3	4	5	6	7
	Teachers' Practices in Promoting Primary Students' Critical Thinking Skills	4.21 (.36)	.136*	.136*	.245**	.267**	.407**	.348**	.13*
1.	Qualification	1.92 (.26)		.005	.013	.041	.037	.136*	-.04
2.	Knowledge on Principles of Critical Thinking	6.09 (1.92)			-.130*	-.009	-.016	.182*	.03
3	Critical Thinking Self-Confidence	43.64 (6.06)				.410*	.430*	.093	.23
4	Systematicity	42.30 (4.17)					.467*	.154*	.05
5	Analyticity	41.19 (4.37)						.171*	.08
6	Principals' Support	2.43 (.40)							.11*
7	Teachers' Professional Development	3.28 (0.75)							

R= .53, R^2 = .28, F (7,309)= 17.38 ,* p <.05 , **p < .01, ***p < .001

According to Table 9, it was found that teachers' practices in promoting primary students' critical thinking skills was positively and significantly correlated with teachers' qualification (r=.135, *p < .05), teachers' knowledge on principles of critical thinking (r=.136, *p < .05), teachers' critical thinking self-confidence (r=.243, ***p< .001), teachers' systematicity (r=.267, ***p < .001), teachers' analyticity (r=.407, ***p < .001) , principals' support (r=.348, ***p < .001) and teachers' professional development (r=.13, *p < .05).

Table 10. Simultaneous Multiple Regression Analysis for Predicting Teachers' Practices in Promoting Primary Students' Critical Thinking Skills (N= 318)

Variables	B	Std.Error	Beta	*p*
Teachers' Qualification	9.27	3.84	.11	.016
Teachers' Knowledge on Principle of Critical Thinking	3.37	1.58	.10	.034
Teachers' Critical Thinking Self-Confidence	.29	.19	.08	n.s
Teachers' Systematicity	.23	.28	.04	n.s
Teachers' Analyticity	1.44	.27	.30	.000
Principals' Supports	13.14	2.63	.25	.000
Professional Development	0.037	0.023	.08	n.s
Constant	1.73	0.25		

R= .53, R^2 = .28, F(6,310)= 19.746, *p < .05 ,** p < .01,***p < .001, n.s= no significance

The data presented in Table 10 shows that the beta coefficients, three of seven variables such as teachers' critical thinking self-confidence, systematicity and teachers' professional development not significantly predicted on teachers' practices in promoting primary students' critical thinking skills. But qualification, knowledge on principles of critical thinking, teachers' analyticity and received principal's support significantly predicted on teachers' practices in promoting primary students' critical thinking skills. The adjected R squared value was 0.28 (R=.53). This indicates that 28% of the variance on teachers' practices in promoting primary students' critical thinking skills by the model, this is a large effect according to Cohen (1992).

The Regression Equation is:

Teachers' Practices in Promoting Primary Students' Critical

***Thinking Skills = 1.73*+9.27TQ+3.37TKCP+.29TCTSC+.23TS +1.44 TA+13.14 PS + 0.04 PD**

According to the β weights, it was also concluded that teachers' analyticity variable (β= .30, ***p <.001) appears to be the best predictor on teachers' practices in promoting primary students' critical thinking skills. The principals' support variable (β= .25, ***p <.001) appears to be the second predictor and teachers' qualification (β= .11, *p < .05) appears to be the third predictor. Teachers' knowledge on principles of critical thinking (β= .10, * p <.05) appears to be the fourth predictor of the teachers' practices in promoting primary students' critical thinking. Teachers' critical thinking self- confidence, professional development and systematicity appear to be important for teachers' practices in promoting primary students' critical thinking skills (See figure 1).

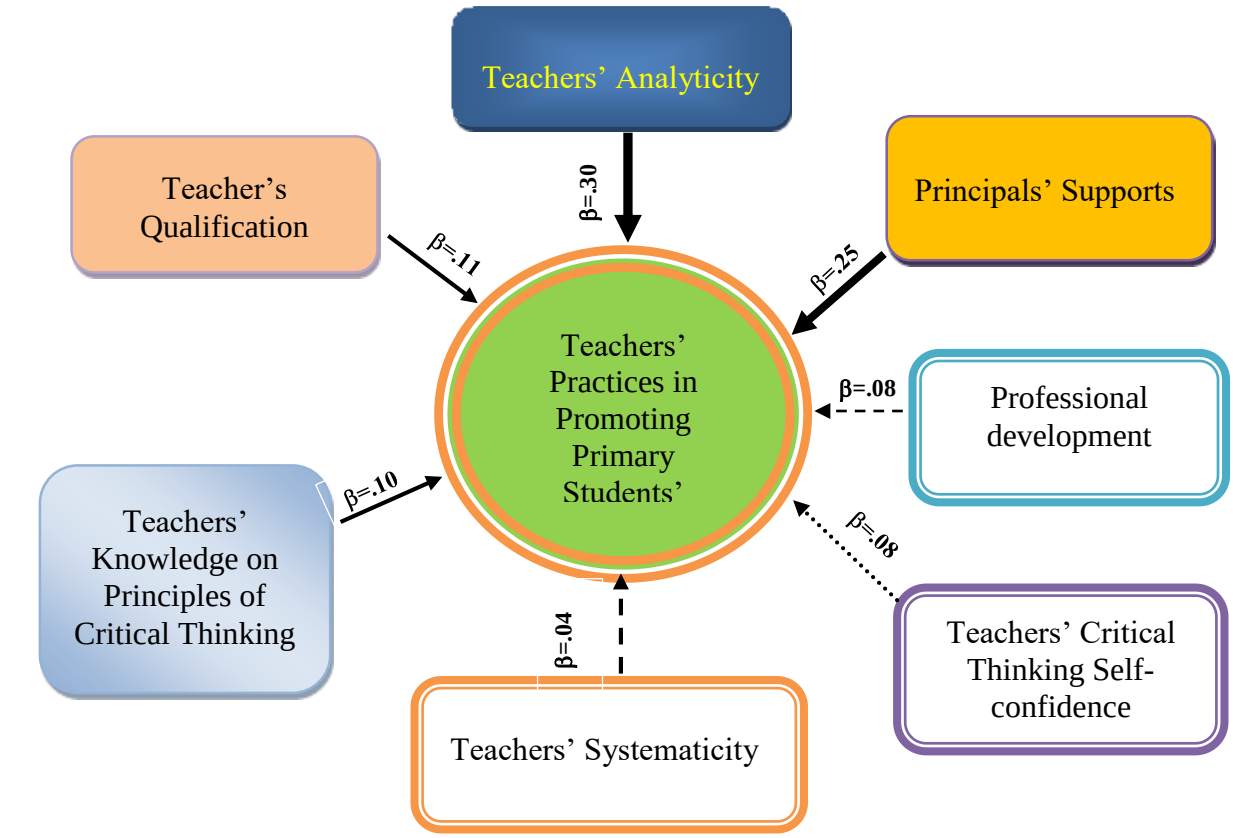


Figure 1. Predictors Affecting on Teachers' Practices in Promoting Primary Students' Critical Thinking Skills

Phase II: Qualitative Research Findings

In observation study, the researcher found that the group of teacher who have highest mean in teaching practices and critical thinking dispositions read the teacher guide and prepared the lesson with clear expectations, with descriptors for each level of performance and describe the procedures clearly. They also prepared the questions for formative or summative assessment. It was also founded that some activities and questions represented high- order thinking. In teaching learning process, they used equal control of teacher and students. They also listen actively to students' response and they gave equal opportunities for all students. It was also founded that they provided positive and constructive feedback to students' response. They all established warm and respectful learning environment and they were confidence in language and behaviours. The researcher also found that the group of teacher who have highest mean in teaching practices and critical thinking dispositions used the following teaching-methods,

- Story- telling method
- Questioning method
- Discussion method

- Inductive approach
- Demonstration method
- Observation method
- Practical method
- Brain-storming method and
- Inquiry- based Learning method

It was also found that they asked the questions with correct and imaginative use of language and the questions concerning with facts, comparison, generalization, self-reflection, open-ended questions. They also asked not only all students but also each student. When they asked the open-ended questions, they gave enough time to think students and gave constructive feedback. It was found that they all praised students who provide unexpected answers.

The researcher found that the group of teachers who have average mean in teaching practices and critical thinking dispositions read the teacher guide and prepared the lesson. They describe the procedure clearly and expressed the questions for formative assessment. It was also found that 1 out of 3 teachers used equal control of teacher and students but others use teachers' control and 2 out of 3 teachers listened actively student' response. Only 1 out of 3 teachers provided positive and constructive feedback to students' response. All teachers established warm and respectful learning environment and 2 out of teachers and their students were confidence in language and behaviours. It was also found that they used the following methods

- Lecture method
- Questioning method
- Discussion method
- Brain-storming method
- Practical method and
- Demonstration method

It was also found that they asked the questions concerning with facts, comparison, and generalization. They also asked open-ended questions and they asked questions to both all students and each student. One of the teachers gave time to answers students and gave feedback The researcher found that the group of teachers who have lowest mean in teaching practices and critical thinking dispositions read the teacher guide and do not prepare but teach with the instruction of teacher guide. It was also found that all teachers used teachers' control and 1 out of 3 teachers listened actively students' response but all teachers encouraged students to participate. They used the following teaching methods

- Lecture method
- Questioning method
- Demonstration method.

The researcher also founded that most asked the questions concerning with facts, comparison, and generalization and they asked to all students.

Overall Findings of Teacher Interviews

Several themes emerged from teacher interviews regarding to teaching students' critical thinking skills. Based on the interview results, the emerged factors related to promoting students'

critical thinking skills were briefly described. Teachers said that they can critically think moderately. 5 out of 25 teachers said that if a teacher teaches students critical thinking skills, he must be a critical thinker. Fourteen of the participant teachers believed that they have a reasonable amount of confidence and they prepare the lesson when they teach students because they can teach with confidence. Teachers said that attending training and supervising principals can improve their confidence in teaching. Five out of twenty-five teachers described that they like learning new things and they study how the knowledge gained apply in real life. 14 out of 25 teachers described that if they read and accepted the news, they search for the source of the news. 40% of the teachers stated that when they decide what is right or wrong, they did not judge by own opinion and they considered different perspectives from different point of views. Seven out of 25 said that when they have a lot of work to do, they focused on the most important thing and allocated time systematically. 56% of the participants believed that working together was more effective than working alone. They had desired to do collective teaching activities.

It was founded that teachers have some critical thinking abilities. Eleven out of twenty-five teachers stated that they keep records of daily activities and they always reflected their actions. 20% of the participant teachers said that they conclude the events based on relevant data and facts gathered. It was found that they acknowledged because of their parents' teaching and life experience, their ability to think would develop. 15 out of 25 teachers said that before doing a task, they were imaginative and they set plan well and think about alternatives. Ten of the participant teachers stated that they evaluate something according to its usefulness.

It was also found all the participants were satisfied with their profession and they loved and appreciated teaching. They also loved their children. Teachers also expressed their difficulties in teaching critical thinking skills. Ten of the participants said that there is no sufficient time to implement the curriculum. They also have difficulties in teaching arts (performing and virtual). 7 out of 25 teachers said that they have difficulties in teaching because there are no sufficient teachers in their school. They explained that if they teach students thinking skills, they prepared lesson well and gave time students to give their opinion. Because of no sufficient teachers, they had to teach two or more classes simultaneously. And so, they did not prepare the lessons well. Some teachers said that they have not enough ability to teach students' thinking skills and it was found that they had desired to attend effective training. Eleven out of 25 described that some students did not have basic knowledge and skills in reading, writing, and computing. Ten participants said that some students did not have courage to express their opinions. 9 out of 25 stated that there is no TV and Video to use in their teaching in their school. 18 out of 25 teachers acknowledged that their principal supervised and gave advice their teaching and they said that teaching and helping of their principal was very valuable for them. All participants described that they want the Ministry to provide a separate classroom for each class. Six participants suggested that workshops for effective teaching would be planed for the teachers and when it was implemented, TEO or DTEO and the experience teachers supervised.

Phase III: Quantitative Research Findings (Students)

Investigating Students' Critical Thinking Skills

To investigate students' critical thinking skills, the researcher selected all students who were taught by teachers who participated in observation study. There were 83 students in this study. The researchers developed questions based on the EDUCATE INSIGHT critical thinking skills Grade 3-5. It consisted of five dimensions: analysis, evaluation, inference, induction and deduction and critical thinking attitude.

Table 11. Mean and Standard Deviations Showing the Primary Students' Critical Thinking Skills (N= 83)

Variable	Mean	SD	Achievement Level
Analysis	6.68	1.02	Moderate
Evaluation	6.44	1.02	Moderate
Inference	7.43	1.03	Moderate
Induction	6.56	.95	Moderate
Deduction	7.42	1.29	Moderate
Total Critical Thinking Skills	**6.91**	**1.06**	**Moderate**

Scoring range: < 5.85 = low 5.85- 7.97 = moderate > 7.97= high

According to Table 11, mean values of participant students' analysis, evaluation, inference, induction, and deduction were 6.68, 6.44, 7.43, 6.56 and 7.42 respectively. The mean value of participant students' critical thinking skills was 6.91 (*SD*= 1.06).

Based on the research, the values of above 7.97 (Mean+1SD) was defined as high level, the values between 7.97 (Mean+1SD) and 5.85 (Mean-1SD) were defined as moderate level and the values below 5.85 (Mean- 1SD) were defined as low level in critical thinking skills. According to the results, the level of the participant students' critical thinking skills was in moderate level.

Table 12. Numbers and Percentages of Participant Students Showing the Level of Critical Thinking Skills (N= 83)

Level of Critical Thinking Skills	No. of Students (%)		
	Group A	Group B	Group C
Low Level	1 (3.7%)	-	-
Moderate Level	21 (77.8%)	24 (82.2%)	26 (96.3%)
High Level	5 (18.5%)	5 (17.8%)	1 (3.7%)

Group A = group of students taught by teachers who have lowest mean value in practices and critical thinking dispositions

Group B = group of students taught by teachers who have average mean value in practices and critical thinking dispositions

Group C = group of students taught by teachers who have highest mean value in practices and critical thinking dispositions

Discussion

The results revealed that the participant teachers in this study had average knowledge on principles of critical thinking. According to the results of open-ended questions and interview, most of the teachers described that critical thinking was logical thinking based on collected data and some teachers defined as thinking for the solution in relation to real-life situations problem based on ones' knowledge and experience. It can be assumed that teachers were more attentive students acquiring knowledge and experience and developing ability to reason. Critical thinking encompasses analysis, synthesis and evaluation (Dinn et al.,2006 as cited in Choy, 2004). It is reasonable and reflective thinking that is focused on deciding what to believe or do (Ennis, 1981). In this research, teachers did not describe critical thinking with the words reflection and evaluation.

The finding highlighted that participant teachers did not understand well the concept of critical thinking. Only when teachers understand the foundations of critical thinking, they can effectively teach for it (Paul, 2005). Moreover, to effectively target instruction towards students' unique learning needs, teachers required knowledge of individual students' skills. Findings also indicated that most of the teachers in this study had average knowledge on understanding learners. In interview study, teachers answered that they knew physical, social and cognitive development of each child who were taught and family background. But they also said that teachers must teach students before they can learn and some students cannot be taught thinking skills and their students cannot think critically. They felt that it was difficult to teach critical thinking skills to primary students because they were not old enough to teach critical thinking skills. Leon (2015) found that critical thinking skills can be developed in classroom of preschool depending on types of activities children carry out and purpose of the activity. This finding highlighted that teacher needed to understand students' cogitative development deeply for teaching students' critical thinking skills.

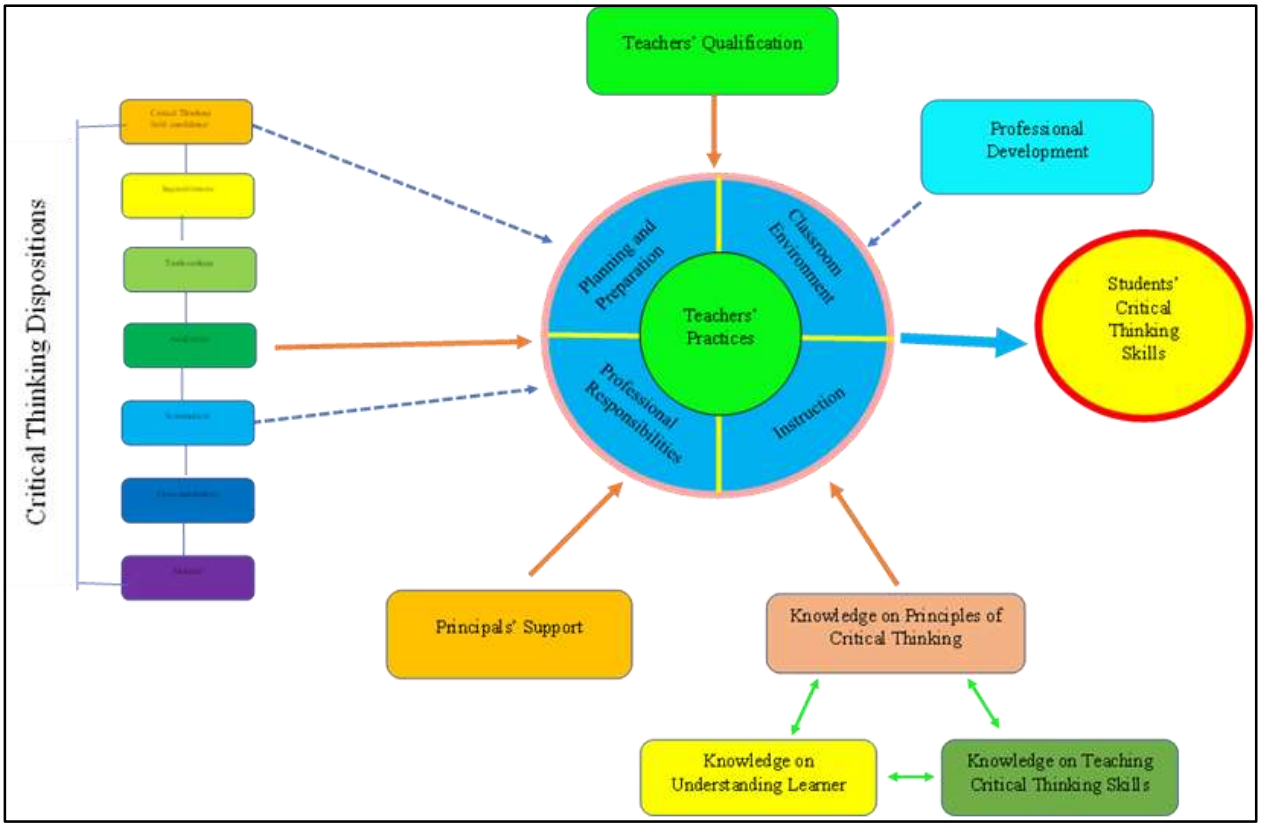
Anderson (as cited in Slameto, 2014) found that teachers' lack of understanding about the teaching methods that can improve critical thinking skills is the reason why critical thinking in education is not developed. In this study, most of the participant teachers had only average knowledge on teaching students' critical thinking skills. Students' critical thinking is best supported when teachers use critical questioning techniques to engage students actively in the learning process. According to the results of open-ended questions, only 5.76% of teachers used questioning method but they mostly asked facts thought. Open-ended questions also allow students to think critically (Rios, 2015). Gibbs (1988) recommended that teacher should provide wait time after asking a question to give less confident students time to think. It was found that although teachers asked open-ended questions, they did not give students enough time to think and sometimes they cannot answer students' unexpected questions. This finding indicated that teachers did not know the importance of questioning techniques and it is needed to improve their questioning skill. Then, 6.99% of teachers said that brainstorming method was used to teach critical thinking skills. The use of this method in every subject matter is enable students to see the model and apply the critical thinking continuously and become a good habit (Schneider, 2002). Moreover, 9.87% of teachers used discussion method in which students can discuss their interpretation of what they read. When the class is discussing an issue about which people disagree, the teacher can encourage to check different points of view and this strategy can be used for teaching critical thinking principle. This finding supported the results by the finding of Broadbear (2003), whereby elementary teachers know their content and receive training in the methods of instruction, by little if any of their training is devoted specially to how to teach critical thinking skills.

A critical thinking disposition was defined as 'the personal traits, habits of mind, attitudes or affective dispositions which seem to characterize good critical thinkers' (Facione,1990). In this study, the critical thinking dispositions of primary teachers were explored by the CCTDI. The results indicated that the critical thinking dispositions of primary teachers in this study were at positive and high levels and the majority of primary teachers are within the positive disposition range. The findings were similar to the results of the study by Cohen (2010) who had found that the majority of graduate students' CCTDI means were within the positive disposition range. However, results obtained by Demirhan and Koklukaya (2014) were not identical with these findings.

The model for facilitating teachers in promoting primary students' critical thinking skills was proposed. It included factors that affect on the teachers' practices in promoting primary students' critical thinking skills. The factors that provide primary teachers to improve in teaching students' critical thinking skills were academic qualification, knowledge on principles of critical

thinking, their analyticity and obtaining from principal support. The finding also indicated that the more teacher practiced in teaching critical thinking skills, the more they promote students' critical thinking skills. This finding supported that the assumptions by Snyder and Synder (2008) in which critical thinking is a learning skill that requires relevant instruction and practices.

Based on the findings and the review of relevant literature, and validation by 16 expert educators, the developed a pedagogic facilitating model in promoting primary students' critical thinking skills was illustrated (see figure 2).



↔ Inter-relationship between two variables

→ Relationship between two variables (Statistically significant)

→ Relationship between two variables (Not Statistically significant)

Figure 2. Developed a Pedagogic Facilitating Model in Promoting Primary Student's Critical Thinking Skills

Suggestion

Based on the findings and the review of relevant literature, the following suggestions were drawn to improve teachers' practices in promoting primary students' critical thinking skills.

- In order to teach students' critical thinking skills, teachers need to understand the concept and foundations of critical thinking. Therefore, there should be program that provides teachers to understand critical thinking.

- Primary teachers should understand cognitive development of children and cognitive psychology well.
- Primary teachers should access learning opportunities to improve their teaching method concerning with improving students' critical thinking skills.
- Primary teachers should be confidence in their reasoning processes.
- Primary teachers should eager to learn new things and study application of knowledge gained in real life situation.
- Primary teachers need to desire to seek the truth and courage to overcome the difficulties in every situation.
- Primary teachers should have information management skills.
- Primary teachers should have the ability to consider the consequences of their behaviour and reflect their actions.
- Primary teachers should be a model as a critical thinker for their students.
- Principals should supervise lesson planning of teachers whether their preparation is consistent with the purpose of education and can be implemented practically or not and teachers' implementing the curriculum.
- Principals should provide material support and advice teachers in making teaching learning materials.
- Principals should create school-based professional learning community.
- Principals should encourage teachers to ask open-ended question and to provide time for students to think.
- Principals should encourage teachers to use brainstorming method, problem-solving method, discussion method, modeling as a critical thinker, story-telling method to encourage students think critically.
- Principals should organize debate competitions in their school.
- Primary school principals and teachers should be provided training workshop concerning with nature of critical thinking and teaching method for improving students' critical thinking skills.
- The empower concerning with using ICT of principals and teachers should be improved.
- Classrooms should be the separate spatial classroom.
- There should be a school library or a classroom library which has sufficient books for teachers and students in primary school.
- Teacher-classroom ratio should be considered to promote students' critical thinking skills.
- Teacher educators need to be model as a critical thinker and to use the method of teaching and assessment that can improve students' critical thinking.
- The teacher education program that supports critical thinking should be provided to teachers based on needs of teachers.
- Primary teachers should have training to use and foster critical thinking in their teaching learning process.
- Primary teachers should cooperate with parents for their students' thinking skills.

Conclusion

In this study, regarding knowledge on principles of critical thinking, most of the teachers in this research had average knowledge on principles of critical thinking. Regarding knowledge on understanding learners, most of the teachers in this research had average knowledge on understanding learners. Relation to knowledge on teaching students' critical thinking skills, most of the teachers in this research had average knowledge on teaching students' critical thinking. Then, most of the participant teachers had positive inclination towards critical thinking. With regarding to principals' support in promoting primary students' critical thinking skills, the percentage of participant teachers who received a little support from principals was 1.6% (N=5). 41.2% (N=131) of the participant teachers believed that their principals moderately support and 57.2% (N=182) of the participant teachers perceived that they were supported adequately by their principals in promoting primary students' critical thinking skills. According to the qualitative and quantitative research findings, teachers' practices in promoting primary students' critical thinking skills varies in terms of their qualification, knowledge on principles of critical thinking, their analyticity and their principals' supports. In conclusion, the students' critical thinking skills varies according to the practices of teachers.

Limitations of the Study

This study is geographically limited to Thegon Township, Bago Region. The participants of this research are three hundred and eighteen teachers who taught in primary level for quantitative study. Based on the results of quantitative study, nine teachers were selected for observation study and twenty- five teachers were selected for interview. Eighteen- Three students were selected to test critical thinking skills. This study is designed to develop a pedagogical facilitating model in promoting primary students' critical thinking skills.

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THE IMPACT OF METACOGNITIVE AWARENESS ON ENGLISH READING COMPREHENSION ABILITY OF HIGH SCHOOL STUDENTS

THE IMPACT OF METACOGNITIVE AWARENESS ON ENGLISH READING COMPREHENSION ABILITY OF HIGH SCHOOL STUDENTS

Wint Wah Wah Tun*

Abstract

As the mastery of English reading comprehension is becoming more important day by day, finding the most effective way of teaching reading comprehension is becoming crucial in the realm of education. With metacognitive awareness, individuals can plan and monitor their reading process and thus, it can directly improve their reading performance. Therefore, the primary purpose of this study is to explore the impact of metacognitive awareness on English reading comprehension ability of high school students. Both quantitative and qualitative approaches were used in this study. A total of 1241 high school students for quantitative study and 30 students for qualitative study from Basic Education High Schools across Myanmar participated in this study. As the research instruments, Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1994) and English Reading Comprehension Ability Test (ERCAT) were used. The reliability of MAI was 0.958 and that of ERCAT was 0.935. Firstly, the standardized English Reading Comprehension Ability Test (ERCAT) was constructed. Then, English comprehension ability of high school students were examined in terms of gender, age and subject combination. The metacognitive awareness of high school students was also examined in terms of gender and age. Regarding gender, female students outperformed in English reading comprehension ability than male students but significant gender related difference was not found on metacognitive awareness. Then, older students were found to possess better comprehension ability and better metacognitive awareness than younger peers. Additionally, English reading comprehension ability of science students were found to be significantly higher than that of art students. According to the quantitative results, there was a positive correlation between metacognitive awareness and English reading comprehension. Then, the follow-up study was performed to examine whether metacognitive training on reading can enhance the comprehension ability. The results pointed out that the significant contribution of metacognitive awareness on the prediction of English reading comprehension ability. Hence, this study can be one of references for the English teachers, instructors, curriculum developers and educators as well as for the students in the light of training the metacognitive awareness as the better way to improve English reading comprehension.

Keywords: Metacognitive Awareness, Reading Comprehension Ability, Follow-up Study

Introduction

The ability to read effectively in a foreign language is an essential and vital skill not only in education but also in life beyond the school years (Eason, Goldberg, Young, Geist & Cutting, 2012). Whenever a person reads a text written either in a mother tongue or in a foreign language, comprehension involves more than the ability to spell correctly or decode words. Fielding and Pearson (1994) defined comprehension as a complex process involving knowledge, experience, thinking, and teaching. They contended that comprehension inherently involves inferential and evaluative thinking and not just the literal reproduction of the author's words. According to them, how well a reader constructs meaning depends in part on metacognition or their ability to think about and control their own learning and thinking process.

As reading is a complex and purposeful act of meaning making, it involves the actions and interactions of perceptual processes, cognitive skills, and metacognitive awareness. Metacognitive

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awareness is important for comprehending a text because it allows the reader to identify and study the parts of the text that he or she did not understand and it also enables the reader to become an accurate judge of his or her own learning (Dunlosky & Lipko, 2007). Therefore, metacognitive awareness has received a considerable attention by language teaching theoreticians, psychologists and researchers.

In Myanmar, reading comprehension texts take a large portion of the content of the English curriculum in contrary to other language elements; listening, speaking and writing. Moreover, they are considered as the base for the other skills specially, vocabulary and structure. This calls for more attention to this important language skill. However, in Myanmar high schools, teaching English reading still almost focus on main ideas and retrieving facts with shallow understanding of the content. Future opportunities for quality educational programming after high school may be limited if high school students are unable to get meaningful comprehension in English reading.

Komariah, et. al (2015) pointed out focusing on the product of reading, rather than the process itself, is considered to be a key reason why students lack the abilities in English as a foreign language reading comprehension. Teachers are noticing gaps in reading comprehension, but are unable to implement research-based strategies to address these skill deficits (Gill, 2008). Teachers require scientifically validated intervention methods to provide effective and efficient teaching for high school students. Thus, by examining the impact of metacognitive awareness on English reading comprehension ability of high school students, this study may offer valuable insights to the most effective and efficient strategies for teachers and students in their teaching and learning English as a foreign language.

Objectives of the Study

The main purpose of this study was to investigate the impact of metacognitive awareness on English reading comprehension ability of high school students.

The specific objectives are

- To construct the standardized English reading comprehension ability test.
- To examine the metacognitive awareness of Myanmar high school students by gender and age.
- To explore the English reading comprehension ability of high school students by gender, age and subject combinations.
- To observe the relationship between high school students' metacognitive awareness and English reading comprehension ability
- To predict the impact of metacognitive awareness on the English reading comprehension ability of high school students.
- To evaluate the effectiveness of metacognitive training for the improvement of high school students' English reading comprehension ability.

Definitions of Key Terms

Reading Comprehension Ability. Reading comprehension ability is the ability to utilize lower order reading processes (including decoding and vocabulary knowledge) and higher order reading processes (including relation of text content to schema and conscious controllable processing) to understand concepts and ideas from text (Pressley, 2002).

Metacognitive Awareness. Based on the two-component model of metacognition, metacognitive awareness can be defined as the awareness of one's own knowledge, processes and cognitive states, i.e., knowledge of cognition, as well as of the regulation of those states which is in term as regulation of cognition (Balcikanli, 2011).

Knowledge of Cognition. Knowledge of cognition refers to what individuals know about their own cognition or cognition in general. It can be categorized into three different kinds of metacognitive awareness: declarative, procedural, and conditional knowledge (Brown, 1987).

Regulation of Cognition. Regulation of cognition refers to a set of activities which especially include planning, monitoring and evaluation in order to help students control their learning. It can be regarded as the control or executive aspect of the learning process as it can help the learners regulate and monitor their learning (Brown, 1987).

Related Literature Review

Metacognitive Awareness and Reading Comprehension

Predating the coining of the term "metacognitive awareness", metacognitive processes have been germane to reading comprehension with a very long history. Thorndike's (1917) study of reading as reasoning was among the first to document that the readers' awareness of their cognitive processes was the major emphasis in sense-making of reading text. Dewey (1910) and Huey (1968) also accepted that comprehension of the text requires planning, checking, and evaluating activities, which are now labelled as component parts of metacognitive awareness (as cited in Baker & Beall, 2009). Since it was in the late 1970s and early 1980s, the perspective that the effective readers must have some awareness and control on their cognitive activities they engage in while they are reading has evolved.

Later, metacognitive awareness has become a relatively new label for a body of theory and research in the area of reading. Earlier research carried out by Baker and Brown (1984), for instance, have investigated several different aspects of the relationship between metacognitive awareness and effective reading. Then, the researchers gave special attention to readers' awareness during the reading process, i.e., their metacognitive awareness, that addresses the readers' knowledge and use of their own cognitive resources (Garner, 1987). Baumann, Jones, and Seifert-Kessel (1993) shared a similar perspective with Garner that metacognitive awareness involves the awareness of whether or not comprehension is occurring, and the conscious application of one or more strategies to correct comprehension.

Carrell (1998) asserted that reading comprehension depends on direct cognitive effort, referred to as metacognitive processing, which consists of both knowledge about and regulation of cognitive processes. Flippo and Lecheler (1987) argued that metacognitive awareness can be thought of as the readers' awareness of whether they understand what they have read or not and one way in which teachers can help the readers become metacognitively aware is by encouraging them to change their reading speeds and to direct attention levels according to what they perceive the difficulty of the text to be. Likewise, McNamara and Magliano (2009) who have studied reading processes and reading strategies for many years found that metacognitive awareness during the reading process can inform the readers about their progress, their insufficient comprehension levels, and whether they are unlikely to reach their reading goals.

According to Alexander and Jetton (2000), during reading, metacognitive awareness is expressed through the uses of strategy, which are procedural, purposeful, effortful, willful, essential and facilitative in nature. To sum up, when applied to the reading process, metacognitive

awareness can be defined as the knowledge of the reader's cognition relative to the reading process and the self-control mechanisms they use to monitor and enhance comprehension. Through metacognitive strategies, a reader allocates significant attention to controlling, monitoring and evaluating the reading process (Sheorey & Mokhtari, 2001).

Metacognitive Practices in Reading Class

Consistent with Kintsch's (1998) words that reading comprehension is a complex and multifaceted ability, it certainly involves the reader's orchestration of a number of skills and strategies. It is metacognitive awareness that might be anticipated to help the reader aware and control their cognitive process while reading, i.e., become active, strategic and proficient comprehenders. Following Flavell's (1976) notion that metacognitive awareness is not innate and it can be acquired through learning, many researchers have focused on the practices of metacognitive awareness in reading classes and advocated some instructions that can be provided to develop students' metacognitive awareness and reading comprehension as well.

Previously, metacognitive awareness practices at schools have focused on two knowledge types: (1) knowledge in a specific domain, and (2) knowledge about self-as-learner (Lin, 2001). Other than general metacognitive strategies, Brown (1987) provided domain-specific metacognitive strategies for teaching reading such as clarifying the purposes of reading, identifying the important elements of the message, focusing on the main content, monitoring ongoing activities to determine whether comprehension is occurring, and recovering from disruptions and distractions. Similarly, Pressley (2002) pointed out that in reading classes, practicing the metacognitive activities such as making predictions, generating questions, constructing mental images that represent the meanings of text, summarizing, monitoring understanding, etc., is essential for achieving reading comprehension.

A study conducted by Paris and Jacobs (1984) found that Informed Strategies Instruction (ISL) was effective in enhancing metacognitive knowledge and improving the comprehension monitoring of students, especially for the poor readers. At the same time, Palincsar and Brown (1984) were undertaking research on a different metacognitive approach, called Reciprocal Teaching (RT) which was designed to foster reading comprehension and to teach students to monitor their comprehension. Transactional Strategies Instruction (TSI) is another metacognitive approach that promotes the idea that students should be flexible users of various strategies available in order to enhance reading comprehension (Pressley, 2002). Klingner, Vaughn, Arguelles, Hughes and Leftwich (2004) developed Collaborative Strategic Reading (CSR) to teach multiple comprehension strategies alongside collaborative learning. Recently, Lam (2010) also suggested seven metacognitive strategies which placed special emphasis on language learning.

Besides, verbalizing self-questioning techniques and modeling the application of such questions can give the readers an idea of what metacognitive awareness looks like practically. In addition, the recent study of Eluemuno and Azuka-Obieke (2013) suggested the direct explicit instruction of metacognitive strategies as an efficient way of promoting metacognitive practices in reading classes. The purpose of direct instruction is to provide explicit explanations on the notion and construct of metacognitive awareness so that students who used to be unaware of their own cognitive activities will become aware of their mental actions when they perform cognitive tasks.

Repeatedly, the literature has indicated the effective metacognitive practices including direct explanation, collaborative discussions, modelling, making predictions, questioning, summarizing and clarifying. The investigations of approaches have also revealed with strong empirical evidence that metacognitive and comprehension-related strategy instruction must be

combined with effective teaching practices. While there is considerable evidence regarding the value of teaching individual strategies, it is also clear that the teaching of multiple strategies might be superior to the teaching of single strategies in developing reading comprehension (van Kraayenoord, 2010). It is suggested that metacognitive practices of multiple strategies allow students to develop a repertoire that they can learn to use flexibly according to the text type, task, and context.

Method

Research Method

In this study, explanatory sequential mixed methods research design was used and thus, this study was conducted with two phases: Phase (1) which was the quantitative study and Phase (2), the follow-up intervention as the qualitative study.

Firstly, to explore the metacognitive awareness and English reading comprehension ability of high school students, descriptive survey design and quantitative approaches were applied in the Phase (1) of the study.

In order to investigate whether English reading comprehension ability of high school students improved or not after the intervention, one group pre-test post-test experimental design was used in the follow-up study of the Phase (2).

Sampling

As the Phase (1) of the study, the participants were chosen by using stratified random sampling technique. Firstly, two states and three regions (30% of total states and regions) were selected. Next, from 10 high schools located in the selected states and regions, the participant students were randomly selected. Finally, 1241 students participated in the Phase 1.

And then, as the Phase (2), it was decided to conduct the intervention at School A since it possessed the heterogeneous group of students having different levels of English reading comprehension ability according to the quantitative results. By using purposive sampling method, 30 students from School A were purposefully selected as the participants in the intervention program. Specifically, 10 students from low ability group, 10 students from average ability group as well as 10 students from high ability group were participated in the follow-up qualitative study.

Research Instrumentation

In the Phase (1) of the study, the Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1994) and the English Reading Comprehension Ability Test (ERCAT) (Form A) developed by the researcher were used as the research instruments to collect the required data. The MAI was a Likert-scale instrument composed of 52 items and the ERCAT (Form A) was the 40-items ability test developed with IRT calibration method by utilizing BILOG-MG 3 Software.

In the follow up study of the Phase (2), the instruments used for the collecting data included K-W-L chart, The Reading Process Checklist, and English Reading Comprehension Ability Test (Form B) for post-test. The K-W-L chart (what I “Know”, what I “Want” to know, and what I have “Learned”) is one form of self-assessment instruments used to develop students’ metacognitive skills (Shepard, 2000). The Reading Process Checklist developed by El-Koumy (2002) was a

checklist for self-assessment of one's own cognitive task. The ERCAT (Form B) was the parallel test form of ERCAT (form A) and it also included 40 items selected by IRT calibration method.

Data Collection Procedure

For the Phase (1) of the study, Preliminary testing and field testing were conducted with the permissions of administrative personnel. Preliminary testing was completed with 316 Grade 10 students in July, 2019. The actual data collection was done with 1241 Grade 10 students across Myanmar during 2020-2021 Academic Year.

As the Phase (2), based on the quantitative results, a follow-up study was continued with 30 students within the period of January, 2022 to February, 2022 and the data were collected before, during and after the intervention by using the pre-determined instruments.

Data Analysis and Research Findings

Development of English Reading Comprehension Ability Test

Checking the Assumption of Unidimensionality

In order to determine whether the assumption of unidimensionality was met, eigenvalue plot of the inter-item correlation matrix for the test was studied. Figure 1 showed the scree plot of the eigenvalues for all items included in the test.

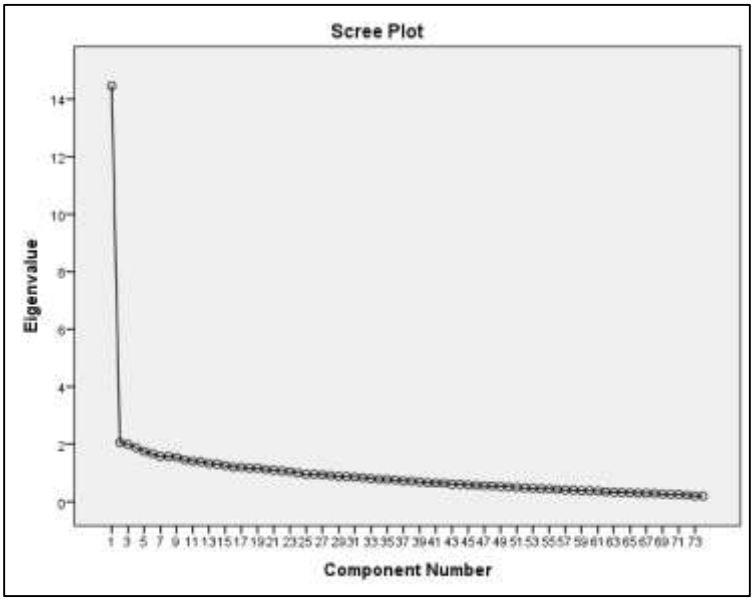
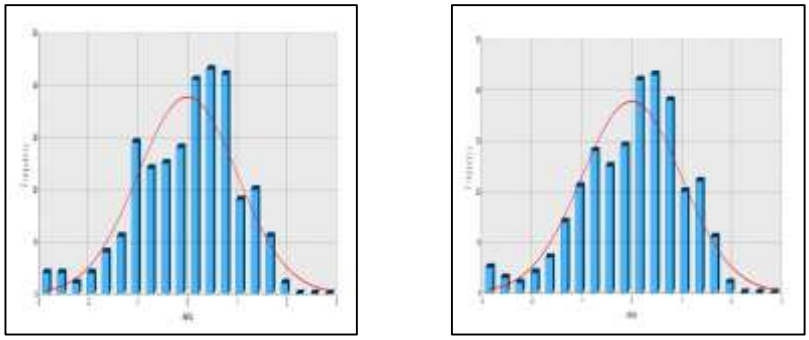


Figure 1. Scree Plot of the Eigenvalues for All Items of the Test

The dominance of the first factor can be observed in Figure1. The largest eigenvalue of the correlation matrix for all items in the test is over three times larger than the second largest eigenvalue. Thus, it could be assumed that it has the unidimensionality. When the assumption of unidimensionality is met, so is the assumption of local independence (Lord, 1980).

Checking the Assumption of Model Data Fitness

In order to check the assumption of model data fitness, the obtained data were firstly analyzed by all three popular models. According to sample size, one-parameter and two-parameter models could be used with the obtained data but three-parameter model was not fit with the observed data.



Note: = observed proportion, = expected proportion

Figure 2. Observed and Expected Proportion of the Test by Appling One-Parameter Logistic Model and Two-Parameter Logistic Model

Then, goodness of the Model Data Fit was checked by Lord's Chi-square method. According to the Chi-square results, it was found that the number of model data fit items were 59 items when one-parameter logistic model was applied. Analyzing with two-parameter logistic model, the number of model data fit items were 72 items. Thus, it could be clearly observed that the number of modal data fit item was larger by using two-parameter logistic model. In addition, the difference between observed and expected proportion of the test by utilizing one-parameter and two-parameter models can be found in Figure 2.

As it can be seen in Figure 2, the residuals were greater while utilizing the one-parameter logistic model (1PLM). It could be assumed that many of the items in the test would not fit with 1PLM. The observed proportion correct was closed to the model expectation when the two-parameter logistic model (2PLM) was applied. Therefore, 2PLM is the best fit with the data of the test.

Analyzing Item Parameters of the Items in English Reading Comprehension Ability Test

Most items in the test had good discrimination and some items had moderate discrimination. But, the item no. 15, 17, 20, 22, 41, 47, 53 and 58 has discrimination less than 0.4 and so these items should not be included in the operational test. Most of the items in the test had the difficulties between the range of -2 to +2 with the exception of item no 15, 17, 22, 41, 47, 53, 58, 68, and 74. The item difficulty values of these items were so high that they were considered to be too difficult for the intended population.

Revising the Table of Specification for the ERCAT

Based on the results from IRT calibration, a table of specifications was reconstructed for the final selection of the items to be included in the test in order to ensure the content coverage of the test.

Final Selection of Items for the ERCAT

In order to select the items for the operational test, the purpose of the test was defined first. The ERCAT was intended to measure the average ability students (i.e., $\theta = -2 \sim +2$). Therefore, a greater number of middle-difficulty items were selected to be able to measure most of the examinees precisely (i.e., $\theta = -2 \sim +2$). Moreover, items with fair and high discrimination were also selected so as to distinguish between low and high performing students.

Item Characteristic Curves (ICCs) for the ERCAT

The item characteristic curves of all items in the ERCAT were graphed in Figure 3 in order to present the probability of choosing the correct answer to an item as a function of the level of the attribute being measured by the test. According to the figure 3, it can be seen clearly that the higher the student's ability level, the greater the probability of getting the correct answer. Then, it was also observed that most item characteristic curves in the test were almost parallel which is meant that most items of the test had similar discrimination. Moreover, the item characteristic curves were placed according to their difficulty, i.e., from easy to difficult, and they were closed together due to small variance in difficulty.

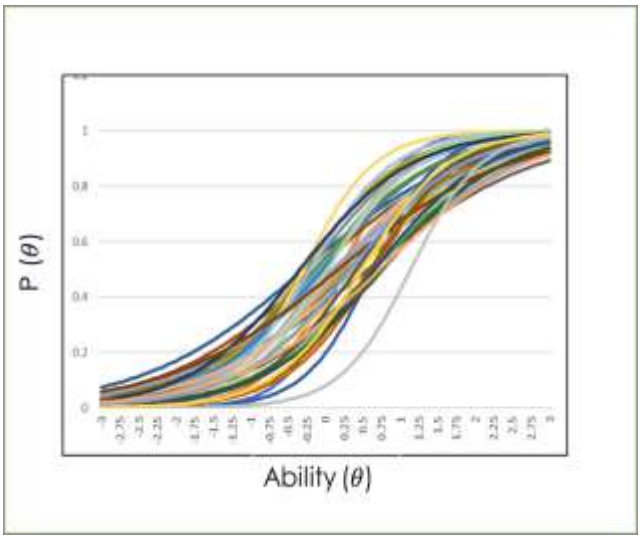


Figure 3. Item Characteristic Curves of All Items in the ERCAT

Test Information Function (TIF) of the ERCAT

In order to know the maximum amount of information obtained by the ERCAT precisely, the test information function of the ERCAT was illustrated in Figure 4.

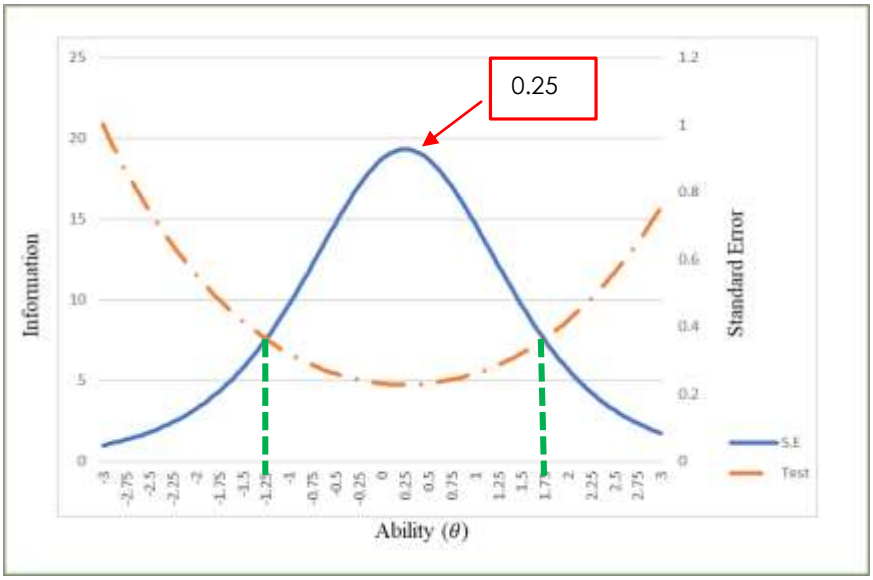


Figure 4. Test Information Function (TIF) for the ERCAT

As shown in Figure 4, the maximum information of the test I (θ) was 19 at θ = 0.25. In other words, this test gave the maximum information about the students who had ability +0.25 The test had smaller standard error across the ability scale from -1.25 to +1.75. Thus, it can be concluded that the test was informative for the average ability range as it was predicted. In addition, it could be interpreted that the ERCAT could be used to determine the student group whose average ability is θ = 0 (-2 < θ < +2).

Descriptive Statistics of High School Students' Metacognitive Awareness

The descriptive statistics corresponding to the eight dimensions and overall performance of student's metacognitive awareness were reported in the following Table 1.

Table 1. Descriptive Statistics of High School Students' Metacognitive Awareness

Variables	*N*	Mean	Mean%	*SD*
Declarative Knowledge (8 items)	1241	20.05	62.7%	5.09
Procedural Knowledge (4 items)	1241	9.33	58.3%	3.13
Conditional Knowledge (5 items)	1241	12.6	63%	3.63
Planning (7 items)	1241	17.77	63.5%	4.39
Information Management (10 items)	1241	25.71	64.3%	5.98
Comprehension Monitoring (7 items)	1241	17.94	64.1%	4.47
Debugging (5 items)	1241	13.20	66%	3.56
Evaluation (6 items)	1241	15.32	63.8%	3.85
Metacognitive Awareness (52 items)	1241	131.91	63.4%	28.89

From descriptive analyses, it was revealed that the mean percentage of overall metacognitive awareness was 63.4% and thus, the metacognitive awareness of high school students in this study seemed to be satisfactory.

High School Students' Metacognitive Awareness by Gender

In order to investigate whether metacognitive awareness of high students differ by gender, descriptive analyses were conducted and the results were provided in Table 2.

Table 2. Means, Standard Deviations and Results of Independent Samples *t*-test for High School Students' Metacognitive Awareness by Gender

Variable	Gender	*N*	Mean	*SD*	*t*	*p*
Declarative Knowledge	Male	586	19.93	4.98	-0.813	.317
	Female	655	20.16	5.18		
Procedural Knowledge	Male	586	9.28	3.12	-0.467	.877
	Female	655	9.37	3.14		
Conditional Knowledge	Male	586	12.48	3.53	-1.000	.105
	Female	655	12.68	3.71		
Planning	Male	586	17.71	4.36	-0.458	.506
	Female	655	17.82	4.43		
Information Management Strategies	Male	586	25.70	5.90	-0.053	.657
	Female	655	25.72	6.06		
Comprehension Monitoring	Male	586	17.97	4.31	0.216	.114
	Female	655	17.91	4.61		
Debugging	Male	586	13.19	3.54	-0.095	.892
	Female	655	13.21	3.58		
Evaluation	Male	586	15.21	3.80	-0.930	.683
	Female	655	15.42	3.90		
Metacognitive Awareness	Male	586	131.47	28.07	-0.502	.128
	Female	655	132.30	29.62		

As it can be seen in Table 2, the results of descriptive analyses revealed that there was a slight difference in mean scores by gender. To make more detailed investigation on the gender difference of high school students' metacognitive awareness, independent samples *t*-test was conducted and the results indicated that there were no significant gender differences in all metacognitive dimensions as well as overall metacognitive awareness. This finding came to support the previous research findings revealed by Ma San Win (2010), Onat (2012), Chantharanuwong et al., (2012), and Hemdan (2012) which consistently stated that there were no significant gender related differences on the dimensions of metacognition.

Comparison of High School Students' Metacognitive Awareness by Age

To examine whether high school students' metacognitive awareness differ with respect to age, descriptive analysis was conducted and the results revealed the differences in means and standard deviations of metacognitive awareness by age as reported in Table 3.

Table 3. Means, Standard Deviations, and ANOVA Results of High School Students' Metacognitive Awareness by Age

Variable	Age (X)	*N*	Mean	*SD*	*F*	*p*
Declarative Knowledge	≥ 17 years	304	20.54	5.22	4.384**	.004
	16 ≤ x < 17 years	364	20.52	5.26		
	15 ≤ x < 16 years	334	19.57	5.05		
	< 15 years	239	19.38	4.56		
Procedural Knowledge	≥ 17 years	304	9.56	3.18	3.779*	.010
	16 ≤ x < 17 years	364	9.63	3.19		
	15 ≤ x < 16 years	334	9.08	3.10		
	< 15 years	239	8.92	2.95		
Conditional Knowledge	≥ 17 years	304	12.93	3.65	3.821*	.010
	16 ≤ x < 17 years	364	12.86	3.70		
	15 ≤ x < 16 years	334	12.36	3.72		
	< 15 years	239	12.05	3.27		
Planning	≥ 17 years	304	18.27	4.25	4.502**	.004
	16 ≤ x < 17 years	364	18.11	4.67		
	15 ≤ x < 16 years	334	17.42	4.50		
	< 15 years	239	17.12	3.88		
Information Management Strategies	≥ 17 years	304	26.56	5.85	6.887***	.000
	16 ≤ x < 17 years	364	26.24	6.27		
	15 ≤ x < 16 years	334	25.16	6.02		
	< 15 years	239	24.58	5.42		
Comprehension Monitoring	≥ 17 years	304	18.44	4.45	7.805***	.000
	16 ≤ x < 17 years	364	18.52	4.66		
	15 ≤ x < 16 years	334	17.50	4.43		
	< 15 years	239	17.04	4.03		
Debugging	≥ 17 years	304	13.71	3.55	5.488***	.000
	16 ≤ x < 17 years	364	13.44	3.63		
	15 ≤ x < 16 years	334	12.90	3.60		
	< 15 years	239	12.64	3.32		
Evaluation	≥ 17 years	304	15.75	3.86	4.242**	.005
	16 ≤ x < 17 years	364	15.61	4.02		
	15 ≤ x < 16 years	334	14.96	3.89		
	< 15 years	239	14.84	3.43		
Metacognitive Awareness	≥ 17 years	304	135.75	28.95	7.146***	.000
	16 ≤ x < 17 years	364	134.94	30.26		
	15 ≤ x < 16 years	334	128.94	29.04		
	< 15 years	239	126.55	25.12		

Note: * p < .05, ** p < .01, *** p < .001

According to Table 3, it can be observed that the mean scores of students in oldest age group, i.e., above 17 years, were highest in all dimensions of metacognitive awareness with the exception of comprehension monitoring. In comprehension monitoring subscale, the highest mean score belonged to the students in the age group of $16 \leq x < 17$ years. The mean scores of the youngest students, i.e., students from below 15 years age group were found to be the lowest in the all dimensions and components of metacognition and also in the overall metacognitive awareness. It seemed that the older students in this study could show better awareness and regulation to their cognitive tasks than the younger ones.

To make the confirmation of the significant difference in high school students' metacognitive awareness with respect to the age groups, one way Analysis of Variance (ANOVA) was executed. The results of ANOVA showed that there were significant age differences in high school students' metacognitive awareness at 0.01 level (see Table 3).

In order to obtain more detailed information about the comparison of high school students' metacognitive awareness among age groups, the post-hoc Test was carried out by Tukey method and the results were presented in Table 4.

Table 4 Results of Tukey HSD Multiple Comparison for High School Students' Metacognitive Awareness by Age

Variable	(I) Age	(J) Age	Mean Difference (I-J)	*p*
Declarative Knowledge	≥ 17 years	< 15 years	1.166*	.039
	16 ≤ x < 17 years	< 15 years	1.143*	.035
Procedural Knowledge	16 ≤ x < 17 years	< 15 years	0.716*	.030
Conditional Knowledge	≥ 17 years	< 15 years	0.882*	.025
	16 ≤ x < 17 years	< 15 years	0.817*	.034
Planning	≥ 17 years	< 15 years	1.145*	.013
	16 ≤ x < 17 years	< 15 years	0.956*	.035
Information Management Strategies	≥ 17 years	15 ≤ x < 16 years	1.397*	.016
		< 15 years	1.979**	.001
	16 ≤ x < 17 years	< 15 years	1.667**	.004
Comprehension Monitoring	≥ 17 years	15 ≤ x < 16 years	0.940*	.038
		< 15 years	1.400**	.002
	16 ≤ x < 17 years	15 ≤ x < 16 years	1.028*	.012
		< 15 years	1.487***	.000
Debugging	≥ 17 years	15 ≤ x < 16 years	0.812*	.020
		< 15 years	1.071**	.003
	16 ≤ x < 17 years	< 15 years	0.806*	.032
Evaluation	≥ 17 years	< 15 years	0.798*	.044
		15 ≤ x < 16 years	0.916*	.030
Metacognitive Awareness	≥ 17 years	< 15 years	6.807*	.015
		15 ≤ x < 16 years	9.199**	.001
	16 ≤ x < 17 years	< 15 years	5.999*	.030
		15 ≤ x < 16 years	8.391**	.003

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

According to the results of Tukey HSD multiple comparison, it became apparent that in each dimension and overall metacognitive awareness, the mean scores of the oldest students (≥ 17 years) and the second oldest student (16 ≤ x < 17 years) were significantly higher than that of the youngest students (< 15 years) at 0.01 level and 0.05 level respectively. Therefore, the older students were likely to possess better metacognitive awareness than their younger peers.

This finding was consistent with the previous research findings revealed Dufresne and Kobasigawa (1989), and Schneider and Lock l. (2002) in that the older students were more likely to reflect on their own performance and evaluate or control their cognitive abilities compared to the younger students. This must be due to the fact that all metacognitive components develop with age. The capability in using cognitive strategies appears to develop by the age of 10 or 12 and knowledge of cognition is well developed in children starting from about 11 years of age (Schneider & Lock l, 2002).

Descriptive Statistics of High School Students' English Reading Comprehension Ability

High school students' English reading comprehension ability was measured by the English Reading Comprehension Ability Test (ERCAT) (Form A). In order to identify the comprehension ability of high school students, the raw scores were firstly converted to the ability scaled scores. After transforming the raw scores to corresponding ability (θ) scaled scores, descriptive analyses were done and reported in Table 5.

Table 5 Descriptive Statistics of High School Students' English Reading Comprehension Ability

Variable	*N*	Mean	*SD*	Minimum	Maximum
English Reading Comprehension Ability	1241	0.013	1.195	-4.00	+4.00

According to Table 5, the mean value of high school students' English reading comprehension ability was 0.013 with standard deviation of 1.195. Since this ability mean value was nearly identical to the average ability score of 0, it may be concluded that Myanmar high school students had average ability to comprehend the text written in English.

Comparison of English Reading Comprehension Ability by Gender

This study tried to investigate whether there is a gender-related difference in English reading comprehension ability of high students and so descriptive analysis was conducted first. Then, the mean and standard deviation of English reading comprehension ability for both male and female students were reported in Table 6.

According to Table 6, it was observed that the mean score of female students was higher than that of male students in English reading comprehension ability. In other words, female high school students seemed to possess better comprehension ability than male high school students while reading in English.

Table 6 Means, Standard Deviations and Independent Samples *t*-test Results of High School Students' English Reading Comprehension Ability by Gender

Variable	Gender	*N*	Mean	*SD*	*t*	*p*
English Reading Comprehension Ability	Male	586	-0.02	1.12	-0.927*	.021
	Female	655	0.04	1.26		

Note: *$p < .05$

To make more detailed investigation on the gender difference of high school students' English reading comprehension ability, independent samples *t*-test was conducted (see Table 6). The results of *t*-test indicated that there was gender difference in English reading comprehension ability. To be exact, inspection of the two group means indicated that the mean score of female students (0.04) was significantly higher than that of male students (-0.02). This finding was congruent with the findings of earlier studies conducted by Logan and Johnson in 2009 and Saidi in 2012 with regard to gender. Their findings revealed that girls consistently outperformed boys in foreign language reading comprehension. This must be due to the fact that in general, females are better than male in language acquisition and language learning because of females' superiority in verbal ability (Saidi, 2012).

However, this finding was contrary to the findings of previous research conducted by Oda and Abdul-Kadhim in 2017 which showed that gender seemed to have some effect on reading comprehension but this effect was not big enough to be statistically significant.

Thus, it should be concluded that further studies are needed to explore the gender-related differences on English reading comprehension ability because there were only a small number of foreign language reading studies that have been conducted and their findings have come up with inconsistent results related to gender.

Comparison of English Reading Comprehension Ability by Age

From the results of descriptive analyses, it was found that the mean scores of the older students were respectively higher than those of younger students (see Table 7). To make the confirmation of the significant difference of high school students' English reading comprehension ability by age group, one way analysis of variance (ANOVA) was executed. The ANOVA result showed that there was significant difference in high school students' English reading comprehension ability by age at 0.001 level (see Table 8). Thus, it can reasonably be interpreted that the older students significantly outperformed well in comprehension tasks than the younger students.

Table 7 Descriptive Statistics for High School Students' English Reading Comprehension Ability by Age

Variable	Age (X)	*N*	Mean	*SD*
English Reading Comprehension Ability	$\geq$ 17 years	304	0.21	1.22
	$16 \leq x < 17$ years	364	0.12	1.28
	$15 \leq x < 16$ years	334	-0.11	1.18
	< 15 years	239	-0.23	0.96

Table 8 ANOVA Results of Mean Comparison for English Reading Comprehension Ability by Age

English Reading Comprehension Ability	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	35.831	3	11.944	8.513***	.000
Within Groups	1735.531	1237	1.403		
Total	1771.362	1240			

Note: *** $p < .001$

According to the results of Tukey HSD multiple comparison, it became apparent that the mean score of students in oldest age group (above 17 years) was significantly higher than those of students in younger age groups ($15 \leq x < 16$ years and < 15 years) at 0.01 and 0.001 level. Similarly, the mean differences between the older students and younger students were significantly stated among other age groups (see Table 9).

Table 9 Results of Tukey HSD Multiple Comparison for High School Students' English Reading Comprehension Ability by Age

Variable	(I) Age	(J) Age	Mean Difference (I-J)	*p*
English Reading Comprehension Ability	≥ 17 years	$15 \leq x < 16$ years	0.33**	.003
		< 15 years	0.44***	.000
	$16 \leq x < 17$ years	$15 \leq x < 16$ years	0.23*	.049
		< 15 years	0.35**	.002
	$15 \leq x < 16$ years	< 15 years	0.12**	.003

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

This finding was in accordance with several studies which found out that older children have better scores than younger ones in reading performance (Borg & Falzon, 1995; Trapp, 1995). Additionally, they reflect a continuation of the trend reported by other researchers (Davis et al., 1980) that younger pupils seemed to be less ready for reading tasks than their older peers.

Again, this finding was developmentally reassuring in that the students at the high school level are generally expected to focus on reading for meaning in depth, but students would move through the comprehension stages at their own pace by adjusting and reorganizing their cognitive structures (Chall, 1983). Therefore, those students at different rates and insufficient mastery of skills at a particular stage would inhibit progress to a higher stage in comparison with their peers. Thus, it should be concluded that the age differences reported in this study could be attributed to the continuous maturation of the visual and auditory temporal processing-capacities necessary for a successful reading during school age years (Dawes & Bishop, 2008).

Comparison of English Reading Comprehension Ability by Subject Combinations

According the new curriculum framework in Myanmar, there are two combinations such as Science, Technology, Engineering, Art, Mathematics, Sports-1 (STEAMS-1) and Science, Technology, Engineering, Art, Mathematics, Sports-2 (STEAMS-2) under Science Stream. Likewise, there are another two combinations such as Social Science, Technology, Art, Mathematics, Sports-1 (STAMS-1) and Social Science, Technology, Art, Mathematics, Sports-2 (STAMS-2) under Arts Stream. In this study, students specializing in either STEAMS-1 or STEAM-2 were regarded as the science students and those following either STAM-1 or STAM-2 were considered as the arts students. To assess if high school students' English reading comprehension differ according to their subject combinations, descriptive analysis was executed again and the means and standard deviations were reported in Table 10.

Table 10. **Means, Standard Deviations and Independent Samples *t*-test Results of High School Students' English Reading Comprehension Ability by Subject Combinations**

Variable	Subject Combinations	*N*	Mean	*SD*	*t*	*p*
English Reading Comprehension Ability	Science	540	0.36	1.32	9.051***	.000
	Arts	701	-0.26	1.01		

Note: ***$p < .001$

It was observed that the mean score of students in science combination (0.36) was higher than that of students in arts combination (-0.26). Thus, it can be assumed that science students showed better comprehension ability in English reading than arts students.

To obtain more detailed information of high school students' English reading comprehension ability with respect to their subject combination, independent samples *t*-test was calculated (see Table 10) and the results revealed that there was significant difference in English reading comprehension ability at 0.001 level by subject combination. Specifically, English reading comprehension ability of science students was significantly higher than that of arts students.

This finding may be related to the nature of subject combinations at high school level in Myanmar in that all the subjects in science combination with the exception of Myanmar have to be written in English and thus science students acquired more exposure to English reading in their daily life than the arts students.

In addition, another reason for this finding may be because most parents and teachers in Myanmar usually encourage the students with academic superiority to follow the science combination when they reach their high school level. Therefore, the academic performance of science students may be better than the arts students in general and their superiority in English reading comprehension ability can be considered in similar way.

Relationship between Metacognitive Awareness and English Reading Comprehension Ability of High School Students

Pearson product-moment correlations were calculated to examine the relationships between the variables (see Table 11). The results of bivariate correlations showed that the higher levels of the dimensions metacognitive awareness were significantly correlated with higher levels of English reading comprehension ability. Particularly, there was a relatively strong correlation between information management strategies and English reading comprehension ability ($r = .584$**, $p < 0.01$) and similarly, between the declarative knowledge and English reading comprehension ability of high school students ($r = .576$**, $p < 0.01$).

Table 11. Correlations between the Metacognitive Awareness and English Reading Comprehension Ability of High School Students

	DK	PK	CK	P	IMS	CM	D	E	**ERCA**
DK	1	.651**	.647**	.666**	.683**	.642**	.654**	.674**	.576**
PK		1	.698**	.645**	.658**	.644**	.637**	.604**	.572**
CK			1	.684**	.717**	.682**	.686**	.649**	.556**
P				1	.736**	.711**	.664**	.627**	.542**
IMS					1	.733**	.701**	.694**	.584**
CM						1	.695**	.649**	.544**
D							1	.651**	.525**
E								1	.553**
ERCA									1

Note: ** $p < .01$

DK = Declarative Knowledge, PK = Procedural Knowledge, CK = Conditional Knowledge,
P = Planning, IMS = Information Management Strategies, CM = Comprehension Monitoring, D = Debugging,
E = Evaluation, ERCA = English Reading Comprehension Ability

Regression Analysis for the Prediction of English Reading Comprehension Ability of High School Students

To test the predictive contributions of the dimensions of metacognitive awareness to English reading comprehension ability, the standard multiple regression analysis was conducted. According to the standard multiple regression analysis, the results pointed out that the six out of eight dimensions of metacognitive awareness made a significant predictive contribution to English reading comprehension ability, F (8, 1232) = 123.25, $p < 0.001$, and explained for 44.1% (adjusted R^2) of the variance in English reading comprehension ability.

Table 12. Summary of Regression Analysis for the Predictive Contributions of Metacognitive Awareness to English Reading Comprehension Ability

Predictors	***B***	**β**	***t***	***R***	***R²***	***Adj R²***	***F***
Constant	3.257			.667	.445	.441	123.25***
1. PK	0.296	0.181	5.434***				
2. DK	0.162	0.164	4.828***				
3. CK	0.099	0.072	1.984**				
4. E	0.157	0.121	3.622***				
5. IMS	0.113	0.135	3.450***				
6. CM	0.064	0.057	1.570*				
7. P	0.050	0.044	1.228				
8. D	0.016	0.011	0.323				

Note: *$p < .05$, ** $p < .01$, *** $p < .001$

DK = Declarative Knowledge, PK = Procedural Knowledge, CK = Conditional Knowledge, P = Planning,
IMS = Information Management Strategies, CM = Comprehension Monitoring, D = Debugging, E = Evaluation

Then, the resultant model can therefore be defined as in the following equation:

ERCA = 3.257 + 0.296PK + 0.162DK + 0.157E+ 0.113IMS + 0.099CK + 0.064CM

where, ERCA = English Reading Comprehension Ability, PK = Procedural Knowledge,

DK = Declarative Knowledge, IMS = Information Management Strategies,

E = Evaluation, CK = Conditional Knowledge, CM = Comprehension Monitoring

Intervention-based Data Analysis and Results (Phase 2)

Intervention Plan for Follow-up Study

Compelling evidence from a number of previous studies suggests that metacognitive awareness is teachable and that students who are trained in metacognitive awareness can improve other measures of academic performance (Payne & Manning, 1992; Mevarech & Amrany, 2008). Based on the findings of the field testing, the metacognitive intervention focusing on reading was performed with 30 Grade 10 students (15 males and 15 females) as the follow-up study. The summarized account on planning the intervention procedure for six-week metacognitive training was described in the following table (see Table 13).

Table 13. Summarized Account on Planning the Intervention

Intervention	Method	Strategy Oriented	Time Allowed per Session
English Reading Comprehension Ability Test (Pre-test)			2 hours
Week 1	Detached Strategy Training	Teaching 12 Metacognitive Reading Strategies	2 hours
Week 2	Blended Strategy Training	Predicting, Underlying, Consulting an external source, Self-questioning	2 hours
Week 3		Skimming, Focusing on understanding, Underlying, Note-taking, Self-questioning	2 hours
Week 4		Previewing, Slow Down and reread, Note-taking, Summarizing	2 hours
Week 5		Self-questioning, Making educated guess, Consulting an external source	2 hours
Week 6		Practicing all Strategies provided in the intervention	2 hours
Recap all the metacognitive knowledge and strategies			2 hours
English Reading Comprehension Ability Test (Post-test)			2 hours

After that, the intervention was carried out according to the intended intervention plan and specific lesson plans. The lesson plans were combined with reading passages, metacognitive strategies, worksheets, group work activities, self-assessment checklists, discussions, as well as question and answer method.

Results of K-W-L Chart

Students' response to K-W-L chart carried much information about their knowledge of cognition, i.e., their knowledge of what, when, and how to use strategies. Therefore, students' responses to K-W-L chart before and after the intervention were recorded as in Table 14 (see Table 14).

From the results of K-W-L chart, it can be concluded that most students showed some improvement in all forms of metacognitive knowledge, i.e., declarative knowledge, procedural knowledge and conditional knowledge, related to reading strategies after the intervention. Hence, after the intervention, students can be expected to perform their reading comprehension tasks better than before as they were likely to possess a larger repertoire of strategies.

Table 14. Summarized Account on Students' Responses to K-W-L Chart

Metacognitive Knowledge		Number of Strategies in Students' Responses	Before Intervention	After Intervention
			What I "Know"	What I have "Learned"
			Number of Students (Percentage)	
Declarative	To describe the name of strategies they know	No response	13 (43%)	-
		1 – 3	11 (37%)	6 (20%)
		4 – 6	4 (13%)	17 (57%)
		7 – 10	2 (7%)	5 (16%)
		10 – 12	-	2 (7%)
Procedural	To describe their knowledge of how to use a particular strategy correctly	No response	21 (70%)	1 (3%)
		1 – 3	7 (23%)	15 (50%)
		4 – 6	2 (7%)	12 (40%)
		7 – 10	-	2 (7%)
		10 – 12	-	-
Conditional	To express their knowledge of when to use a particular strategy correctly	No response	18 (60%)	1 (3%)
		1 – 3	11 (37%)	9 (30%)
		4 – 6	1 (3%)	14 (48%)
		7 – 10	-	5 (16%)
		10 – 12	-	1 (3%)

Results of the Reading Process Checklist

Within each blended training period of intervention, the students were requested to check on the specific behaviour they were doing or they have done before, while and after reading the text passages. The percentage of the average response rates of students to the metacognitive skills within five weeks of blended intervention were illustrated in Figure 5.

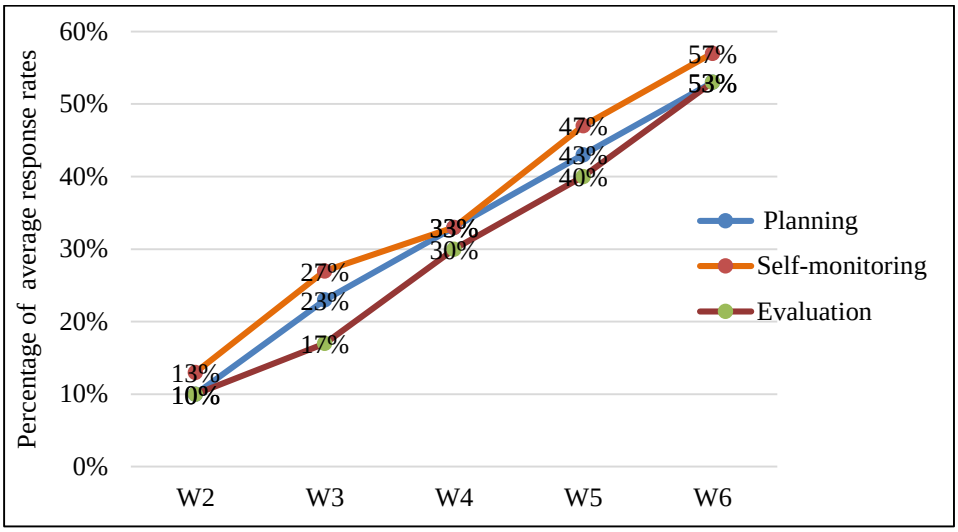


Figure 5. Percentage of Average Response Rates of Students to the Metacognitive Skills

As it can be seen in Figure 1, the most frequently used metacognitive skill of students when they conducted their reading process was self-monitoring strategies, beginning with 13% in week 2, rising slightly to 27% in week 3. It experienced nearly about 10% increase from week 3 to week 6 and the percentage of students who responded that they self-monitored their reading process became 57% in week 6. The second most frequently used metacognitive skill was found to be planning strategies, which began 10% in terms of percentage response rate, going up more than 40% in week 6. Regarding the percentage response rate of evaluation strategies, it rose slightly from 10% to 17% within the first two weeks, then steeply to 30% in week 4 and continued with the regular increase of about 10% in the remaining weeks. Although it got the lowest percentage of response rate compared to the other two metacognitive skills in the first four weeks, it recovered with 53% of response rate in week 6. From the results, a regular increase was found in the average response rate of students to their metacognitive skills while reading indicating that the students can become more aware of their cognitive tasks and can properly monitor and control their processing within their participation in intervention.

Results of English Reading Comprehension Ability Test

To examine the students' English reading comprehension ability before and after the intervention, the paired samples *t*-test was conducted. According to the results of statistical analysis, the mean scores differed prominently at $p < 0.001$. Therefore, it can be said that English reading comprehension ability of students after the intervention was significantly higher than that of students before the intervention as it can be observed in Table 15.

Table 15. Paired Samples *t*-test Results of English Reading Comprehension Ability Before and After Intervention

Intervention	Mean	*N*	*SD*	Mean Difference	*t*	*df*	*p*
Before	-0.715	30	1.79	-0.876	-6.125***	29	.000
After	0.160	30	1.74				

Note: ***$p < .001$

Conclusion, Discussion and Recommendations

Metacognitive awareness plays an important role in educational settings, and consequently has been the subject of a great deal of research in educational psychology. Research has consistently shown that metacognitive awareness is positively related to academic achievement and it is one of the greatest influences on academic performance (Schraw, 1998; van der Stel & Veenman, 2010; Wang, Haertel, & Walberg, 1990). While related to the reading comprehension process, many researchers pointed out that metacognition-based instruction was more beneficial than traditional reading and instruction (Hilden & Pressley, 2007; Veenman, 2013).

Therefore, this study was primarily intended to explore the impact of metacognitive awareness on high school students' English reading comprehension ability since high school students are those who may be supposed to operate formal operational thinking in performing their cognitive tasks. Firstly, English reading comprehension ability test and metacognitive awareness of high school students were examined. Then, the relationship of metacognitive awareness and English reading comprehension ability was investigated. Finally, it was also analyzed how high school students' metacognitive awareness has an impact on their comprehension ability.

As the Phase (1) of the study, a total of 1241 Grade 10 students (male = 586, female = 655) from the selected basic education schools across Myanmar were participated in this study. English Reading Comprehension Ability Test (ERCAT-Form A) and Metacognitive Awareness Inventory (MAI) were used as research instruments. According to descriptive analyses, it can be concluded that the metacognitive awareness of high school students seemed to be satisfactory and Myanmar high school students had average ability to comprehend the text written in English.

Again, Pearson product-moment correlation was executed to find out the relationship between metacognitive awareness and English reading comprehension ability of high school students and the criterion $p < 0.05$ was used to determine statistically significant correlations.

To test the predictive contributions of the dimensions of metacognitive awareness to English reading comprehension ability, the standard multiple regression analysis was conducted. Based on the findings of quantitative study, in order to examine whether metacognitive training on reading can enhance the comprehension ability of high school students, the follow-up intervention was conducted as the Phase (2) of the study. The follow-up study was conducted with 30 students by using one group pre-test post-test experimental design. After six-week intervention, the results pointed out that the metacognitive knowledge and regulation of students over their reading process was seen to improve. According to the results of the paired samples *t*-test, it was observed that English reading comprehension ability of students after the metacognitive training with special focus on reading was significantly higher than that of students before the intervention at $p < 0.001$.

Therefore, it can be concluded that results and findings of quantitative analysis in this study have pointed out the significant contribution of metacognitive awareness on the prediction of English reading comprehension ability of Myanmar high school students. In addition, the metacognitive training for reading implemented in this study was found to make significant improvement in the high school students' English reading comprehension ability. Accordingly, the teachers and educators should consider to make their students become more metacognitively aware to their cognitive tasks including reading comprehension so that they can maximize their performance in academic settings.

Reading comprehension is a deliberate action, requiring self- invoked plans, cognitive skills, awareness and deliberate use of before, during and after-reading comprehension monitoring and regulation strategies. For efficient reading, readers need to not only use their cognition but also

benefit from their metacognitive awareness. However, all students still need to monitor and regulate their own reading process for better comprehension. When deciding how to and what to train students with, it is important to be aware of what they possess and what they need (van der Stel & Veenman, 2010). The results of the study revealed that students showed some variations in their level of metacognitive awareness. Because of the differences in students' metacognitive knowledge and skills, it is always beneficial to know about the characteristics of target group to be trained.

In fact, training students with metacognitive strategies to enhance their reading comprehension had better be done by teachers who are knowledgeable enough about metacognition and its training. In such instructional environments, students can progressively hand over the strategy use, experience whole-class discussions, work in small groups, and finally work at individual levels to build up their metacognitive knowledge and skills repertoire. Thus, it should be noted that it is necessary for the preservice and in-service teachers to be instructed with metacognitive strategies and guided how to teach them.

Moreover, it can be expected that the more metacognitively aware the teachers, the more efficient they can be in helping their students to improve their academic performance. In Myanmar, it can be suggested that teacher education institutions including Yangon University of Education, Sagaing University of Education, and all the Education Degree Colleges across the country should take the responsibility of training the pre-service and in-service teachers to become metacognitively aware and to engage in higher level cognitive processing activities so that they can become more innovative and effective in teaching their students.

Based on the quantitative and qualitative findings of this study, it should be suggested that training students with metacognitive strategies requires a well-designed intervention program, as well. This is because, teachers being well-informed about metacognitive awareness and metacognitive strategies may not be enough to reach the ultimate goal. As learning emerges from the interaction of learners, materials and strategies, by paying attention to each component children's metacognitive strategy development can be supported as much as possible. So, training children with familiar texts can be helpful, because they not only activate children's background knowledge, but also lessen the mental load.

As a final recommendation, since this study spotlighted the current situations of high school students' metacognitive awareness and English reading comprehension ability, the findings of this study can be used as the knowledge base for teachers, educators and curriculum developers. This study could be beneficial to the students by providing the metacognitive ways of improving their comprehension ability. Additionally, the findings of this study could also help teachers by reminding them to adopt teaching methods that can promote the metacognitive awareness of their students. To sum up, this study could hopefully help high school teachers and students in Myanmar by providing the innovative and effective ways of teaching and learning English as a foreign language to some extent.

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INTEGRATING COLLABORATIVE LEARNING TECHNIQUES AND CONCEPT MAPPING IN TEACHING PHYSICS

INTEGRATING COLLABORATIVE LEARNING TECHNIQUES AND CONCEPT MAPPING IN TEACHING PHYSICS

Nann Yin Yin Moe*

Abstract

The main purpose of this study is to investigate the impact of using the proposed model based on the integration of collaborative learning techniques and concept mapping in teaching physics. To conduct this research, embedded design was adopted. In this research, qualitative data collection was embedded in the quantitative method. A quasi-experimental design was used as the quantitative design and a case study design was used as the qualitative design. Instruments like pretest, posttest, questionnaires, self-assessment forms, lesson plans prepared with the proposed model, and worksheets were used as the quantitative instrument. An observation checklist and semi-structured interview questions were used as qualitative instruments. A random sampling method was used to choose four high schools from Yangon Region. The purposive sampling method was applied for collecting qualitative data. Quantitative data findings were expressed in three parts. Quantitative findings by ANCOVA showed that the Physics achievements of students who were taught with an integrated collaborative concept mapping model were higher than the students who did not receive it. Attitudes questionnaires results by the Wilcoxon Signed Rank Test showed that there were positive attitudes changes were found by comparing before and post results. Friedman Test results of Self-assessment forms showed that the students who participated in experimental groups have improvements in all 5 Cs like collaboration, communication, critical thinking and problem solving, creativity and innovation, and citizenship across the three-time points. Qualitative findings revealed that the students and teachers who participated in experimental groups preferred this model, actively participated in the intervention periods, and are willing to apply an integrated collaborative concept mapping model in their teaching process. All the results proved that the integrated collaborative concept mapping model was supportive in teaching Physics concepts included in the new curriculum.

Keywords: Learning, Collaborative Learning, Concept, Concept Mapping, Collaborative Learning Techniques

Introduction

Education is a purposeful activity to facilitate learning to acquire knowledge, skills, values, beliefs, responsibility, and habits. In preparing learners for the world of work, requirements are exploring and developing one's own ability to: work collaboratively; communicate effectively and convince others with one's own ideas, and critical thinking and problem-solving skills. According to Khin Zaw (2001), the aims of education may be summed up under three aspects: to help the child to develop his personality; to relate himself to the society in which he lives, and to be an active and creative force in society. Every child comes into the world endowed with certain powers and potentialities. The work of education is to help him to develop all his powers in relation to one another, and to the whole personality, harmoniously, so that the result is an integrated and controlled personality.

Ideally, science teaching aims to encourage and enable students to develop inquiring minds and curiosity about science and the natural world; acquire knowledge, conceptual understanding, and skills to solve problems and make informed decisions in scientific and other contexts; develop skills of scientific inquiry to design and carry out scientific investigations and evaluate scientific evidence to draw conclusions; communicate scientific ideas, arguments, and practical experiences

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accurately in a variety of ways; think analytically, critically and creatively to solve problems, judge arguments and make decisions in scientific and other contexts; and demonstrate attitudes and develop values of honesty and respect for themselves, others, and their shared environment (MYP, 2007). Physics is one of the branches of science and therefore, it is so important to make students aware of these aims. Moreover, Physics teachers should always encourage students' scientific attitudes through meaningful learning and must concentrate on cultivating students' problem-solving attitude of mind along with teaching Physics concepts. Therefore, the main target is to develop a teaching model which is based on collaborative learning techniques and concept map creations that aims to cultivate the students to acquire deep conceptual understanding, problem-solving skills, communication skills, and social skills, and recognize the importance of science in their daily life and apply their acquired knowledge in their future learning.

1.1 Objectives of the Research

(1) To develop a model based on the integration of collaborative learning techniques and concept mapping

(2) To investigate the impact of using the model based on the integration of collaborative learning techniques and concept mapping on students' achievement in Physics

(3) To compare the attitudes of students towards Physics teaching through collaborative learning techniques and concept mapping

(4) To examine the attitudes of teachers towards using the proposed model in teaching Physics

(5) To explore the students' acquired soft skills along with teaching Physics concepts

(6) To suggest ways and means to improve the teaching of Physics

1.2 Research Hypotheses

1. There is a significant difference in achievement scores between Grade 10 students who will be instructed by using the model based on collaborative learning techniques and concept mapping and who will not receive it.
2. There is a significant difference in the attitudes of students towards learning Physics who will be instructed by using the model based on collaborative learning techniques and concept mapping before and after the intervention.
3. There is a significant difference in the attitudes of teachers towards using the model based on collaborative learning techniques and concept mapping before and after using this model.
4. There are significant changes in the students' acquired soft skills after teaching Physics with the proposed model.

1.3 Scope of the Study

- This study is geographically restricted to the Yangon region.
- Participants in this study are Grade Ten students from the selected high schools.
- This study is limited to the content areas of forces, pressure, work, and energy from the Grade Ten Physics textbook prescribed by the Basic Education Curriculum, Syllabus, and Textbook Committee, 2020-2021.

1.4 Definitions of Key Terms

Learning: Learning is a process that leads to change, which occurs as a result of experienced and increases the potential for improved performance and future learning (Ambrose, Bridges, DiPietro, Lovett, & Norman (2010).

Collaborative Learning: Collaborative learning is an umbrella term for a variety of educational approaches involving a joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product (Smith & MacGregor, 1992).

Concept: A concept may be thought of as a mental framework of an event or an object. Any event or object is a concept because it has some identifiable properties or ideas associated with it (NCERT, 2013).

Concept Mapping: Concept mapping is a technique that visually represents relationships among ideas (Novak & Gowin, 1984, cited in Collette & Chiappetta, 1989).

Collaborative Learning Techniques (Operational Definition): Collaborative learning techniques are the techniques used for general learning activities such as discussion, reciprocal teaching, problem-solving, information organizing, and collaborative writing.

1.5 Statement of the Problem

Understanding science often demands that concepts are grasped by the learners. When the student can apply the concept in a varying context, then it is claimed that the student has understood the concept (cited in Khan & Din, 2014).

To effectively explore the new educational system in Myanmar, the core unit of the whole enterprise of the teaching-learning process in the classroom need to be examined. In most of the classrooms in Myanmar, the classroom situation is dominated by teacher talk before. Teachers often disseminate knowledge and generally expect students to identify and replicate the fields of knowledge disseminated, in a flowchart of classroom communication, most of the directions point to or away from the teacher. Student-initiated questions and student-to-student interaction are atypical in the past decade.

Second, most teachers rely heavily on textbooks (Ben-Peretz, 1990, cited in Brooks & Brooks, 1993). His assumption is currently in line with the classroom situation in Myanmar. Most Myanmar teachers rely very much on the prescribed textbooks. They all mainly emphasized the concepts included in the textbooks. Often, the information teachers disseminate to students is directly aligned with the information offered by textbooks, providing students with only one view of complex issues, one setoff truths.

Third, although there exists a growing interest in cooperative learning in the current education system, most classrooms structurally discourage cooperation and require students to work in relative isolation on tasks that require low-level skills, rather than higher-order reasoning. Trying hard for completing homework given by teachers and lacking to discuss in the classroom need to be mainly considered.

Fourth, student thinking is devalued in most classrooms. When asking students questions, most teachers seek not to enable students to think through intricate issues, but to discover whether

students know the ‘right’ answers. Consequently, students quickly learn not to raise their hands in response to a teacher’s question unless they are confident, they already know the sought-after response.

Fifth, schooling is premised on the notion that there exists a fixed world that the learner must come to know. The construction of new knowledge is not as highly valued as the ability to demonstrate mastery of conventionally accepted understandings.

So, the above factors foster to the investigation of the effectiveness of using a model based on the integration of collaborative learning techniques and concept mapping in teaching physics for students to develop meaningful learning away from rote learning and enhance higher-order thinking skills throughout their learning process.

Review of Related Literature

Philosophical Foundations: Collaborative learning techniques and creating concept mapping are child-centered teaching and active learning process. Progressivism, constructivism, and social constructivism are deeply taken into account in this study. The progressives believe that learning should be an active process and that students should do much more than receive information passively. Experience and experiment are two keywords for the progressives (Kneller,1971, cited in Hessong & Weeks, 1991).

According to constructivism, individuals create or construct their new understandings or knowledge through the interaction of what they already know and beliefs and the ideas, events, and activities with which they come in contact. Knowledge is acquired through involvement with content instead of imitation or repetition. Learning activities are created by active engagement, inquiry, problem solving, and collaboration with others (Siddiqui, 2008).

According to the social constructivists, learning is self-governed, problem-based, and collaborative. Learning is considered to be an interactive activity between what is known and what is to be learned. Individual development derives from social interactions. Individuals construct knowledge in transactions with the environment, and in the process, both the individual and the environment are changed. Meaningful learning occurs when individuals are engaged in social activities such as interaction and collaboration.

Learning Theories: Piaget’s cognitive learning theory, Vygotsky’s socio-cultural learning theory, Ausubel’s meaningful learning theory, and information processing theory are also taken into account in developing the integrated collaborative concept mapping model. According to Piaget, the teachers will benefit when they understand at what levels their students are functioning. All students in a class should not be expected to operate at the same level (Wadsworth, 1996, cited in Schunk, 2012). Teachers can try to ascertain levels and gear their teaching accordingly. The students in grade ten fit with the formal operational stage. Students from Grade Ten can do mathematical calculations, think creatively, use abstract reasoning, and imagine the outcome of particular actions, and thus concept maps can be used as the proper tool for teaching concepts in Physics.

Vygotsky discusses the development of conceptual thinking, logical memory, and self-regulated attention. Helping students acquire cognitive mediators (e.g., signs, symbols) through the social environment involves the concept of instructional scaffolding. Reciprocal teaching comprises social interaction and scaffolding as students gradually develop skills. An important application area is peer collaboration, which reflects the notion of collective activity. Social interaction leads to more advanced cognitive development in the area of academic achievement.

Providing opportunities for children to interact with others forces them to think and communicate about their thought.

From the point of view of Ausubel's theory, for meaningful learning to occur, three requirements must be met. First, the material to be learned must itself have potential meaning. Secondly, the learner must possess relevant concepts and propositions that can serve to anchor the new learning and assimilate new ideas. Thirdly, the learner must choose to relate the new information to his/her cognitive structure in a non-verbatim, substantive fashion. If any of these three elements are lacking, meaningful learning cannot occur, at least in the initial stages of a given learning sequence.

Developing an Integrated Collaborative Concept Mapping Model

Teaching refers to an activity or process which is related to the impact of certain specific knowledge or skill, guiding and assessing, with the aim of assisting students to learn effectively. Today there is almost universal agreement that every learner must construct her/his own knowledge structure, or cognitive structure, through her/his own efforts. Students have multidimensional personality traits and different learning styles with numerous individual differences. These individual differences required different teaching strategies to match them.

The proposed new model was developed based on Dick and Carey’s model for the systematic design of instruction, Glaser's Basic Teaching Model, Ned Flanders Model of Interaction Analysis, Neocybernetic Psychology-Based Model of Talyzina, and Khin Zaw's Model of Multimodal. Moreover, for teaching problem-solving, Dewey's Problem-Solving Model is used in developing the proposed model.

The proposed model, an integrated collaborative concept mapping model (See Figure 1), is intended to contribute to Physics teaching by dealing with teaching concepts and solving problems to be a more active learning process and more meaningful. This model consists of three main components. They are planning, instructional maneuver phases, and evaluation.

In the first component, planning, the teachers have to decide the learning contents and prepare the relevant mastery concept map. Then the teachers set down the instructional goal, what the instructors hope the learners will learn from the given contents, and the learning objectives describing what the learners will be expressed to learn acquired by the end of a defined period. Based on these goals and objectives, the teachers prepare relevant test items to check whether the learning objectives are acquired at the end of the instruction as a text worksheet. In addition, instructional technique suited for the learning contents is considered, and then instructional materials called teaching aids such as charts or maps or worksheets, or suitable materials for teaching need to be prepared by the teacher before teaching. All of the requirements for this component are arranged by the teacher.

In instructional maneuver phases, the preliminary phase such as recalling prior knowledge, linking new knowledge (Pre), grouping; the expounding phase such as expounding the theory/concept, linking new knowledge (During), identifying the focus problem; exploration phase such as guiding for constructing concept maps, approaching drawing maps, group problem solving is involved. In the preliminary phase, the teacher assesses students’ prior knowledge to link prior knowledge to the new one by using concept maps or questioning techniques and groups the learners as the assigned collaborative techniques. In the second phase, the students first conducted the hands-on activities with the lab worksheets concerned with the learning contents by participating in group work actively. They all explored their ideas and thought by negotiating among members

and presenting the finding facts to the class. The third phase is the exploration phase in which the students have the chance to share ideas and ways to find solutions to be interactive in the classroom. And the last phase, the closure phase is composed of summarizing the concepts/solutions. The final step of the model is the evaluation in which Formative Assessment (Pre-Instruction), Summative Assessment (Post Instruction), and feedback processes are included.

The third component of this proposed model is evaluation in which the students have the responsibility to answer the test worksheet for each lesson respectively. This is also called the summative evaluation. If the time is not enough in the teaching period, this test worksheet is delivered to the students as homework and then feedback is conducted in the next period by discussing the answers and checking the previous knowledge at that period

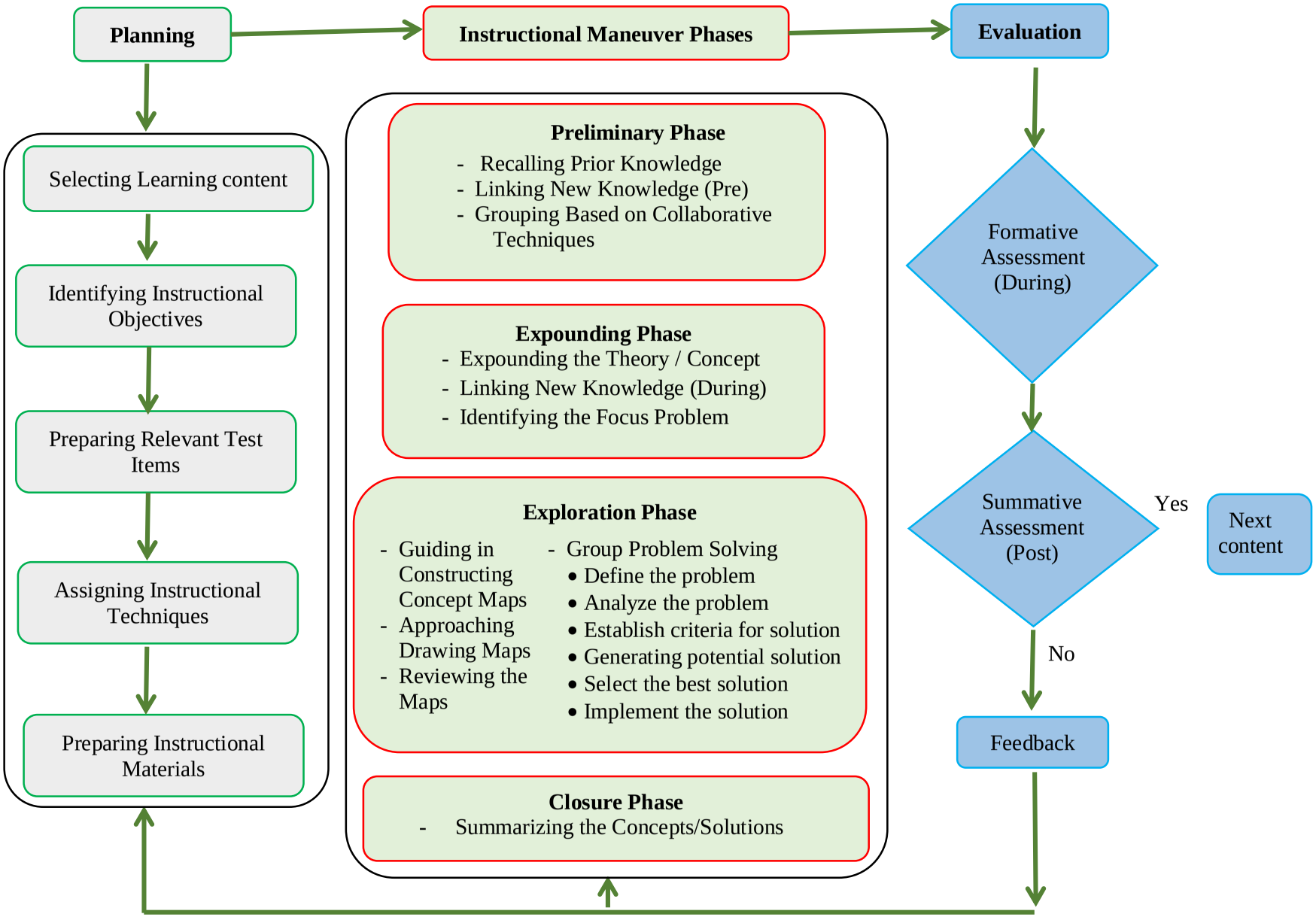
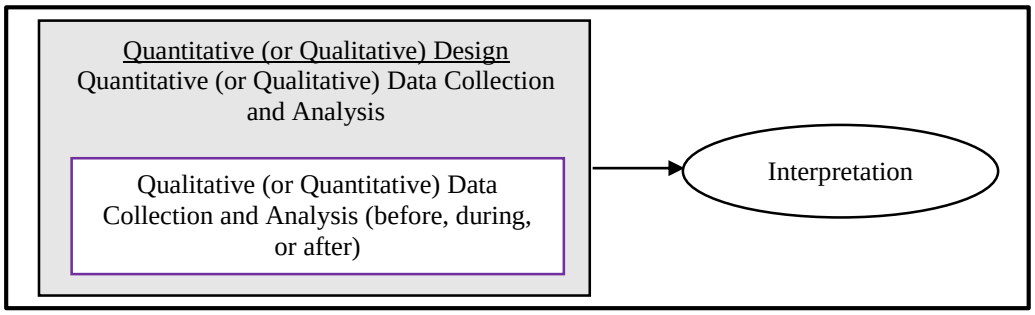


Figure 1 An Integrated Collaborative Concept Mapping Model

Research Method

4.1 Research Design: In this study, one of the mixed-method research designs, the embedded design (See Figure 2) was used in which the qualitative method was embedded in quantitative research. Quantitative data was primary and qualitative data was secondary data to support the findings of quantitative results.



Source: From Creswell and Plano Clark (2011), p. 111.

Figure 2 The Embedded Design

Quantitative Research Design: As the experimental research design, a nonequivalent control group design was chosen. Population and sample size are described in Table 1.

Table 1 Population and Sample Size for Quantitative Research

Region	District	Township	School	No. of Population	No. of Sample		Group
Yangon	East	North Okkalapa	No. (3) BEHS	125	50	25	Experimental Group
						25	Control Group
	West	Bahan	No. (2) BEHS	183	42	21	Experimental Group
						21	Control Group
	South	Thanlyin	No. (2) BEHS	102	44	22	Experimental Group
						22	Control Group
	North	Mingaladon	No. (1) BEHS	230	64	32	Experimental Group
						32	Control Group
	Total			640	200	100	Experimental Group
						100	Control Group

Note: BEHS = Basic Education High School

Qualitative Research Design: In this research, a case study research design was utilized to conduct an in-depth study on the process of teaching situations in accordance with the proposed model.

Population and Sample Size for Qualitative Research

Table 2 shows the population and sample size for the qualitative study. As shown in this table, (100) sample students who participate as experimental group participants and (4) teachers, and (32) students were selected to collect data for the qualitative study.

Table 2 Population and Sample Size for Selected Schools (Qualitative Study)

District	Township	School	No. of Subject for Questionnaire		No. of Subject for Interview	
			Teacher	Student	Teacher	Student
East	North Okkalapa	No. (3) BEHS	1	25	1	8
West	Bahan	No. (2) BEHS	1	21	1	8
South	Thanlyin	No. (2) BEHS	1	22	1	8
North	Mingaladon	No. (1) BEHS	1	32	1	8
Total			4	100	4	32

Note: BEHS = Basic Education High School

4.2 Instruments

Pretest, posttest, self-assessment form, and questionnaires were used as quantitative research instruments, and semi-structured interview questions and observation checklists were used as qualitative research instruments.

4.3 Procedure

The model was developed and required instruments and lesson plans were prepared first. After taking validation, a pilot study was conducted. Qualitative data were collected before intervention by interviewing and administering questionnaires to both the students and teachers. After that, the intervention was followed. During the intervention, observation checklists and self-assessment forms were used. The self-assessment form was utilized for the three-period; the first week of the intervention, the middle of the intervention, and at the end of the intervention. Finally, a posttest was administered to both groups. Then interviewing process was conducted again. After collecting the data, the data were prepared for analysis with SPSS.

4.4 Data Analysis

Statistical Package for the Social Science (SPSS) was mainly used to generate descriptive statistics to compare the achievement results of students from both groups. One-way Analysis of Covariance (ANCOVA) was used to analyze the quantitative data, Wilcoxon Signed Ranks Test was used to know the differences between before and after intervention dealing with the attitude changes concerning the implemented model. And Friedman Test was also used to show the improvements of soft skills which are compared among three times points. Descriptive statistics (percentage), was used to know the attitudes of the students involved in the experimental groups towards the proposed integrated collaborative concept mapping model and the attitude of teachers who taught the experimental groups with this model. Interview data and data from observation checklists were interpreted by using Thematic Analysis according to Miles and Huberman (1994).

Research Findings

In this research, two parts of research findings were presented systematically. The first one is quantitative findings and the second one is qualitative findings.

5.1 Quantitative Research Findings: One-way analysis of covariance (ANCOVA) to reveal the results for hypothesis H1: there is a significant difference in achievement scores between Grade Ten students who are instructed by using the model based on collaborative learning techniques and concept mapping and who do not receive it. The following table 3 described the initial results in four schools.

Table 3 Analysis of Covariance (ANCOVA) Results of Pretest Scores on Initial Ability in Four Schools

School	Group	N	M	SD	MD	*F*	*p*	Partial Eta Squared
S1	Experimental	25	33.08	3.43	- 4.00	9.603	.003**	.16
	Control	25	37.08	5.46				
S2	Experimental	21	26.57	7.16	2.24	1.245	.271(ns)	.03
	Control	21	24.33	5.76				
S3	Experimental	22	27.68	8.09	-12.36	36.258	.000***	.46
	Control	22	40.05	5.21				
S4	Experimental	32	32.88	2.11	3.36	8.915	.004**	.12
	Control	32	29.78	5.47				

Note: S1 = No. (3) Basic Education High School, North Okkalapa, S 2 = No. (2) Basic Education High School, Bahan, S 3 = No. (2) Basic Education High School, Thanlyin, S 4 = No. (1) Basic Education High School, Mingaladon, ns = not significant, $^{***}p < .001$. $^{**}p < .01$.

There were significant differences between the initial knowledge of experimental groups and control groups in school 1, school 3, and school 4. According to the result of school 2, there was no significant difference between the two groups.

Table 4 Analysis of Covariance (ANCOVA) Results of Pretest Mean Scores on Cognitive Levels in Overall Schools

Level	Group	N	M	SD	MD	*F*	*p*	Partial Eta Squared
Remembering	Experimental	100	1.96	0.95	-0.39	7.984	.005**	.039
	Control	100	2.35	0.99				
Understanding	Experimental	100	12.30	2.19	-0.03	.006	.938(ns)	.000
	Control	100	12.33	3.16				
Applying	Experimental	100	10.68	3.20	-2.01	15.053	.000***	.071
	Control	100	12.69	4.07				
Analyzing	Experimental	100	1.92	0.63	0.15	2.817	.095 (ns)	.014
	Control	100	1.77	0.63				
Evaluating	Experimental	100	3.60	1.76	0.02	.008	.930(ns)	.000
	Control	100	3.58	1.43				
Total	Experimental	100	30.46	6.08	-2.26	5.078	.025*	.025
	Control	100	32.72	7.97				

Note: ns = not significant, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 4 shows the pretest mean scores of each level for all schools. There was no significant difference on understanding, analyzing and evaluating level, but there were significant differences on remembering, and applying. Based on the results of pretest mean scores, the control group is higher on the level of remembering, applying, and the overall results than the experimental group prior to the intervention. The post-test results on Physics achievement in four schools are presented in Table 5.

Table 5 Analysis of Covariance (ANCOVA) Results of Posttest Scores on Physics Achievement in Four Schools

School	Group	N	Unadjusted M	Adjusted M	MD	*F*	*p*	Partial Eta Squared
S1	Experimental	25	24.00	24.61	4.78	21.23	.000***	.150
	Control	25	20.44	19.83				
S2	Experimental	21	29.48	29.05	11.24	15.40	.000***	.070
	Control	21	17.38	17.81				
S3	Experimental	22	24.95	26.67	14.06	25.91	.000***	.075
	Control	22	14.32	12.61				
S4	Experimental	32	27.00	26.68	14.92	223.02	.000***	.053
	Control	32	11.44	11.76				

Note: ***$p < .001$.

After adjusting for pre-intervention scores (pretest scores) as covariate, there were significant differences between the two groups on post-intervention scores (posttest scores) on Physics achievement according to the adjusted mean scores for school 1 (24.61,19.83) and F (1,47) = 21.23, p =.000, for school 2 (29.05,17.81) and F (1,39) = 15.40, p =.000, for school 3 (26.67,12.61) and F (1,41) = 25.915, p =.000, and for school 4 (26.68,11.76) and F (1,61) = 223.026, p =.000. From the above data, it can be interpreted that the two groups from each school were not the same on the dependent variable because their mean scores showed that the experimental groups have better achievement on the Physics achievement test than the control groups. It can be assumed that the students of experimental groups gained a significant effect due to the utilization of an integrated collaborative concept mapping model in teaching Physics.

Table 6 Analysis of Covariance (ANCOVA) Results of Posttest Scores for Cognitive Levels on Physics Achievement in All Schools

Level	Group	N	Unadjusted M	Adjusted M	MD	*F*	*p*	Partial Eta Squared
Remembering	Experimental	100	2.08	2.12	0.89	32.83	.000***	.039
	Control	100	1.27	1.22				
Understanding	Experimental	100	11.01	11.01	4.12	99.10	.000***	.010
	Control	100	6.88	6.87				
Applying	Experimental	100	9.36	9.53	3.87	54.48	.000***	.029
	Control	100	5.83	5.66				
Analyzing	Experimental	100	1.29	1.30	0.40	14.86	.000***	.019
	Control	100	0.91	0.89				
Evaluating	Experimental	100	2.58	2.57	1.89	66.02	.000***	.004
	Control	100	0.68	0.68				
Total	Experimental	100	26.32	26.53	11.17	143.92	.000***	.039
	Control	100	15.57	15.36				

Note: $^{***}p < .001$.

As shown in Table 6, the adjusted mean values of the one-way analysis of covariance for the respective levels of overall schools are presented. Based on these results, demonstrates that there were significant differences in the post-test mean scores between the experimental group and control group on all of the separated level questions. Therefore, it can be interpreted that utilizing the proposed model, an integrated collaborative concept mapping model, in teaching Physics can support improving higher-level thinking skills, especially analyzing, and evaluating skills. The implemented reform new curriculum can also improve the higher-order thinking skills because it focuses on using collaborative learning techniques in the current situation. Nevertheless, the proposed model, an integrated collaborative concept mapping model, supplies to improve the conceptual understanding of dealing with Physics according to the results of this research.

5.2 Findings of Wilcoxon Signed Rank Test for Students' Attitudes Questionnaires

In using Wilcoxon Signed Rank Test, the Z value and the associated significance levels presented as Asymp. Sig. (2-tailed) need to be checked. If the significance level is equal to or less than .05, the difference between the two scores is statistically significant (Pallant, 2010).

Table 7 Wilcoxon Signed Rank Test Results for Students' Attitudes

School	No. of Participant	Components	Before Md	After Md	z	Asymp. Sig(2-tailed) *p*	*r*
S1	25	AP	46	59	-3.217	.001**	.45
		ACLT	54	62	-2.755	.006**	.38
		ACM	50	60	-3.609	.000***	.51
S2	21	AP	51	58	-3.340	.001**	.51
		ACLT	56	60	-2.368	.018*	.36
		ACM	49	60	-3.981	.000***	.61
S3	22	AP	55	59	-2.243	.025*	.33
		ACLT	58	64	-2.634	.008**	.39
		ACM	53	60	-3.738	.000***	.56
S4	32	AP	51	55	-3.071	.002**	.38
		ACLT	59	63	-1.822	.068(ns)	.22
		ACM	48	58	-4.509	.000***	.56
All four schools	100	AP	52	58	-6.001	.000***	.42
		ACLT	58	62	-4.758	.000***	.33
		ACM	50	60	-7.914	.000***	.55

Note: AP = attitudes towards Physics, ACLT= attitudes towards collaborative learning techniques, ACM= attitudes towards creating concept maps, Md = Median, ns= not significant, $^{***}p < .001$. $^{**}p < .01$. $^{*}p < .05$.

In all four schools as the overall results as shown in Table 7, Wilcoxon Signed Rank Test revealed a significant difference dealing with attitudes towards Physics, collaborative learning, and creating concept map between before intervention (Time 1) and after intervention (Time 2), Z = -6.001, -4.758, -7.914, p = .000, .000, .000 (p = <.000), with medium and large effect size (r = .42, .33, .55). The median score on the attitudes towards Physics increased from before intervention (Md = 52) to after intervention (Md = 58). The median score on the attitudes towards collaborative learning techniques increased from before intervention (Md = 58) to after intervention (Md = 62). The median score on the attitudes towards creating concept maps increased from before intervention (Md = 50) to after intervention (Md = 60). It can be interpreted that the positive attitudes dealing with the three components increase after the intervention and there was a significant difference in the attitudes of students towards learning Physics who were instructed by using the model based on collaborative learning techniques and concept mapping before and after intervention in all four schools.

5.3 Friedman Test Results for Self-Assessment Form Linking to 5 Cs

The assessment form contains five components for 5 Cs and is administered to the participants at least three times (the first week of the intervention, in the middle of the intervention, and at the end of the intervention). According to Pallant (2010), in analyzing these data, one sample of participants, measured on the same scale or measured at three different time periods is required. Therefore, the collected data were analyzed by using Friedman Test. In analyzing these data, Asymp. Sig. level, median, and mean rank are required to compare the results. Comparing mean rank is the main fact in deciding whether there is an improvement or not dealing with the testing area causes of the treatment. If the mean ranks are increasing, it can be interpreted that there is an improvement.

Table 8 Friedman Test Results of Self-Assessments on 5 Cs in Overall Schools

School	No. of Students	5 Cs	Mean Ranks			Md (Median)			*df*	*Chi-Square* X^2	*p*
			B	D	A	B	D	A			
All four schools	100	C1	1.67	1.88	2.46	18	19	20	2	37.358	.000***
		C2	1.59	1.86	2.56	17	18	20	2	57.926	.000***
		C3	1.73	1.83	2.45	16	17	19	2	34.381	.000***
		C4	1.50	1.96	2.55	16	18	20	2	62.695	.000***
		C5	1.72	1.96	2.32	19	19	20	2	20.494	.000***

Note: C1 = Collaboration, C2 = Communication, C3 = Critical Thinking and Problem Solving, C4 = Creativity and Innovation, C5 = Citizenship, B = Before, D = During, A = After, $^{***}p < .001$.

The expressed data can be interpreted that there is a change in skills dealing with 5 Cs across three time periods. Comparing the Mean Ranks for the three sets of scores as shown in Table 8, it appears that there were improvements in all 5 Cs such as collaboration, communication, critical thinking and problem solving, creativity and innovation, and citizenship over time in all participants. It can be interpreted that applying an integrated collaborative concept mapping model in teaching physics let the students improve their soft skills along with learning deep Physics concepts.

5.4 Qualitative Research Findings: Based on the research design, qualitative data was collected first because the qualitative phase of the study is intended to provide data to support or supplement the quantitative data from the experimental design. In this design, semi-structured interviews and observation (during) were conducted before intervention and after the intervention. The validity of the qualitative results can be enhanced by the quantitative results. There are two parts to qualitative data. These qualitative research findings are calculated by using Descriptive statistics by frequencies (to present the results of the responses as a percentage), and thematic analysis for both interview and observation data.

Findings of Students'/Teachers' Interview: Thematic analysis results for students/teachers' interview responses are expressed in tabulated forms (See Table 9 and 10).

Table 9 Display Data for Students' Interview Responses

No.	Main Themes	Sub Themes	Responses	Before	After
1	Attitudes on Physics Learning	Reasons of learning	- Interested in Physics/calculation - As a subject/including in curriculum - Support for further learning - Associated with daily life	- 44% - 34% - 9% - 13%	- 53% - 9% - 19% - 19%
		Like/ Dislike	- Like - Dislike	- 78% - 22%	- 91% - 9%
		Usefulness for self	- Useless - No answer (Silence) - Usefulness	- 6% - 16% - 78%	- 3 % - 0 - 97%
		Teaching methods	- Formal teaching - Proposed model	- 100 %	- 100%
		Effectiveness for daily life	- Not accept the assumption - Accept assumptions	- 25% - 75%	- 16% - 94 %
		Extra learning	- No - Yes (Google / YouTube)	- 66% - 34%	- 13% - 87%
2	Attitudes towards Collaborative Learning Techniques	Learning style	- Individual learning - Group learning	- 6% - 94%	- 3% - 97%
		Understanding	- No answer (Silence) - Unknown exactly - 4 or 5 per group work together - Cooperation - Sharing knowledge - Collaboration (work by group)	- 16% - 31% - 31% - 3% - 13% - 6%	- 0 - 3% - 6% - 0 - 3% - 88%
		Enjoying	- Dislike - Like	- 16% - 84%	- 0 - 100%
		Assigning Groups	- Group by teacher - Group by wish	- 81% - 19%	- 100% - 78%
		Kinds of a well-organized group	- Academic (good, fair, poor) - Unity/ active / negotiation/ social - 4/5/6 per group (members) - Good intelligence - No answer (Silence) - Responsibility	- 25% - 31% - 31% - 6% - 6% - 0	- 31% - 34% - 0 - 0 - 0 - 34%
		Assigning Tasks	- Assign tasks for individual - Solve by the strength of unity	- 91% - 9%	- 0 - 100%
		Motivation	- Help each other	- 100%	- 100%
		Assessment	- Assess by teacher - Assess by peer - Not assess	- 100 % - 81% - 19%	- 0 - 100% - 0
		Benefits	- Friendships, Social interaction skills, Communication skills	- 100%	- 100%
3	Attitudes on Creating Concept Maps	Experience	- Learnt before (accept) - Learnt before (not accept)	- 0 - 100%	- 100%
		Interest	- Uninteresting - Interesting	- 6% - 94%	- 0 - 100%
		Usefulness	- No answer (Silence) - Identify misconceptions	- 63% - 38%	- 0 - 100%
		Benefits / Drawbacks	- No answer (Silence) - Benefits	- 41% - 59%	- 0 - 100%

Table 10 Display Data for Teachers' Interview Responses

No.	Main Themes	Sub Themes	Responses	Before %	After %
1	Understanding Collaborative Learning Techniques	collaboration	- Exchange ideas/knowledge	- 50%	- 100%
		an effective learning group	- Academic (good, fair, poor) - Competition groups - Heterogeneous groups	- 25% - 25% - 25%	- 100%
		Causes	- Competitions - Cooperation - Sharing knowledge - Negotiation	- 25% - 25% - 25% - 25%	- 100%
		Consideration facts	- Individual ability, Fair groups - Heterogeneous, Intelligence	-75%	- 100 %
		Difficulties	- Time-consuming	-100%	- 100%
		Ways of grouping	- School Council Teams - Rows - Heterogeneous groups - Randomly	- 25% - 50% - 25%	- 0 - 0 - 0 - 100 %
2	Assessment	Participation	- Active participation - Check around the group	- 50% - 50%	- 100%
		Exchanged strategies	- Explaining again but coach - Asking easy questions	- 100 %	- 100%
		Improvements	- Assess by looks	- 100 %	- 100 %
3	Expected Outcomes	Skills	- Observation / Social skills	- 100%	- 100 %
		Feelings	- Good if time enough	- 100 %	- 100%

According to the results of the observation checklist for teachers (expressed in table 11) the teachers who taught the experimental groups are trying to enhance the preparation steps, implementing the expounding and exploration phases as much as they can. Cause of their hard-working manner, they performed well in the later process for all phases. Therefore, teaching Physics concepts with an integrated collaborative concept mapping model succeeded in 80 %.

Table 11 Results of Classroom Observation Checklists for Teachers

Phases	Observed Factors	Frequency	%
Preliminary Phase	1. Begins class on time.	74	77.03 %
	2. Review prior class concepts.		81.9 %
	3. Appears well-prepared for class.		79.2 %
	4. Related today's lesson to previous.		83.8 %
	5. Provided clear directions for grouping.		83.8 %
Average %			**81.1 %**
Expounding Phase	1. Used good examples to clarify points.	74	77 %
	2. Provided group tasks.		78.4%
	3. Related new ideas to familiar concepts.		79.7%
	4. Explained major/ minor points with clarity.		84.3 %
	5. Defined unfamiliar terms, concepts, and principles		81.9%
	6. Emphasized important points.		85.7 %
	7. Responded appropriately to non-engaged students.		81.9%
	8. Effectively managed time.		81.6%
	9. Identify the focus concept or problems.		84.1%
	10. Explicitly states relationships.		85.9%
Average %			**82.1%**
Exploration Phase	1. Monitor every group's activity all the time.	74	81.4%
	2. Actively encouraged student questions.		83.8%
	3. Treats class members equitably.		83.2%
	4. Encourages mutual respect among students.		83.8%
	5. Provides enough time for reviewing the maps.		81.9%
	6. Allows sufficient time for completion.		84.6 %
	7. Provides enough time for problem-solving.		85.7%
Average %			**83.5 %**
Closure Phase	1. Summarize the concepts together with all the students.	74	81.9 %
	2. Evaluate the concepts maps or solutions.		82.2 %
	3. Deliver the evaluation test questions.		84.9 %
Average %			**83 %**

According to the results of observation checklists for students (expressed in the following table 12), most of the students actively participated in the learning process by talking to their members and also to teachers, showing various angles of view, and accepting questions without focusing on the right and wrong aspects. Some of them did not learn well and did not give their assumptions dealing with the lessons to their group member at first. All the students got the opportunities to act, learn and understand the need to work in groups. Although they were not interested in teaching, they all conducted group work actively and happily. Notwithstanding absence in a group discussion by learning passively in the first teaching period, they later actively participated in learning because of their teacher's motivation and their classmates' active participation. From the observation, some participants did not accept to create the concept maps

because of time-consuming. They all wanted the readymade concept maps for the Physics concepts and they all liked to learn with these created concept maps.

Table 12 Results of Classroom Observation Checklists for Students

Main Themes	Observed Factors	Frequency	%
Collaboration	Focused on team activities.	74	80.81%
	Stay in the group until the activities finish.		85.41%
	Demonstrate good self-control.		81.89%
	Ask useful questions to deepen the study.		81.89%
	Share information that they collected.		81.62%
	Share personal views.		81.08%
	Well prepared for group activities.		85.95%
	Explain ideas with clarity and appropriate concepts.		76.76%
	Give helpful feedback.		75.14%
	Accept useful feedback.		75.14%
Average %			**80.59**%
During Learning	Listen attentively.	74	92.97%
	Answer actively.		81.62%
	Asks misunderstanding facts at once.		84.05%
	Accept assigning group works.		96.76%
	Pay attention to other's sharing ideas.		81.89%
	Average %		**87.46**%
Creating Concept Maps	Well prepare to create a concept map.	74	78.92%
	Record the facts systematically.		78.92%
	Accept others' useful and helpful opinion.		79.19%
	Conduct interestingly.		82.43%
	Explain the created concept map clearly.		84.86%
Average %			**80.86**%

Summaries of the research findings are as follows:

- According to the quantitative results, the experimental groups scored significantly higher than the control groups on achievement scores.
- According to the qualitative results, there were significant differences in the attitudes of students towards learning Physics who were in experimental groups before and after the intervention. Their attitudes changed positively.
- According to the responses of teachers, there were slight changes in the attitudes towards using the proposed model before and after the intervention.
- According to the Fried man test results, there were significant changes in the students' acquired soft skills after intervention in all schools.
- According to the results of thematic analysis for observation and interview, the students who participated as experimental group members actively participated in the intervention periods.

Discussion, Suggestions, Recommendations, and Conclusion

Discussion

The results of the teachers' interview suggested that the integrated collaborative concept mapping model increases the students' interest in learning the concept of Physics, and attracts the students' attention to a more active learning process in teaching Physics. Furthermore, the teachers answered that exchanging new ideas and knowledge, participating actively in group work, increasing the ability to ask the unknown facts at once, and improving problem-solving skills are the supportive facts of utilizing the Integrated Collaborative Concept Mapping Model in teaching Physics for the students. From the points of students' interview, most of the students answered that learning with this model let them change their attitudes towards Physics learning. They all enjoyed learning Physics concepts with the Integrated Collaborative Concept Mapping Model because their ability to work collaboratively increase obviously. Moreover, they all accepted that creating a concept map can help them to understand the concepts related to Physics, identify the concept, link prior knowledge via concept maps, easily summarize the concepts, and improve knowledge. And then they expressed the effect of using concept maps that it lets them recognize the concept easily, and increases the retention rate. This finding is in agreement with the results of quantitative research findings. It is also highlighted that the Integrated Collaborative Concept Mapping Model should be used in teaching Physics in order to improve the students' Physics learning. From the above observing facts, it is also pointed out that the first objective, to develop a model based on the integration of collaborative learning techniques and concept mapping, has been implemented successfully.

Impact of using the proposed model on Physics achievement: On the overall Physics achievement, there were significant differences in initial knowledge of Physics for the pretest between the control and experimental groups. Based on the overall results, showed that the control groups had more initial background knowledge of Physics than the experimental groups. But the results of the one-way analysis of covariance (ANCOVA) for posttest scores conversed with the initial results. The ANCOVA results showed that the students from the experimental groups performed better than those who participated in the control groups in overall achievement in Physics. Therefore, it can be interpreted that the use of the proposed model, An Integrated Collaborative Concept Mapping Model, significantly improves the students' achievement in Physics causes of increasing their conceptual understanding. This result is in line with the study of Doris (2018) that the students who taught with the concept mapping mode of instruction performed significantly better than those taught with conventional modes. This study recommended that teachers should imbibe the concept mapping method in the teaching of Physics to enhance students' comprehension and identification of relationships that exist between concepts and creativity.

Attitudes Results of Students: Significant improvement was found in the students' attitudes towards Physics when interviewing 32 students who were selected purposively from the experimental groups. The percentage results indicated that the Integrated Collaborative Concept Mapping Model performed better in positive attitude changes. This study is in line with the result obtained from the study of the effect of concept mapping on attitude and achievement in a Physics course conducted by Karakuyu (2010) that expressed that the experimental group students were observed to have a tendency of more positive attitude than the control group students.

Wilcoxon Signed Rank Test for students' attitudes questionnaires revealed significant differences dealing with attitudes towards Physics, collaborative learning, and creating concept maps between before intervention (Time 1) and after intervention (Time 2) in school 1, school 2,

school 3, and school 4. But no significant difference was found in attitudes towards collaborative learning in school 4.

Soft Skills Improvement: Friedman Test results showed that the improvement was found in all the collaboration skills, communication skills, critical thinking and problem-solving skills, creativity and innovation skills, and citizenship. There were statistically significant differences in self-assessment scores across the three-time points. It can be interpreted that Integrated Collaborative Concept Mapping Model enhances students' soft skills.

Moreover, using the integrated collaborative concept mapping model in teaching Physics can enhance students' positive attitudes towards Physics learning. Thus, it can be said that the second research hypothesis was accepted by these findings.

Attitudes Results of Teachers: The results from teachers' questionnaires analyzed by descriptive statistics showed that the participated teachers had positive attitudes towards the nature of collaborative learning and stated that 75% of teachers accepted the assumptions from questionnaires before the intervention and changed 100% of their positive attitudes completely on the use of this model in their teaching Physics. Therefore, it can be interpreted that the Integrated Collaborative Concept Mapping Model can be supportive in teaching Physics to be a more active learning process. The results of observation showed the implementation percentage of the Integrated Collaborative Concept Mapping Model. The results showed that 80% were successful in implementing this model. Causes of their hardworking manner to implement this teaching process, the expected results were obtained. Therefore, it can be interpreted that teachers' attitudes towards the proposed model changed over time properly when comparing Time 1 and Time 2. The interviewee teachers agreed that the Integrated Collaborative Concept Mapping utilizing is more valuable for them if they have time enough. In the current situation, they have insufficient time to implement this model completely in their teaching. Nevertheless, from the finding of the teachers' interviews, it can be interpreted that this Integrated Collaborative Concept Mapping Model is effective in teaching Physics. The results of observation showed that 80% were successful in implementing this model. Causes of their hardworking manner to implement this teaching process, the expected results were obtained. Therefore, it can be interpreted that teachers' attitudes towards the proposed model changed over time properly when comparing before and after the intervention.

Suggestions

Suggestions for Physics Teachers: Teachers should exactly know what collaboration is, how to use it, and the usefulness of concept map creation in their teaching. They should know the grouping nature in using collaboration. They could review each group's performance to monitor participation and progress and intervene when the need arises. They should explain the purpose and usefulness of a task before students carry out the task. This arouses the learners' interest. Moreover, they should be careful in a collaborative learning environment that how to divide the learners into optimal teams, how to train students' social skills, and how to foster supportive interactions between group members should be considered as issues.

Johnson and Johnson (1989) concluded that interactive discussion is a key factor in the development of higher-order cognitive strategies in collaborative learning. The process of interaction with peers for solving problems and creating concept maps via collaboration can crease learning motivation and thus results in better memorization and a deeper understanding of learning topics. Therefore, the teacher should give their attention to students' performance throughout their teaching period to be able to nurture to acquire these properties for students.

Suggestions for Physics Students: According to Pabon-Galan, Hernandex-Suarex, and Paz-Montes (2021), the use of concept maps in the teaching-learning process of Physics allowed for classifying and categorizing information; assimilating information, ideas, and concepts; finding connections between various concepts; supporting creative thinking; using graphic and schematic relationships effectively instead of using written or verbal descriptions; creating relationships between already known concepts; helping in problem-solving among others. Therefore, all the students should be suggested that collaborative concept mapping is not a boring technique, and is capable of systematically study with it by giving proper time, a deep understanding of Physics concepts and the expected achievement in Physics can be acquired.

Suggestions for School Administrators: Some of the suggestions are given for school administrators. Although the reformed new curriculum for Physics included using collaboration and the summary concept maps at the ends of each chapter, during the intervention period, it was found that in the other classroom, the teaching style of teachers needs to be changed completely to student-centered. Therefore, school administrators play a critical role in improving the overall academic progress of students and in implementing the reformed new curriculum in the Basic Education sector in Myanmar. In order to be sure teachers' understanding of dealing with the reformed new curriculum and its aims for twenty-first-century skills, school administrators should observe the activities of teachers' daily teaching approaches. Moreover, as school administrators, if possible, encouraging, supporting, discussing, and giving feedback on the teachers' teaching styles should be conducted. Then, the teachers need to be trained or discussed the teaching approaches in the CPD (Continuous Professional Development) period which was conducted one time per month by school administrators or by subject deans. In this research, it was found that most teachers still prefer using the teacher-centered approach in teaching Physics. This may be due to the fact that during the current situation of the Covid-19 Pandemic, the time to open the school was late, and they all try hard to complete the syllabus in time. Nevertheless, school administrators themselves should learn and watch the current reformed trend of curriculum, and then check whether the teachers are also in line with the reformed curriculum or whether they cover the reduced content during the Covid-19 Pandemic. Furthermore, school administrators should foster to change the teachers' teaching styles as much as they can owing to teachers' preference on teacher-centered approaches although the education system has been changed since 2016-2017 academic year.

In Myanmar, the current reformed new curriculum was implemented in the 2016-2017 Academic Year. The developing secondary high school Physics course for Grade Ten was completed in the 2019-2020 Academic Year. The teachers were trained during summer vacations. All the teachers experienced this collaborative learning nature at once and so they all have difficulties applying it in their classroom. Hence, it should be suggested that the extra training program or workshop for collaborative learning techniques need to be conducted further for teachers to be skillful. Symimgton and Novak (1992, cited in Mistades, 2009) found that primary grade students are capable of developing very thoughtful concept maps, which they can explain intelligently to others. This observation led the researchers to explore even more the value of concept maps in organizing the instructional material and helping students learn this material including this current research. In other countries, concept map creation is studied with computers. In this research, although the students performed the creation of concept maps with paper and pencil, they all proved that it is very beneficial for them. Therefore, if it is possible, the required computers should be supported for each school.

Recommendations

1. According to the obtained results of this current research, it is claimed that teaching Physics concepts with the Integrated Collaborative Concept Mapping Model can enhance the students' achievement in Physics along with a deep understanding of the concepts. Moreover, applying this model with formal procedures can prepare the students to explore and develop their own abilities to work collaboratively, communicate effectively and convince others with their own ideas and critical thinking and problem-solving skills. Furthermore, it can improve the students' positive attitudes concerning learning Physics because it lets them acquire a deep understanding of the concept taught in the classroom.
2. For further implementation of concept mapping in the future and to enhance the enthusiasm of teachers in giving Physics courses; intensive training for the teachers is highly recommended to implement concept mapping not only in Physics but also in other disciples.
3. Students should be encouraged to draw a map of concepts of the topic being taught after teaching not only individually but also in the grouping.
4. In this study sample schools were randomly selected from Yangon Region. Further research should be carried out for the rest states and regions for replication.
5. This study was conducted for only three chapters from Physics Textbook (2020-2021). Further research should be carried out for the whole syllabus.
6. Some of the collaborative learning techniques were used in the present study. Other studies should be carried out by other collaborative learning techniques.
7. In this study, observation can be conducted by the researcher without taking video recording. Therefore, further research should be carried out with two observers if possible and should take the video recording.
8. In this study, the effectiveness of the proposed model was not evaluated through science process skills. It can also be evaluated by science process skills.

Conclusion

The Ministry of Education (MOE) is committed to improving the basic education curriculum to make it more relevant to the lives of students by focusing on 21st -century skills, soft skills (including personal development and employability skills), and higher-order thinking skills. According to the obtained results from this study, the use of the integrated collaborative concept mapping model is more supportive than formal instruction which was emphasizing the teacher-centered approach to teaching Physics concepts at the secondary high school level. Friedman Test results showed that the improvement was found in all the collaboration skills, communication skills, critical thinking and problem-solving skills, creativity and innovation skills, and citizenship. Thus, the integrated collaborative concept mapping model can enhance students' soft skills.

To sum up, the Physics teacher should avoid emphasizing the teacher-centered (giving explanation, questioning and answering, as well as doing homework) which do not provide opportunities for students to develop creativity and critical thinking. Emphasizing the learner-centered (letting students use the power of reason to enable a way of what to think and how their thinking processes are, through the learning methods of collaborative concept mapping, discovery, discussion, experimentation, and other methods) should be favored in the current 21st-century classroom. Collaborative concept mapping is an active learning strategy that moves the students

beyond rote memorization to critical thinking and is meaningful learning in the classroom both for teachers and students.

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THE EFFECT OF SOCIAL MEDIA MARKETING ON BRAND EQUITY OF MYANMAR COSMETICS

THE EFFECT OF SOCIAL MEDIA MARKETING ON BRAND EQUITY OF MYANMAR COSMETICS

Cho Mar Lwin*

Abstract

Social media marketing has become an indispensable tool for promoting customer engagement and brand equity of products with the advent of the internet. This study aimed to examine the effects of social media marketing, and customer brand engagement on brand equity of six selected Myanmar cosmetic brands. Both qualitative and qualitative methods were applied. In the qualitative method, sales managers and managers of cosmetic brands were carried out in-depth interviews. In the quantitative method, a questionnaire survey was conducted with 514 shoppers visiting seven shopping malls located in Yangon on the weekends during January, 2020 and January 2021, by using 3 in 1 systematic sampling method. The multiple linear regression (MLR) and path analysis were used to analyse quantitative data. The findings from MLR indicated that except word of mouth, social media advertising, social media sale promotion and interactive marketing have a positive and significant effect on the customer brand engagement of Myanmar cosmetics. Only social media word-of-mouth shows no significant effect on any element of brand equity. The path analysis indicated that the elements of customer brand engagement such as emotion, cognition, and intentional behaviour have partial mediation effects on brand equity of Myanmar cosmetics. The findings indicate that overall customer brand engagement serves a partial mediator between overall social media marketing and overall brand equity, thereby suggesting an intervening role played by customer brand engagement in translating the costly social media marketing practices into brand equity of Myanmar cosmetics brand. Brand managers of Myanmar cosmetics brands have suggested to develop an effective social media marketing procedures such as advertising, promotion and interactive marketing because proper implementation of these practices can improve customer brand engagement and then create high brand equity.

Introduction

Social media is the most powerful and fastest growing phenomenon of the 21st Century. Consequently, this social media development influences the marketing strategy and activities (Mooij, 2019). Social media has also opened the opportunity for customers to become active co-creators and co-managers of brand- related content on social media sites. With the rise of social media applications (Dholakia *et al.* 2004; Puchan, 2015), marketers are switching to various social media such as Twitter, Facebook, YouTube, Google, and Instagram. People use the internet their daily life activities such as searching for information on Facebook, and shopping via social media. Similarly, marketers implement integrated marketing practices through social media to reach their potential and current consumers.

While the importance of effective marketing strategies in brand building is vital, marketers have noted the benefits of social media sites in designing social media marketing strategies in recent years. Social media marketing includes social media advertising, social media promotion, social media interactive marketing and social media word-of-mouth. Social media provides brand managers with endless chances for sharing and posting information in the forms of photographs, videos, messages, and comments about their brands and companies through fan pages or brand profiles made on the platform (Vries *et al.*, 2012). Social media marketing helps organizations build positive customer relationships, improve their brand image, and help build and maintain successful brand equity (Bruhn, *et al.*, 2012).

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1.1 Problem Statement of the Study

The market for cosmetics is becoming very competitive since the country has become more market-oriented. The economic transition paved the way for the personal care industry with survey findings in 2016, the average expenditure on cosmetic products is about 3% to 7% of total income (Myanmar Consumer Survey data, 2016). The expenditure is low in comparison to other industrialized countries; however, the total revenue created by the industry is significant for Myanmar. Therefore, most cosmetics brands are entering the domestic cosmetics market via social media. For instance, Innis Free products introduce special kit sets at reasonable prices via Facebook pages. They enjoy popularity amongst many young consumers and homemakers who are fans of the "Korean Wave", brought to them by Korean TV dramas.

Meanwhile, local manufacturers are under pressure to bring competition with better quality and foreign brands' image. Most of the Myanmar customers perceive that Myanmar cosmetics are not worth it to them, and they do not want to pay a premium price on Myanmar cosmetics. This is an important challenge for domestic cosmetics manufacturers because Myanmar customers prefer foreign brands. Most Myanmar customers believed that foreign cosmetic brands are worthwhile to use. Moreover, customers perceive that using foreign cosmetics brands gives them more confidence, makes them more attractive and elegant. The advertisements, the contents, and informative information via social media attract Myanmar customers to engage with foreign cosmetics. In order to counter foreign competition and attract domestic customers, some of the local manufacturers are spending substantial amounts of money on marketing activities to raise awareness and gain customers' trust in their brands.

Therefore, the identification of marketing communication tools that will help building strong brand equity is critically necessary for Myanmar cosmetics products. Achieving this aim can not only help the survival and profitability of Myanmar's domestic firms but also indirectly contribute to the development of different local industries where major downstream and upstream activities are involved in the production of cosmetics. Thus, this research seeks to understand the ways social media marketing influence customer engagement through brand equity of cosmetics brands.

According to the research problems, this study will set forth to answer the following research questions:

1. Does social media marketing affect the brand equity of Myanmar cosmetics?
2. How does customer brand engagement mediate between social media marketing and brand equity of Myanmar cosmetics brands?

1.2 Objectives of the Study

The general objective of the study is to examine how brand equity could be promoted by social media marketing via customer brand engagement in Myanmar cosmetics brands. The specific objectives of the study are:

3. To analyze the effect of social media marketing on brand equity of Myanmar cosmetics brands.
4. To examine the mediation effect of customer brand engagement on the relationship between social media marketing and brand equity of Myanmar cosmetics brands.

Summary of Literature Review

This part presents a brief background of theoretical literature around social media marketing and brand equity.

2.1 Social Media

Social media are websites and other digital communication and information channels through which active consumers engage in certain behaviors. According to Brake and Safko (2009), social media refers to the activities, practices, and behaviors of individuals who gather online to share information, expertise, and ideas via conversational media. Over the post years, social media has gained enormous popularity among businesses and customers. The most prominent social networking sites currently in Asia are Facebook, Twitter, YouTube, LinkedIn, and Instagram. Despite LinkedIn is frequently utilized by businesses, Facebook, Twitter, and YouTube are the most common channels used by companies in online marketing to create brand awareness or customer engagement.

2.2 Social Media Marketing

Social media marketing is also a form of marketing communication and social media marketing consists of marketing activities using various social media. Research has identified that social media communication pertains to two forms of content: Firm-Created Content (FCC) and User-Generated Content (UGC). User Generated Content (UGC) permits end-users, rather than professionals, can create and exchange publicly available contents (Kaplan & Haenlein, 2010). They include social media advertising, social media promotion, and social media interactive. Social media word-of-mouth belongs to UGC. These tools are explained as follows.

2.2.1 Social Media Advertising

Any sort of content that is uploaded or shared on either fan pages or general social media walls is called social media advertising. Social media advertising is an important brand communication tool that can be used to promote ideas, goods, or services (Keller, 2009). Substantial amounts of marketing effort across industries are exerted on advertising for the purpose of building successful brands (Chi, 2011; Okazaki & Taylor, 2013). This is because advertising helps to popularize brands and evoke various types of brand associations in consumers' memories (Mizik & Jacobson, 2003).

2.2.2 Social Media Sale Promotion

According to Shen and Bissell (2013), sales promotions can be found in posts linked to sharing coupons, discount codes, product trials, and giveaways, among other marketing strategies employed on Facebook. Similarly, Taecharungroj (2016) affirmed that store promotion, product promotion, and campaign promotion are the major types of marketing communications that are shared on social media. It is critical to offer sales promotions such as price reductions, product trials, discounts, and reward announcements in order to build brand equity (Keller, 2009).

2.2.3 Social Media Interactive Marketing

One of the most common sorts of social media marketing activities and communications is interactive marketing (Abedniya & Mahmouei, 2010). One of the main reasons for social media's prominence as a medium for marketing communications and marketing activity is its interactive qualities (Burton & Soboleva, 2011). Social media interactive marketing involves engaging

prospective and current customers to engender a direct and effective connection with brands (Taecharungroj, 2016). Interactive marketing is also used to encourage people to make favorable purchasing decisions (Rohm et al., 2013).

2.2.4 Social Media Word-of-Mouth

According to Van Doorn et al. (2010), social media WOM has boosted consumers' role in the establishment of brand identity and brand equity development. It also has a stronger impact on consumer behavior, attitude, and response than other marketing messages (Wolny & Mueller, 2013). Because of the importance of social media WOM, research has been conducted in a variety of approaches. Some research looked at the role of social media word-of-mouth in establishing brand equity (Keller, 2009). Consumers form their opinions of brands through the eyes of other consumers (Shi et al., 2014).

2.3 Customer Brand Engagement

According to Van Doorn et al. (2010), engagement is a motivating state. It arises from an individual's focal interacting experiences with a certain item or agent (Hollebeek, 2011a, 2011b). Engagement' is a multi-dimensional notion that includes relevant cognitive, emotional, and behavioral dimensions (Hollebeek, 2011a, 2011b). Customer brand engagement (CBE) is a critical new criterion for assessing a brand performance (Bowden 2009; Kumar et al., 2010).

Emotional CBE was conceptualized as the customer’s degree of positive brand activity-related affect. ‘Emotional’ activity may be represented by a customer’s level of brand- related inspiration and/ or pride (Salanova et al., 2002). Hollebeek (2011a) explored the emotional aspects of engagement related to advertisements.

Cognitive CBE, on the other hand, is an affect-related thinking process that is linked to the customer's degrees of brand activity-related thought processing and information elaboration (Hollebeek, 2011a). Another example of a customer's cognitive brand, individual's level of focus and/or engrossment with the brand (Brakus et al., 2009).

Intentional CBE refers to a customer’s interest in devoting energy, effort and time to a brand activity. It is thought to lead to two-way collaborations between customers and brand activities (Hollebeek, 2011a). Intentional CBE comprises engagement behavior beyond exchange transaction (e.g., Facebook ‘likes’ and comments) (Van Doorn et al., 2010). They can also be noted in behavior and physical brand-related activities (i.e. Facebook ‘likes’ and comments).

2.4 Brand Equity

According to Aaker (1991), brand equity is a collection of a brand’s assets and liabilities, which is based on four dimensions such as brand awareness, brand association, perceived quality, and brand loyalty.

Brand awareness is a critical component of brand equity that exists in the minds of consumers (Aaker, 1991; Keller, 1993). Brand awareness can create a sense of familiarity and a signal of substance, commitment, and awareness. It also influences choice at the memory level by affecting which brands are considered and chosen. Brand awareness generates a high degree of purchase, boosting the firm's profitability and sales (Brakus et al., 2009).

The most widely understood part of brand equity is ***brand associations***. In reality, it's anything that a customer associates with a brand. Product qualities, customer benefits, uses, users, lifestyles, product classes, rivals, and nations are examperes of brand connections. Customers can

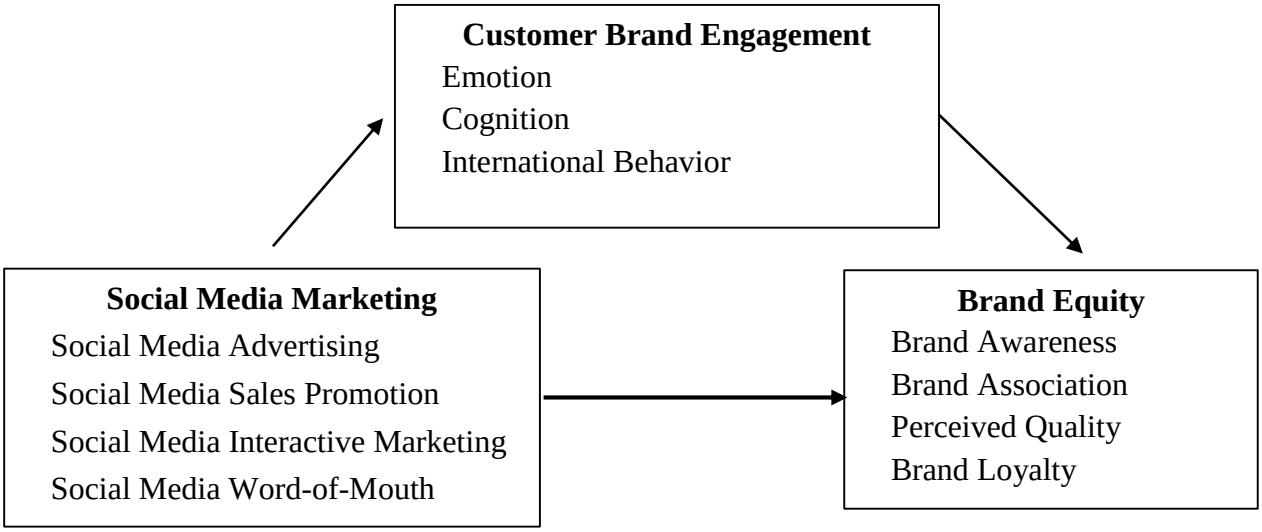
use associations to assist them digest or retrieve information, differentiate and extend their offerings, give them a cause to buy, and produce good sensations.

Perceived quality refers to a customer's opinion of a product's overall excellence or superiority (Zeithaml, 1988). Perceived quality is considered a separate asset from brand. It is a major business focus for many companies, and it can serve as inspiration for programmes aimed at boosting brand equity. Perceived quality is a sufficiently important and accepted strategic consideration (Aaker, 1992).

Brand loyalty is that loyal customers expect the brand to be available at all times and encourage others to use it by recommending it. Retaining current consumers is far less expensive than acquiring new ones. Even if switching costs are modest, clients have a high inertia level. Competitors also have a hard time communicating with satisfied brand users since they have little desire to learn about alternatives.

2.5 Conceptual Framework of current Study

Based on previous studies, this research fills research gaps by combining the major marketing communication tools, brand equity, and customer brand engagement, which is shown in the following conceptual framework.



Source: Own Compilation for this Study, (2019)

Figure 1. Conceptual Framework

As depicted in Figure (1), brand equity can be built through customer brand engagement and social media marketing. Social media marketing initiatives like social media advertising, social media sales promotion, social media interactive marketing, and social media word-of-mouth are independent variables. The study's mediator variable is customer brand engagement. Brand equity are the dependent variables.

Research Methodology

3.1 Sampling Procedure and Sample Size

The population of this study consisted of cosmetics users who actively engaged in six brands on social media, which are popular in Myanmar such as Facebook, Twitter, and Instagram. For sample selection, two-stage random sampling was applied in this study. In the first stage, seven shopping malls were selected from 13 shopping malls in Yangon by using a simple random sampling method. The selected shopping malls were Junction City, Myanmar Plaza, City Mall, Hledan Centre, Ocean North Point Mall, Junction Square, and Junction 8. In the second stage, the 514 respondents who visited shopping on the weekends were selected by using a 3 in 1 systematic sampling method, i.e., a selection of one visitor from every three. Survey was carried out from 1 pm to 5 pm. Approximately seventy shoppers were selected from each shopping mall.

The study's targeted sample size is 385 customers, which was derived from calculation with the Cochran's (1977) Formula. The appropriate sample size was based on a 95% level of confidence, and a margin of error of 5% was sufficient to estimate the population characteristics.

3.2 Data Collection Method

This study used both quantitative and qualitative method. In qualitative method, firstly, a preliminary stage survey was conducted by asking salespeople at cosmetics counters of shopping malls to explore which brands are getting larger interest from cosmetics buyers. The sales persons identified that the Bella, SAI Cosmetix, Doaru, Shwe Pyi Nann, Shwe Bo Mintha mee, and Taung Gyi Mauk Mai, are most well-known brands. These are also six well-known cosmetics brands out of 19 cosmetics brands approved by the FDA (Food and Drug Administration 2018) in Myanmar. Consequently, these six brands were targeted for the study.

In qualitative method, in-depth interview were conducted with managers of the selected cosmetics brands with face-to-face at their offices. The interviews aimed to explore the background information about their brand, the nature of their products, and the marketing practices which were currently being utilized. A manager from each cosmetics brand participated in the interview, and six managers participated in the interviews. The interviews were lasted about 40 minutes which were voice recorded.

3.3 Questionnaire Design

The questionnaire set consists of two sections, which are section A and section B. Section A contains questions on demographics to acquire some basic information about the respondents: the respondent's gender, age, marital status, highest education completed, current job experience, and job title.

For Section B, the questions include dependent variables, mediator variables, and independent variables for this study. The independent variables in this study are social media marketing. Social media marketing in this study includes social media advertising (Bronner & Neijens, 2006), social media sales promotion (Keller, 2009), social media interactive marketing (Buil *et al.*, 2013) and social media word-of-mouth (Jalilvand & Samiei, 2012). The mediating variable in the study is Customer brand engagement, which includes three variables (emotion, cognition, and Intentional behaviour). This section of the questions is adapted from Hollebeek *et al.* (2014) and Solem & Pedersen (2015). Brand equity in this study includes brand awareness, brand association, perceived quality, and brand loyalty adopted from Erfan *et al.* (2014). All the

questions are arranged on a five-point Likert-scale, ranging from 1 = strongly disagree to 5 = strongly agree.

3.4 Reliability Test

The reliability of research measures, which are crucial parts of any survey, is assessed and examined to make sure of the goodness of the measures used in the research. The results of the reliability test for social media marketing variables, customer brand engagement and brand equity in this study are presented in Table (3.1). Cronbach's Alpha values of all variables are greater than 0.7, which indicates that there is the reliability for internal consistency in the constructs.

Table 1. Reliability of Variables

Sr. No.	Variables	No. of Items	Reliability
			Cronbach's Alpha
1	Social Media Advertising	5	0.717
2	Social Media Sales Promotion	5	0.754
3	Social Media Interactive Marketing	14	0.860
4	Social Media Word-of-Mouth	8	0.857
5	Emotion	4	0.851
6	Cognition	4	0.831
7	Intentional Behaviour	4	0.861
8	Brand Awareness	4	0.787
9	Brand Association	5	0.750
10	Perceived Quality	4	0.804
11	Brand Loyalty	7	0.830

Source: Survey Data (2019**)**

3.5 Assumptions of Multiple Linear Regression

In this study, multiple linear regression method employed so the following assumptions such as multicollinearity, constant residuals, normal distribution and outliers are tested. None of the results did not indicate any violations of assumptions.

Analysis on the Effect of Social Media Marketing on Brand Equity of Myanmar Cosmetics

This section presents the profile of participants and results of regression analysis.

4.1 Profile of Respondents

This section offers the profile of the respondents including their demographic and socio-economic background information to recognize the nature of respondents of the study.

Table 2 Profile of Respondents

Sr. No.	Characteristics		No. of Respondents	Percentage
1	Age (Years)	Less than 20	199	38.7
		20-30	173	33.7
		30-40	83	16.1
		40 and above	59	11.5
		Total	**514**	**100.00**
2	Education	High School Level	6	1.2
		Diploma Level	52	10.1
		Bachelor/ University student	416	80.9
		Master Students /Doctoral	40	7.8
		Total	**514**	**100.00**
3	Current Career	Private	169	32.9
		Government	88	17.1
		Business Owner	13	2.5
		Non-Profit	3	0.6
		Student	234	45.5
		Unemployment	7	1.4
		Total	**514**	**100.00**
4	Monthly Income (kyats)	Under 100,000	51	9.9
		100,000-200,000	164	31.9
		200,000- 300,000	191	37.2
		300,000-400,000	45	8.8
		400,000- 500,000	39	7.6
		500,000 and above	24	4.7
		Total	**514**	**100.00**
5	Customer Chosen Brands	Bella	183	35.6
		SAI Cosmetix	128	24.9
		Doaru	105	20.4
		Shwe Pyi Nan	44	8.6
		Thung Gyi Mauk Mai	20	3.9
		Shwe Bo Minthamee	34	6.6
		Total	**514**	**100.00**
6	Traditional Media	TV	262	51.0
		Radio	54	10.5
		Magazine	38	7.4
		Billboard	133	25.9
		Street Board	27	5.2
		Total	**514**	**100.00**

Source: Survey Data (2020)

As shown in Table (2), the largest age of respondents is less than 20 years old (38.7%). Only 11.5% of respondents are aged 40 and above. This data shows that respondents aged below 20 years old use Myanmar cosmetics brands. Concerning education level, many respondents are university students, which represent 80.9%. Government staff is 17.1%, and unemployment is 1.4%. Only 2.5% of respondents are business owners. The monthly income of 200,000 "kyats and below represents 41.8 %, the monthly income of between 200,000 and 300,000 kyats is 37.2% and above 500,000 kyats is 4.7% respectively. It can be seen that customers whose income level is below 300,000 kyats prefer Myanmar cosmetics brands.

4.2 Customer Perceptions on Social Media Marketing, Customer Brand Engagement and Brand Equity

This study examines customer perceptions of social media marketing, customer brand engagement, and brand equity.

4.2.1 Social Media Marketing

In this study, the social media marketing tools utilized by cosmetics brands can be classified into four categories. The mean value and standard deviation of social media marketing of Myanmar cosmetics are shown in Table (3).

Table 3 Social Media Marketing of Myanmar Cosmetics

Sr. No.	Items	Mean	Standard Deviation
1	Social Media Advertising	3.79	0.79
2	Social Media Sale promotion	3.88	0.77
3	Social Media Interactive Marketing	3.83	0.74
4	Social Media Word-of-Mouth	4.16	0.73
Overall Mean Value		3.92	

Source: Survey Data (2020)

Overall mean value of social media marketing is high; the mean value score is 3.92, and it can be said that customers perceive the selected cosmetics brands use social media marketing.

4.2.2 Brand Equity

In this study, the brand equity utilized by cosmetics brands includes brand awareness, brand association, perceived quality, and brand loyalty. In Table (4), the mean value and standard deviation of brand equity of Myanmar cosmetics are shown.

Table 4. Brand Equity of Myanmar Cosmetics

Sr. No.	Items	Mean	Standard Deviation
1	Brand Awareness	3.92	0.716
2	Brand Association	3.57	0.746
3	Perceived Quality	3.36	0.739
4	Brand Loyalty	3.41	0.796
Overall Mean Value		3.56	

Source: Survey Data (2020)

The overall mean value of brand equity is 3.56. Brand Awareness has a mean score of 3.92. The mean value of brand association is 3.57. The mean values of perceived quality and brand loyalty are less than 3.5. Since mean scores for all dimensions are higher than 3.5, it can be said that customers have brand equity over Myanmar cosmetics.

4.3 Effect of Social Media Marketing on Brand Equity

In this study, multiple linear regression models were applied to test the effects of social media marketing on customer brand engagement and brand equity. The results are shown in Table (5).

Table 5. Effect of Social Media Marketing on Brand Equity

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	VIF
	B	Std. Error	Beta			
(Constant)	0.537	0.204		2.636	0.009	
Social media advertising	0.180***	0.037	0.198	4.835	0.000	1.321
Social media sale promotion	0.150***	0.040	0.165	3.754	0.000	1.522
Social media interactive marketing	0.392***	0.051	0.351	7.646	0.000	1.664
Social media word- of-mouth	0.035	0.036	0.036	0.981	0.327	1.069
R	0.595					
R^2	0.354					
Adjusted R^2	0.349					
F- test	69.785***					

Source: SPSS Outputs (2020) (Appendix C)

Statistically significant indicator *** at the 1% level and ** 5% level and * at 10% level

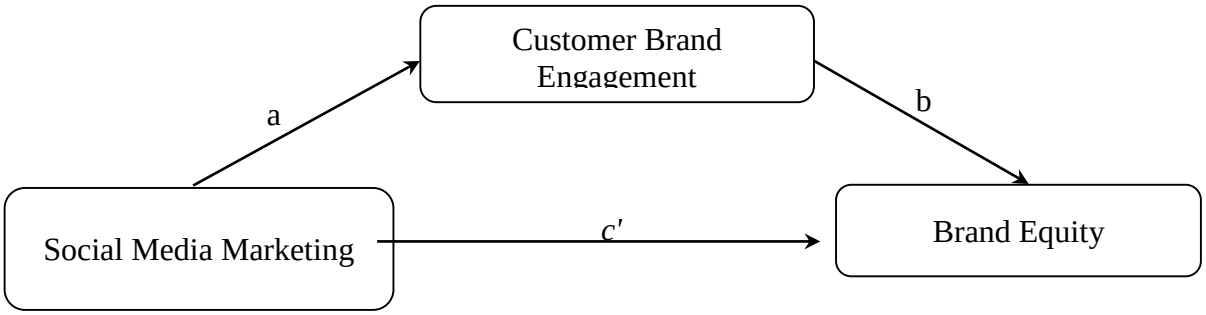
As shown in Table (5), the value of the F-test, the overall significance of the model, is highly significant at a 1% level. The adjusted R^2 is 0.349, which means that 34.9% of the variation in brand equity is explained by the four tools of social media marketing.

As for the effect of social media marketing, the standardized coefficient of social media advertising is 0.198 and that of social media sales promotion is 0.165, both at the 1% significance level. At the 1% level of significance, social media interactive marketing is 0.351. There is, however, no relationship between social media word of mouth and the brand equity of Myanmar cosmetics. One reason may be the nature of cosmetics products; which customers may feel equity only if they are suitable for their skin. Customers do not feel equity to every brand that is known to social media. The result suggests that except WOM the other three social media marketing all have a favorable impact on brand equity. Interactive social media marketing is the most effective at increasing brand value and has the greatest beta value.

4.4 Mediation Effect of Customer Brand Engagement

For this study, path analysis is used to find out the mediating effect of customer brand engagement (emotion, cognition, intentional behavior) on social media marketing and brand equity of Myanmar cosmetics.

Independent variables Mediation variables Dependent variable



Source: Own compilation (2021)

Figure 2. Mediation Model for Estimating and Testing Mediation Conditions

(i) Mediation Analysis of Customer Brand Engagement

The results of the direct, indirect, and total effects of each mediator on customer brand engagement between social media marketing factors and brand equity are shown in Table (6).

Table 6 Direct, Indirect and Total Effects of Social Media Marketing

Variable	Indirect	Direct	Total Effect
SMM → BE (Emotion)	0.2161***	0.5795***	0.7956***
SMM → BE (Cognition)	0.3076***	0.4880***	0.7956***
SMM → BE(Intentional behavior)	0.1365***	0.6591***	0.7956***
SMM → BE (Overall CBE)	0.3373***	0.4582***	0.7956***

Source: SPSS output (2021) (Appendix D)
Statistical significance indicate *** at the 1% level, ** 5% level and * 10% level

From the Table (6), the bootstrapping result of the indirect effect of social media marketing on brand equity through emotion is significant ($b = 0.2161$, $p < 0.01$). Therefore, emotion has a partial mediating role in the relationship between social media marketing and brand equity for the Myanmar cosmetics brands.

The bootstrapping result of the indirect effect of social media marketing on brand equity through cognition is also significant ($b = 0.3076$, $p< 0.01$). Therefore, cognition has a partial mediating role in the relationship between social media marketing and brand equity for the Myanmar cosmetics brand.

The bootstrapping result of the indirect effect of social media marketing on brand equity through intentional behavior is significant ($b = 0.1365$, $p< 0.01$). Therefore, intentional behavior has a partial mediating role in the relationship between social media marketing and brand equity for the Myanmar cosmetics brand.

The bootstrapping result of the indirect effect of social media marketing on brand equity through overall customer brand engagement is significant ($b = 0.3373$, $p < 0.01$). Therefore, overall customer brand engagement has a partial mediating role in the relationship between social media marketing and brand equity for the Myanmar cosmetics brands.

Conclusion

5.1 Findings and Discussions

This study examines the effect of social media marketing on customer brand engagement and brand equity of Myanmar cosmetics. A total of six Myanmar cosmetics brands were selected by asking the questions to sale girls working at the cosmetics counters, the most interested cosmetic brands came to be explored by customers. The authorized persons from the respective cosmetics brands were asked about the use of social media marketing.

The first research objective is to analyze the effect of four social media marketing tools on brand equity of Myanmar cosmetics brands. According to the findings, except WOM, the other three social media marketing have a positive and significant effect on brand equity. The positive effect of social media advertising on overall brand equity implies that the advertisements hosted on social media by brand managers and brand owners are important marketing communications for enhancing the acceptance of brand equity of cosmetics brands. Hence, the useful, credible, creative, unique, original, and persuasive information and content that are posted on social media prove to enhance positive perception and increase acceptance of Myanmar cosmetics brands.

The positive effect of social media sales promotion on overall brand equity implies that the promotional information that is disseminated via social media is vital for developing successful brand equity of Myanmar cosmetics brands. Specifically, the promotional announcements, product trials, price deals, gifts, discounts, rebates, coupons, and service deals that are shared on social media all have positive implications on the acceptance of cosmetics brand equity. This may be that when brands are sold at a discount, consumers feel a greater association with the brand and this may induce repeated purchases.

The positive effect of social media interactive marketing on overall brand equity implies that the interactive marketing content has a meaningful relationship with the development of brand equity of cosmetics brands. Invariably, persuasion and evoking positive purchase decisions and interactive marketing content of brand awareness lead to increased brand equity. The interactive marketing activities on social media refer to opinion exchange, information sharing, and the easy delivery of opinions. Solving customer complaints leads to increased brand equity.

The study does not significant effect of social media word-of-mouth on overall brand equity imply that the comments, consumer reviews, and consumer experiences shared on social media do not encourage other consumers to make favorable and confident decisions about cosmetics brands. The reason seems to be that customers may not be paying adequate attention to the social media reviews of other customers who are strangers to them. If the WOM were given by their close friends, family members, influencers, and bloggers, they would be interested in their WOM and thus increase their equity.

The second objective of this research is to examine the mediation effect of customer-brand engagement on the relationship between overall social media marketing and overall brand equity for Myanmar cosmetics brands.

Based on the findings, emotion were found to be a mediator between social media marketing and brand equity. In other words, the more advertising content, discounts, rebates, coupons, customer complaints, likes, shares, and information sharing of consumers are seen on social media, the more likely it is for stimulating their emotions. Also, the more they are emotionally engaged to the brand.

Cognition does appear to be a mediating mechanism for attaining brand equity, such as through social media marketing of customer cosmetics brands. Thus, they involve persuading current and prospective customers of cosmetics brands to greater engagement in their cognition towards that brand. For example, advertising on social media allows more online users to become familiar with their cosmetics brands, which increases customers' awareness of the brand. The more social media performs sale promotion of products, the more likely most users will pay attention to their brands.

Intentional behavior does appear to be a mediating mechanism for attaining brand equity, such as the brand awareness, brand association, perceived quality, and brand loyalty of Myanmar cosmetics. If negative WOM about a cosmetics brand is shared and posted on social media, consumers' desire, interest, and enthusiasm for cosmetics brands will decline, and less engaged customers will not be able to put forth attempts to recognize, recall, connect, and perceive high value, which are key elements of brand equity for cosmetics brands.

When testing mediation effects, this study investigated the direct effects of social media marketing on CBE and direct effects of CBE on brand equity. The results show that the different practices of social media marketing have various effects on customer brand engagement. Three social media marketing tools have a positive and significant influence on customer brand engagement. However, social media word-of-mouth shows no significant effect on customer brand engagement.

These results imply that customer brand engagement can be developed with great effort and effective use of social media advertising and sales promotion. Customers' brand engagement can improve if the cosmetics brands increase their spending on social media advertising and sales promotion. Customers are more engaged when the cosmetics brands exercise more marketing activities associated with advertising and sales promotion. For social media interactive marketing, cosmetics brands always reply to all comments, so customers are satisfied with the information. However, social media word-of-mouth has no significant effect on customer brand engagement. Consumers do not rely on social media word-of-mouth to purchase cosmetics. It could be that social media word-of-mouth spreads both positive and negative information. Even if a user recommends a product and says it is good, customers may not be able to believe it and buy it because if they switch from their current brand to it, they may have the feeling that it will change their skin type, and hence it will be difficult to obtain strong engagement from customers through WOM.

In testing the effect of CBE on brand equity, individual elements of customer brand engagement have a significant and positive effect on overall brand equity. Engaged customers of Myanmar cosmetics brands believe in good quality and show loyalty to that brand. In addition, they keep buying the products and using it instead of other brands. Every day, they are waiting for this cosmetics page to post a new advertisement. They always look for emotion in page's live sales and page's posts. This means that once a brand evokes customers' cognitive, emotional, and motivational elements, they may assign the highest value towards that brand for successful brand equity.

Overall, customer brand engagement is essential to promote the positive effect of overall social media marketing on the brand equity of cosmetics. Unless a cosmetic brand excels at building strong customer engagement in affective, intentional behavior, and cognitive components, social media communication practices used Myanmar cosmetics may not bring into stronger awareness, association, perceived quality, and loyalty to customers.

5.2 Implications to managers and entrepreneurs of cosmetics brands

Based on findings of this study, the findings presented in this study holistically provide limitless opportunities to brand managers and marketers for enhancing brand equity and evoking favorable responses from consumers through social media.

- Cosmetics firms are advised to increase social media advertising in an interesting way and should give reliable information via social media. Content should be interesting and updated regularly. This is because nowadays, consumers believe that social media commercials are more engaging, creative, educational, and interactive than traditional marketing.
- Managers should invest in advertising with clear objectives to increase brand equity. In creating advertising, marketers must make sure to attract target customers at the right time and right place because the target audience in future will act as an opinion leader to the young consumers.
- The marketers of cosmetics brands should utilize a wide variety of promotion programs for a brand to market such as giveaway programs, lucky draw programs, early bird promotions, free samples, etc. Price reduction can also be arranged so as to increase sales even for the short term.
- The managers should definitely answer any questions from customers, such as price, usage, where to buy it, and user skin tone for interactive marketing. They also need to make sure they have 24-hour customer contact and disseminate customized messages to different customers when customers come to contact on social media sites.
- Mangers can improve the WOM for increasing customers' reaction. firms should check their social page Facebook page often and resolve misunderstandings and misinformation about the brands if negative information is spread on social media.
- They should control over writing bad customer reviews or usage experiences of products. They should cultivate opinion leadership to spread positive information about brands as well as to reduce the negative word-of mouth information. Using opinion leaders should enable firms to mitigate the negative word-of-mouth information.
- Cosmetics brands should provide customers with more information about their products, use various advertising themes for different customer groups, and give unique messages for different types of customers in order to increase brand awareness and brand association. They should also listen to customer voices, for partnering with customers, and building customer loyalty programs.

5.3 Contribution of the Study

This study highlights the importance of social media marketing in building engaged customers and brand equity. The research findings suggest that social media marketing is vital for attracting customers to make the final purchase of personal care products. There are many ways this study helps us understand the success of domestic cosmetics businesses and other businesses.

This study offers several contributions. The most important contribution of this study is a pioneered study to look how social media marketing tools are imperative for local cosmetics brands in Myanmar, the notion that previous studies has overlooked. As the use of social media marketing is becoming greatly intensified in Myanmar, this study illuminates how it can help build brand equity of local cosmetics brands in Myanmar beyond the traditional marketing tools. By differentiating the different social media marketing tools, one can understand the differential impacts of each marketing tool and evaluate its value on brand engagement and brand equity of cosmetics brands in Myanmar.

The second contribution of this study is to improve apprehension of how cosmetics firms can build brand equity for customers by using social media online marketing. Not only the selected cosmetics firms but also other cosmetics firms can use social media marketing communication tools for getting customer engagement and building brand equity. As such, cosmetics industries in Myanmar can strengthen their customer base and long-term success.

The third contribution is providing insights to understand the role of social media marketing in cosmetics businesses in Myanmar in building customer brand engagement and brand equity. Nowadays, in Myanmar, customers are more likely to shop online than go shopping especially during the COVID-19 period. Apprehension of social media marketing strategies is important because the importance of social media marketing could be context-specific, i.e., depending on the products and country. Different types of businesses necessitate different social media marketing strategies for building customer brand engagement and brand equity. Therefore, this study advances our understanding of the exact nature of influential social media marketing tools for cosmetics products in Myanmar.

Finally, by promoting comprehension on how SMM can benefit BE, this study not only directly contributes to growth and survival of Myanmar cosmetic firms but also indirectly contributes to the development of SMEs in different local industries, where major downstream and upstream activities are involved in the production and sale of cosmetics products. The success of these firms, including SMEs, will enable greater employment opportunities for Myanmar people and economic development of Myanmar as a whole in the long run.

5.4 Needs for Further Study

- This study only relies on the opinions and perceptions of respondents in measuring customer based brand equity. Further studies may be considered using secondary data, especially financial base brand equity.
- This study focused only on social media marketing tools for promoting brand equity. Further study of social media marketing variables can be built on the Honeycomb model, such as online communities, interaction, sharing content, credibility, accessibility, sharing relationships, groups, and identity, and so on.

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ESTIMATION OF RATE OF RETURNS ON INVESTMENT IN EDUCATION IN MYANMAR

ESTIMATION OF RATE OF RETURNS ON INVESTMENT IN EDUCATION IN MYANMAR

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Abstract

Education is one of the main drivers of economic growth and development. The success of education system of a country depends on the motivation of individuals within the system. This study aims to analyse the returns on education in Myanmar by using data from Labour Force Survey (2015) of Myanmar. The Mincer's wage model and recursive (path) model were used to analyse the rate of returns on investment in education. The findings showed that education had positive and significant effect on earnings, and the rate of returns was about 2.9 per cent in 2015. Moreover, there was an inverted U-shaped relationship between working experience and earnings. The results of path model indicated that working family members' education could contribute to improve the type of their occupation and higher wage. And then according to the estimated coefficients of the path model, father education, father occupation, other working family members' education, occupation and their earnings are significantly linking. Based on the findings, it is recommended that the estimation of rate of returns on investment in education is important for the policymaker in order to create the society with people more pursuing education. In such a way, the society will tend to achieve economic stability, healthier environment, lower crime, and greater equality.

Keywords: Returns on Education, Mincer model, Inverted U-shaped, Labour force survey

Introduction

Education is regarded as one of the driving forces to economic growth and poverty reduction at individual level as well as national level. At individual level, it gives personal growth and opportunities for socioeconomic improvement. At national level, it provides high quality workers and expands knowledge among citizens of the respective countries.

In terms of productivity, the education can be recognized by seeing the ability of workers to adapt new technology and instructions, which are determined by the level of education. According to Montanini (2013), it can also be seen that the level of higher education is related to the abilities required in the job market. Therefore, the productivity contributes to upsurge number of skilled workers, reflecting the higher salaries and vice versa.

There is a strong consensus among economists that education is the vital determinants of people's earnings. According to the human capital theory, education is an investment that increase the skills and productivity of individuals involved in various industries (Low, 2000). Accordingly, these individuals earn higher income in job market due to their skills and efficiencies. Education can also increase earnings. According to this view, education mainly serves as a signal about the qualifications of the workers to potential employers.

In Myanmar, education is regarded as an important element in the development of socio-economic sector. Educating children and young people may lead to better economic and social changes which is vital for economic development of Myanmar. Basic education structure of Myanmar is 5:4:2 with five years at primary school, four years at middle school and two years at high school.

In economics, wage level is determined by productivity of labour. Among all possible contributing factors to labour productivity, education is more indispensable comparing to other

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factors. Decision making on education investment is similar to that of other financial assets. It compares the cost incurred at the present period with the present value of the future flows of benefits, and investment is made only when the total benefits outweigh the total cost. It also needs to check out whether it is worth more investing in education in Myanmar. Therefore, it is essential to carry out this study to get to the estimates of return on education from the investment in education.

Objectives of the Study

The main objective of this study is to examine the expected rate of returns on investment in education in Myanmar. In particular, the specific objectives are:

(1) To identify the factors that influence the rate of returns on investment in education using Mincer wage model

(2) To estimate the rate of returns on investment in education using Mincer wage model

(3) To examine the direct and indirect effects of rate of returns on investment in education using recursive (path) model

Data and Methods

2.1 Source of Data

The main source of data for the study was obtained from the "Myanmar Labour Force Survey," which was carried out from 1st January to 31st March, 2015 by the Department of Labour under the Ministry of Labour, Immigration and Population. The census included 80,557 enumeration areas, of which a sample of 1,500 enumeration areas was selected and within these areas 24,000 households were chosen for this labour force survey. The first collected sample size is 13,173 respondents, which includes both people in the labour force and not in the labour force. However, due to the constraints such as respondent must be at the working age of between 15 and 65 years, respondent must earn regular wages, and respondent must be combined with parents, the sample size was reduced to 2,134 respondents in estimating the Mincer wage model.

2.2 Description of Variables Included in the Study

This study describes the thirteen variables and definitions which are mainly used in estimation of returns on education in Myanmar. Out of the thirteen variables, gender, marital status, and location variables are binary dummy variables. The other variables are continuous variables such as wage, age, education, working experience, and occupation data are collected from respondents while father education and father occupation data are collected through their parents.

In this study, lnwage is the dependent variable. Explanatory variables are education, father education, occupation, father occupation, age, experience, gender, marital status, location and states and regions. Dependent variable and explanatory variables included for the study are;

1. wage: Variable for earnings, this measures the salary or wage of respondent per month in thousand kyats.
2. lnwage: This measures the natural logarithm of monthly wage of respondent from job.
3. educ: Variable for respondent's education, this measures the years of schooling of the respondent.

4. Fathereduc: Variable for father education, this is defined in the same way as variable for respondent's education.
5. occupation: This measures the types of occupation of the respondent. Occupation is measured by the scale of International Standard Classification of Occupation (ISCO-08) groups similar kind of occupations. In those case where occupations are used as part of the measurement of the skill level of an occupation. In this study, skill level is assumed to be interval scales.
6. father occupation: This measures the types of occupation of the respondent's father. This is defined in the same way as variable for occupation.
7. age: Age in years.
8. age^2: This is defined the square of age in years.
9. exp: Variable for experience, this measures the working experience in months.
10. exp^2: This is defined the square of working experience in months.
11. male: This is defined gender of the respondent (1 if male and 0 female).
12. single: This is defined marital status of the respondent (1 if single and 0 otherwise).
13. urban: This is defined location of the respondent (1 if urban and 0 rural).

2.3 Method of Study

The statistical methods such as descriptive analysis, Mincer wage model and recursive (path) model are used in this study. In the basic form of Mincer's wage model, logarithm of wage was regressed on education level and experience while in the extended form other control variables such as squared-experience, gender, and location were included.

2.3.1 Basic Mincer Wage Model and Extended Mincer Wage Model

The rate of returns on education is estimated by the following basic Mincer's wage model, which is a function of education and working experience.

$$lnwage = \beta_0 + \beta_1 educ + \beta_2 exp + \beta_3 exp^2 + \varepsilon$$

where ln wage = Natural Logarithm of Wage in Months ('000 kyats)

educ = Years of Schooling

exp = Working Experience in Years

exp^2 = Square of Working Experience in Years

$\beta's$ the population regression coefficients and ε the error term.

The basic Mincer wage model is, therefore, extended by incorporating gender, marital status, and location variables. From the extended Mincer wage model:

Extended Model (1)

The following Model (1) extended the Mincer wage model to include the interaction between education and male.

$$lnwage = \beta_0 + \beta_1 educ + \beta_2 (educ \times male) + \beta_3 exp + \beta_4 exp^2 + \beta_5 male + \varepsilon$$

where the dependent variable is lnwage while the independent variables are education, interaction of education and male, experience, squared experience, and male.

Extended Model (2)

The following Model (2) extended the Mincer wage model to include the interaction between education and single.

$$lnwage = \beta_0 + \beta_1 educ + \beta_2 (educ \times single) + \beta_3 exp + \beta_4 exp^2 + \beta_5 single + \varepsilon$$

where the dependent variable is lnwage while the independent variables are education, interaction of education and single, experience, squared experience, and single.

Extended Model (3)

The following Model (3) extended the Mincer wage model to include the interaction between education and urban.

$$lnwage = \beta_0 + \beta_1 educ + \beta_2 (educ \times urban) + \beta_3 exp + \beta_4 exp^2 + \beta_5 urban + \varepsilon$$

where the dependent variable is lnwage while the independent variables are education, interaction of education and urban, experience, squared experience, and urban.

2.3.2 Background of Recursive (Path) Model

Path analysis is a statistical technique to examine the comparative strength of direct and indirect relationships among variables. A series of parameters are estimated by solving one or more structural equations in order to test the fit of the correlation matrix between two or more causal models, which are hypothesized by the researcher to fit the data.

However, there are many theories and concepts which highlight the specific causal links among the variables of family background, intellectual ability, educational attainment, occupational status, and labour earnings. For instance, Psacharopoulos and Tinbergen (1978) use the following model of causal link flowing from family background to labour earnings.

$$\begin{pmatrix} Family \\ background \end{pmatrix} \rightarrow \begin{pmatrix} Intellectual \\ ability \end{pmatrix} \rightarrow \begin{pmatrix} Educational \\ attainment \end{pmatrix} \rightarrow \begin{pmatrix} Occupational \\ status \end{pmatrix} \rightarrow \begin{pmatrix} Labour \\ earnings \end{pmatrix}$$

In the above model, family background is the exogenous to the model. It affects respondent's ability, which in turn affects respondent's educational attainment, occupational status, and labour earnings, recursively. The advantages of path model are to be able to specify the causal links among variables explicitly. Moreover, it can estimate multiple equations system simultaneously and provide the overall fit of the model. The causal relationships can be observed from the path diagram.

3. Literature Review for Returns on Investment in Education

According to human capital theory, the rate of return can be used to calculate the value of education and work practice. Return on education is the rate of return to income with each additional year of schooling. A rate of return is the net gain or loss on an investment over a specified time period, expressed as a percentage of the investment's initial cost.

The benefits of investments in education are broad and difficult to quantify. These benefits might involve not only the economic returns, also non-economic and social returns. Measuring

returns on investments in education estimate the benefits of increased education at both individual and national levels. The benefits of increased education at the individual level are known as private rates of return on education, and the benefits of increased education at the national level are known as social rate of returns on education. More specifically, private returns on education refer to the individual's benefits from investing in education whereas social returns refer to the large-scale benefits of such investments. Social returns also take into consideration the direct costs of schooling incurred by institutions or governments. When calculating private and social rate of return on education based on educational level and income, attention is generally given to individual income tax payment.

Brandolini and Cipollone (2002) examined the returns on education using gross labour earning obtained from Social Security Files along with years of schooling from the Labour Force Survey in Italy. They adopted an Instrumental Variable approach that exploits as instrument for the exogenous variation in school achievement according to the 1962 Mandatory Middle school reform. The best estimates range from 7 to 10 % a year depending on the method used.

The relationship between earnings and number of years of schooling has been studied for many years in the past. Mincer (1974) used a linear education term, a linear experience term and a quadratic experience term as explanatory factors for the log earning function. Education and experience are integral parts of the Mincerian wage function but in addition to these human capital factors, it now is common practice to add several other control variables, such as social, demographic, regional, and economic measures, that affect wages in the labour market.

Psacharopoulos and Tinbergen (1978) examined some alternative path analyses on the explanation of schooling, occupation and earnings. This study estimated the path coefficients of the traditional path analysis linking family background, ability, schooling, occupation and earnings with the aid of the very large sample of the British General Household Survey of 1972. The result shows that the level of educational attainment is better explained by family background and ability than occupation or earnings are. On the other hand, family background is much more import in determining the respondent's occupation, the latter in turn strongly determining earnings. Thus, family background operates on earnings mainly in an indirect way. The same result holds for schooling, although here both the direct and indirect effects are substantial.

Results

This section provides the results of descriptive statistics and the estimates of the rate of returns on education for the nation by the least squares. It extends the standard multiple regression approach to wage model and estimates the recursive (path) model.

4.1 Descriptive Statistics

Appendix Table (1) presents the summary of general characteristics of variables included in the study. According to this Table, wage distribution shows that the majority earn less than 100,000 kyats while only few respondents earn above 400,000 kyats.

In the result of respondent's education, the distribution of the years of schooling seems to be fairly symmetric. More than half of the respondents have education with no more than middle school whereas a small portion of respondents are graduates. Concerning the father's education, the majority of fathers have education level up to middle school.

According to the age distribution, the majority of respondents are under 35 years. Concerning the respondents working experience, about one third of respondents have working

experience of 2 years. The results also indicate that 54 percent of respondents are males and 46 percent of respondents are females. About 86 percent of respondents are single while 14 percent of respondents possess other marital status. The 58 percent of respondents are from rural areas while 42 percent from urban areas.

Appendix Table (2) presents the summary statistics for the variables used to estimate the returns on investment in education in Myanmar. According to this Table (2), the statistics describe that the number of respondents of wage earner is 2134. The average monthly wage is 123.86 (000) kyats, with a standard deviation of 420.80 (000) kyats. As regards to education, the mean years of schooling for the respondents is about 9 years, ranging from a minimum of no education to a maximum of 17 years. An average of respondent's working experience has around three years, ranging from a minimum of two months to a maximum of 10 years. An average of respondent's age has 23 years, ranging from a minimum of 15 years to a maximum of 50 years. The average of respondent's father education has 6 years in education, ranging from a minimum of no education to a maximum of 21 years.

Appendix Figure (1) (a**)** shows the histograms of the monthly wages as a dependent variable, the distribution of monthly wage is highly skewed to the right. That is, the majority earn a low level of wage while a few people earn a high level of wage. In order to have a symmetric distribution, the level of monthly wage is transformed into the log of monthly wage. Appendix Figure (1) (b**)** shows the histograms of the dependent variable, log monthly wage. As expected, the histogram of log monthly wage becomes symmetric. The log monthly wage will, therefore, be used in the later analyses in order to have a relatively normal distribution.

Appendix Figure (2) (a) shows the scatter diagrams of the dependent variable, log monthly wage, and the independent variable, education. It shows that the log monthly wage and education are linearly and positively associated. Appendix Figure (2) (b) shows the scatter diagrams of the dependent variable, log monthly wage, and the independent variable, experience. It shows that the log monthly wage and experience seems to indicate a non-linear relationship.

Both graphs cannot show a clear pattern of relationship between the variables, thus need to check the strength of the relationship.

As shown in Appendix Table (3), it was shown that the correlation coefficients between the dependent variable, log monthly wage, and the two independent variables, education and working experience. In these results, the correlation between education and log monthly wage is about 0.18, which indicates that there is a weakly positive relationship between the variables. The correlation between working experience and log monthly wage is about 0.05, which indicates that there is a weakly positive relationship between the variables. These two correlation coefficients are very small, however, there are statistically significant as indicated by their corresponding p-values. It is common that the size of correlation coefficient is small in empirical research using cross section data.

4.2 Analysis of Returns on Education in Myanmar

This section provides the analysis of rate of returns on investment in education by using Mincer wage model and recursive (path) model.

4.2.1 Estimation for Basic Mincer Wage Model

This section estimates the following Mincer's wage model, where log-wage is regressed on education, experience, and squared-experience. The constant (linear) effect of experience on wage is very restricted. In reality, wage can increase until a certain level of experience, beyond which wage can decrease as experience increases. In order to capture this quadratic effect (inverted U-shape) of experience on wage, the squared experience term is introduced in the model.

$$lnwage = \beta_0 + \beta_1 educ + \beta_2 exp + \beta_3 exp^2 + \varepsilon$$

Table (4.1) reports the estimated OLS results of the basic Mincer wage model. The estimated equation yields the following information. All the coefficients are highly and significantly different from zero since the absolute *t* statistics (8.34) are much larger than the 5 percent critical value of 1.96. R^2 is particularly low, suggesting that is explained by human capital only 4 percent of the variation of the log-wage of respondents. The return of an additional year of education is estimated to be approximately 2.9 percent.

In the first month in the labour force, other things being equal, the relationship between experience and wage shows that respondent get 0.5 percent on average, but it will decline after a certain level of experience. The negative coefficient related to quadratic term for experience reveals the concavity of the experience-wage relationship which is in confirmatory in almost all Mincer based studies. Therefore, the return on education or wage is decreasing with extra working experience since the function is resulted as an inverted U- shape. The estimated constant coefficient suggests that someone entering the labour market for the first time with no educational investment will on average have monthly wage of 63.50 thousand kyats $\left(= e^{4.151}\right)$.

Table 4.1 Estimated Basic Mincer Wage Model with OLS

Variables	OLS
educ	0.02939***
	(0.00352)
exp	0.00523***
	(0.00149)
exp2	-0.00003***
	(0.00001)
Constant	4.15084***
	(0.04015)
N	2,134
R-squared	0.0393

Standard errors in parentheses

Note: *, **, *** Significant at the 10%, 5%, and 1% level respectively.

4.2.2 Estimation for Extended Mincer Wage Models

This section presents the extended Mincer wage models are estimating returns on education by control variables. Table (4.2) presents the estimated results of extended Miner wage models. The second column of Table (4.2) shows that all variables in the basic Mincer wage equation are still significant. The coefficient of the binary gender variable, *male*, is positive and significant, suggesting that the average wage of male is higher than female.

The coefficient of the interaction term, *educ*male*, for a respondent with additional one year of education, suggesting that male respondent leads to an increase in wages of approximately [0.81975-0.06148 (1) = 0.75827]. It also would indicate that the slope of gender-earnings profile depends on the level of education (especially on male). Because human capital theory (Becker,1962) implies that males with the higher level of education are likely to be getting the better job opportunities with highly salaries. Those males who have the higher levels of education are still learning the education or training in order to improve their skill or knowledge.

The third column of Table (4.2) shows that all variables in the basic Mincer wage equation are still significant. The coefficient of the binary marital variable, *single*, is positive and significant, indicating that the average wage of single is higher than other marital status.

The coefficient of the interaction term, *educ*single*, for a respondent with additional one year of education, suggesting that single respondent leads to an increase in wages of approximately [1.12819-0.14203 (1) = 0.98616]. It also would indicate that the slope of marital status-earnings profile depends on the level of education (especially on single). Because human capital theory implies that singles with the higher level of education are likely to be getting the better job opportunities with highly salaries. Those singles who have the higher levels of education are having the space in their life to spend quality time for themselves. Therefore, the interaction term is expected to take a negative sign.

The fourth column of Table (4.2) shows that all variables in the basic Mincer wage equation are still significant. The coefficient of the binary urban variable, *urban*, is positive and significant, indicating that the average wage of urban area is higher than rural area.

The coefficient of the interaction term, *educ*urban*, for a respondent with additional one year of education, suggesting that who lives in urban respondent leads to an increase in wages of approximately [0.36618-0.03839 (1) = 0.32779]. This result also would indicate that the slope of location-earnings profile depends on the level of education (especially on urban). Because human capital theory implies that the people who have the higher level of education in urban areas are likely to be getting the better job opportunities with highly salaries. Those people who have the higher levels of education are getting the better access to medical facilities and better job opportunities with higher salaries, having more convenient in all aspects for life in cities and getting the well transportation system.

Table 4.2 Extended Mincer Wage Models with IV Method

Variables	Model 1	Model 2	Model 3
Educ	0.08420***	0.17213***	0.07312***
	(0.01176)	(0.04261)	(0.01901)
educ*male	-0.06148***		
	(0.12731)		
Exp	0.00493***	0.00342**	0.00459***
	(0.00166)	(0.00186)	(0.00173)
exp^2	-0.00003**	-0.00002	-0.00003**
	(0.00001)	(0.00001)	(0.00001)
Male	0.81976***		
	(0.12219)		
educ*single		-0.14203***	
		(0.04205)	
Single		1.12819***	
		(0.36619)	
educ*urban			-0.03839**
			(0.01906)
Urban			0.36618**
			(0.15547)
Constants	3.50634***	3.02708***	3.78744***
	(0.10845)	(0.36073)	(0.14466)
N	2134	2134	2134

Robust standard errors in parentheses

Note: *, **, *** Significant at the 10%, 5%, and 1% level respectively.

4.2.3 Model Specification of Recursive (path) Model

This section extends the standard multiple regression approach to earning model. Empirical analyses in this study use recursive (path) models where the sequence of causation follows.

$$\begin{pmatrix} Father \\ education \end{pmatrix} \rightarrow \begin{pmatrix} Father \\ occupation \end{pmatrix} \rightarrow \begin{pmatrix} Respondent \\ education \end{pmatrix} \rightarrow \begin{pmatrix} Respondent \\ occupation \end{pmatrix} \rightarrow \begin{pmatrix} Labour \\ earnings \end{pmatrix}$$

In the above model, following the theoretical causal structure among social and economic variables, four-equation recursive models are fitted that they are:

(1) Father occupation = f (Father education)

(2) Respondent education = g (Father education, Father occupation)

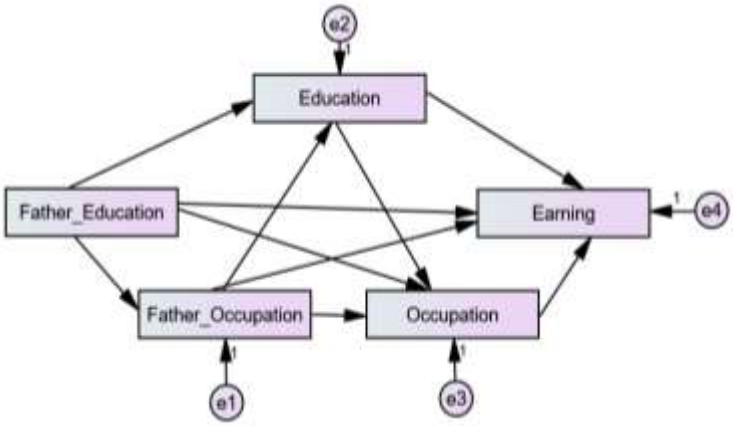
(3) Respondent occupation = h (Father education, Father occupation, Respondent education)

(4) Respondent earning = i (Father education, Father occupation, Respondent education, Respondent occupation)

The above model consists of a set of four equations and five observed variables, of which four variables are endogenous and one is exogenous.

Education is measured by the respondent's number of years of schooling completed. Occupation is measured by the scale of International Standard Classification of Occupations, where higher number indicates the higher labour-intensive occupation. Earnings are measured by the respondent's monthly wage in thousand kyats from employment.

Figure (4.1) shows the recursive (path) model of earnings, where father's education by the education level of respondent father; father's occupation by the occupation of respondent father, *education* is respondent's number of years of schooling completed; *occupation* is respondent's occupation; *earnings* are respondent's monthly wage in thousand kyats; and e1~e4 are random error terms. The model is recursive. Observed endogenous variables are *father's occupation*, respondent's *education*, their *occupation* and their *earnings* while observed, exogenous variable is *father's education*. Unobserved exogenous variables are four error terms. The head of arrows shows the direction of causal link among the variables.



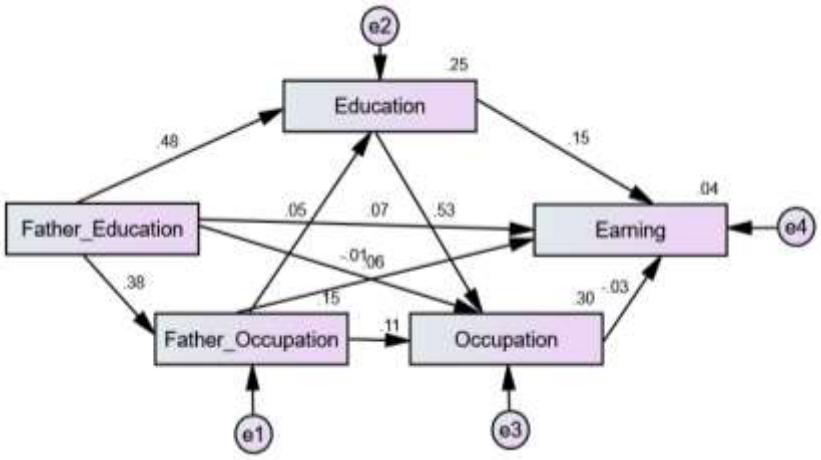
Source: Own Calculations

Figure 4.1 Recursive (path) Model of Earnings

4.2.4 Estimating the Recursive (path) Model

Figure (4.2) shows the estimated recursive (path) model of earnings. The figures on the arrows are standardized regression weights. The advantages of using standardized coefficients are to be able to compare the contribution of competing variables. The figures on each endogenous variable are the multiple correlation coefficients, which indicate the proportion of the variance of the dependent variable explained by the model.

The sample includes 2,134 respondents. The model is exactly identified because the degree of freedom is zero (the number distinct sample moments is exactly equal to the number of distinct parameters to be estimated), and thus the goodness-of-fit measures cannot be calculated (Ho, 2013).



Source: Own Calculations

Figure 4.2 Estimated Recursive (path) Model of Earnings

In Table (4.3), the results indicate that the father's education is significantly and positively related to be father's occupation, it also significantly and positively correlated with respondent's education. Father's occupation is significantly and positively associated with respondent's occupation. Respondent's education is significantly and positively effect on their occupation, it also significantly and positively associated with their earnings.

Furthermore, it appears respondent's' education not only strong effect (0.526) on their occupation but also moderate effect (0.146) on their earnings, suggesting that respondent's earnings is largely dependent on their occupation and their education. Father's occupation had a moderate effect (0.105) of respondent's occupation, but their father's occupation had no substantive effect on other respondent's education. Moreover, Father's education had a strong effect (0.479) on another respondent's education. If father's education is high, respondent who achieve at a high level of education because of father's educational guidance, in turn, improves their subsequent respondent's earnings. It was also found that father's education had a strong effect (0.384) on their occupation.

Table 4.3 Maximum Likelihood Estimates of Standardized Regression Weights

	Estimate
Father_ Occupation <---- Father_ Education	0.384***
Education <---- Father_ Education	0.479***
Education <---- Father_ Occupation	0.046
Occupation <---- Father_ Education	-0.015
Occupation <---- Father_ Occupation	0.105***
Occupation <---- Education	0.526***
Earning <---- Father_ Education	0.068
Earning <---- Father_ Occupation	0.062
Earning <---- Occupation	-0.027
Earning <---- Education	0.146***

Source: Own calculations.
Note: *, **, *** Significant at the 10%, 5%, and 1% level respectively.

In Table (4.4), results show that father's education explains about 0.147 or 14.7% of the variance of father's occupation. Father's education and their occupation account for about 0.249 or 24.9% of the variance of respondent's education. Father's education, father's occupation, and respondent's education explain about 0.304 or 30.4% of the variance of respondent's occupation. Father's education, father's occupation, respondent's education, and their occupation account for about 0.042 or 4.2% of the variance of their earning.

Table 4.4 Squared Multiple Correlation

Endogenous	Estimate
Father Occupation	0.147
Education	0.249
Occupation	0.304
Earning	0.042

Source: Own calculations

Table (4.5) presents the total effect of the exogenous variable on each endogenous. Total effect is the sum of direct and indirect effects. Thus, in terms of standardized units, the total effect of father education on respondent's education (0.497) is higher than (sign ignored) the effect of father occupation. Furthermore, the total effect of respondent education (0.526) on their occupation is higher than (sign ignored) the effect of father education and father occupation. Moreover, the total effect of father education (0.157) on respondent's earnings is higher than (sign ignored) the effect of father occupation, respondent education and their occupation.

Table 4.5 Standardized Total Effects

Exogenous / Endogenous	Father Education	Father Occupation	Education	Occupation
Father Occupation	0.384	0.000	0.000	0.000
Education	0.497	0.046	0.000	0.000
Occupation	0.287	0.129	0.526	0.000
Earning	0.157	0.066	0.132	-0.027

Source: Own calculations.

Table (4.6) presents the direct effect of exogenous variable on each endogenous variable. Father education had a strong effect on their occupation (0.384), suggesting that types of occupation of fathers depend on their education. Furthermore, Father's education had a strong effect on respondent's education (0.479), meaning that respondent's education is largely dependent on father's education. Whereas, father's occupation had a weak effect on respondent's education and their earnings (0.046 and 0.062, respectively). Moreover, education of respondent had strong effect on their occupation (0.526), indicating that types of occupation of respondent depend on their education. The moderate effect on respondent's earning was from their education (0.146); more able respondents also take more earning in high level of education.

Table 4.6 Standardized Direct Effects

Exogenous / Endogenous	Father Education	Father Occupation	Education	Occupation
Father Occupation	0.384	0.000	0.000	0.000
Education	0.479	0.046	0.000	0.000
Occupation	-0.015	0.105	0.526	0.000
Earning	0.068	0.062	0.146	-0.027

Source: Own calculations.

Table (4.7) presents the indirect effect of exogenous variable on each endogenous. Indirect effect can be obtained by subtracting the direct effect from the total effect. The results of this analysis suggest that father's education has direct effect on respondent's education, it does have an indirect effect, through father's occupation. Father's education affects respondent's earning. Furthermore, the highly educated father takes more respondent in high level of education, and these educations, in turn, improve their earnings. Moreover, father's occupation affects respondent's occupation, which in turn affects their earning. This makes sense: more father's occupation takes more respondent's occupation in job, and their occupation, in turn, improves their earning.

Table 4.7 Standardized Indirect Effects

Exogenous / Endogenous	Father Education	Father Occupation	Education	Occupation
Father Occupation	0.000	0.000	0.000	0.000
Education	0.018	0.000	0.000	0.000
Occupation	0.301	0.024	0.000	0.000
Earning	0.089	0.003	-0.014	0.000

Source: Own calculations.

Discussions

This study aims to estimate the rate of returns on education in Myanmar. Mincer's wage model, which was driven from human capital theory, was used. This model particularly explores the relationship between earnings and the number of years of schooling. The findings of this study show that the rate of returns on education are estimated to be about 2.9% and the coefficient of the number of years of schooling is positive and significant. This result indicates that the rate of returns on education in Myanmar is low. The similar findings were found in the previous studies: Shabbir and Khan (1991) claimed that the returns on education were 9.1% in Pakistan with the basic Mincer's wage function; Maluccio (1998) also claimed that returns on education were 7.3% in Philippines and Alqattan (2013) showed that the returns on education were 5.2% in Kuwait.

Moreover, the findings of positive coefficient of the linear term of working experience and the negative coefficient of the quadratic term of working experience of this study indicate that it is an inverted U-shape relationship between working experience and earnings. The implication is that earnings will not always increase at a constant rate as working experience increases. Instead, the rate of increase in earnings will decline beyond the certain level of working experience. The similar findings were found in a previous study Alqattan (2013) which showed that the employed

Mincerian earnings model was estimated by positive and significant coefficient of returns on education and a negative coefficient of quadratic year of experience in Kuwait. And, it was also found that the returns on education in Kuwait were low.

The estimation results of the extend form of Mincer's wage model indicates that in addition to the coefficient of male dummy variable is positive and significant, earnings of male are, on average, higher than female, while other things are constant. The similar findings were found in a study of Aslam (2009) in which the differential returns on education of male and female are well explained on the gender gap in education in Pakistan, and consequently, the returns in the labour market were much higher for men. Another similar finding, from Guris and Caglayan (2012) clearly showed that the returns on education for males were higher than that for females.

The estimation results of the extend form of Mincer's wage model indicates that the coefficient of marital status of single dummy variable is positive and significant in this study. Moreover, earnings of single are, on average, higher than other marital status, while other things are constant. Furthermore, the coefficient of urban dummy variable is also positive and significant. The findings also highlighted those earnings in urban areas are, on average, higher than rural areas, while other things constant. The similar findings were found in a study from Arshad and Ghani (2015) in which an evidence of wage differentials attributable to regional/urban-rural locations in Malaysia was significant.

Moreover, the coefficient of the interaction term, *educ*male*, for a respondent with additional one year of education, suggesting that male respondent leads to an increase in wages of approximately 0.75827. The coefficient of the interaction term, *educ*single*, for a respondent with additional one year of education, suggesting that single respondent leads to an increase in wages of approximately 0.98616. The coefficient of the interaction term, *educ*urban*, for a respondent with additional one year of education, suggesting that who lives in urban respondent leads to an increase in wages of approximately 0.32779. The similar findings were found in a previous study Alqattan (2013) which showed that the employed Mincerian earnings model was estimated by negative and significant coefficient of returns on education include the terms of the interaction in Kuwait.

In the recursive (path) model, a proposed model with explicit directions of causality was estimated. This study found that father occupation is significantly and positively associated with respondent's occupation. Father education is significant and positive correlated with their occupation and respondent's education. Father education is one of the main factors of respondent's education while high level of respondent's education could attract a better type of their occupation. Moreover, respondent education is significantly and positively associated with respondent occupation and their earnings. In addition to the respondent education could provide a better type of respondent's occupation and a higher wage for respondents. In conclusion, there have the causal links between father occupation and respondent occupation, father education and respondent education, and respondent education and their occupation, and their earnings. The similar findings were found in a study of Psacharopoulos and Tinbergen (1978) that showed to some alternative path analyses on the explanation of schooling, occupation and earnings. Therefore, the results of that study are in line with the results of Myanmar.

Conclusion and Recommendations

The study indicates that the level of rate of return to investment on education in Myanmar is low with 2.9%. The low returns on education are highly reflected by the low education level of the participants. Moreover, it can be explained that the salaries of government employees are

increased by their positions, and the rate of return is also increased regularly before their retirement. However, once these government employees retire from their jobs, their salaries or, their rate of returns on education decline. Therefore, the relationship between earnings and experience is represented by the inverted U-shape curve. And then, the slope of the male-earning, single-earning, and urban-earning profiles depend on the level of education. Human capital theory implies that educated males with the higher level of education are likely to be getting the better job opportunities with highly salaries. Results indicate that educated employees who have the higher levels of education are still learning the education or training related to their fields to be improved the skill or knowledge. Furthermore, that study estimated the path coefficients of the traditional path analysis linking family background, ability, schooling, occupation and earnings.

It is therefore important to consider the parents should be aware of the benefits of higher education and interested in encouraging their children to pursue this level of education. As the government, it should assist with doing the top management in the field of human capital investment on education, focus on getting the chance of high income-based economy and monitor the education system in Myanmar. In addition, the government should promote the role of educated workers through raising their salaries and wages so that the investment in education might be improved.

In this study, educational level, working experience, age, gender, marital status, residential area, and father's education, father's occupation was considered as the determinants for measuring returns on investment in education. This study has some limitations. In fact, there are some other factors that may have influence on determining the returns on education. These include cost of living, cost of training, skills/qualification, and demographic factors such as household size, number of siblings, sibling's current job, sibling's earnings, ease of getting access to education and so on. Therefore, it would be found out the more precise findings on returns on investment in education if someone could carry out the future research taking into account all those related factors. Moreover, the return on education should be measures in terms of social and health status in addition to monetary term. In addition, future research on returns on education should be conducted through simulation analysis.

Acknowledgements

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Appendix

Appendix Table (1) Characteristics of Variables

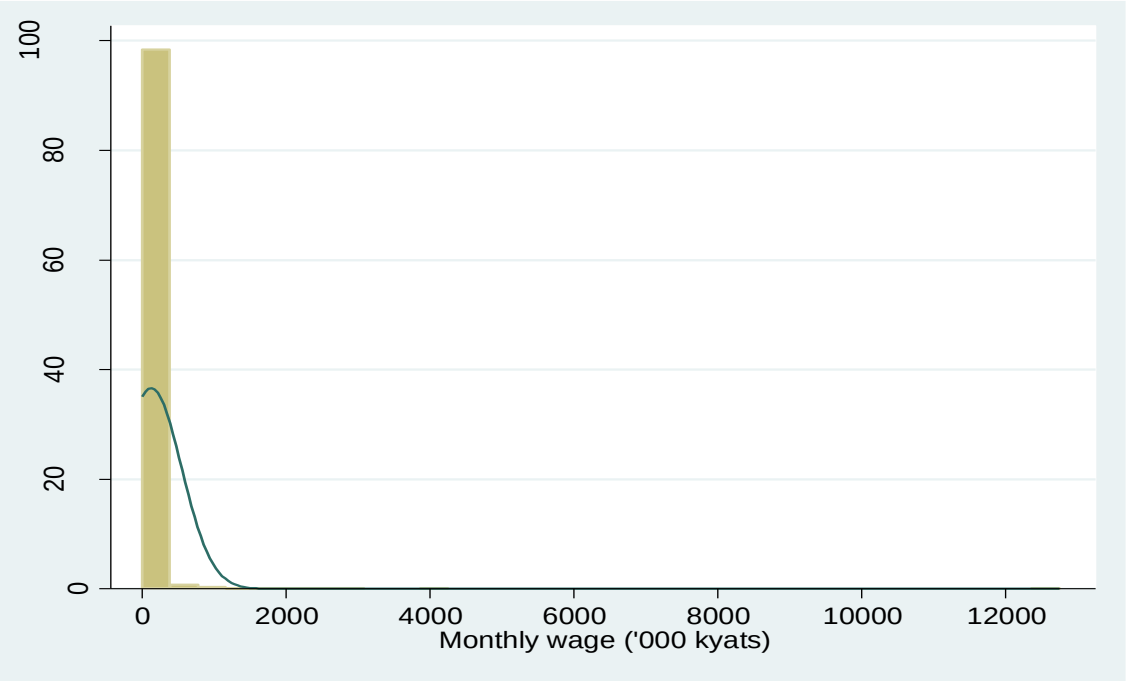
No.	Wage Group ('000 kyats per month)	Number of Respondents	Percent
1	<100	1348	63.17
	100-200	647	30.32
	200-300	79	3.70
	300-400	26	1.22
	>400	34	1.59
	Total	2134	100.00
2	**Respondent's Education (in years)**	**Number of Respondents**	**Percent**
	0	1	0.05
	4	243	11.39
	5	670	31.40
	9	566	26.52
	11	238	11.15
	15	413	19.35
	17	3	0.14
	Total	2134	100.00
3	**Father's Education (in years)**	**Number of Respondents**	**Percent**
	0	25	1.17
	4	495	12.20
	5	972	45.55
	9	412	19.31
	11	150	7.03
	15	78	3.66
	17	1	0.05
	21	1	0.05
	Total	2134	100.00
4	**Respondent's Occupation**	**Number of Respondents**	**Percent**
	1	2	0.10
	2	1796	84.20
	3	67	3.10
	4	269	12.60
	Total	2134	100.00
5	**Father's Occupation**	**Number of Respondents**	**Percent**
	1	1	0.05
	2	1992	93.34
	3	80	3.75
	4	61	2.86
	Total	2134	100.00

6	**Age (in years)**	**Number of Respondents**	**Percent**
	15-19	625	29.29
	20-25	744	34.86
	25-29	416	19.49
	30-34	234	10.97
	35-39	80	3.75
	40-44	27	1.27
	45 and over	8	0.37
	Total	2134	100.00
7	**Working experience (in months)**	**Number of Respondents**	**Percent**
	2	109	5.11
	3	112	5.25
	6	228	10.68
	12	445	20.85
	24	705	33.04
	60	332	15.56
	120	203	9.51
	Total	2134	100.00
8	**Gender**	**Number of Respondents**	**Percent**
	Female	973	45.60
	Male	1161	54.40
	Total	2134	100.00
9	**Marital status**	**Number of Respondents**	**Percent**
	Others	304	14.25
	Single	1830	85.75
	Total	2134	100.00
10	**Location**	**Number of Respondents**	**Percent**
	Rural	1245	58.34
	Urban	889	41.66
	Total	2134	100.00

Appendix Table (2) Summary Statistics of Variables in Mincer Wage Model

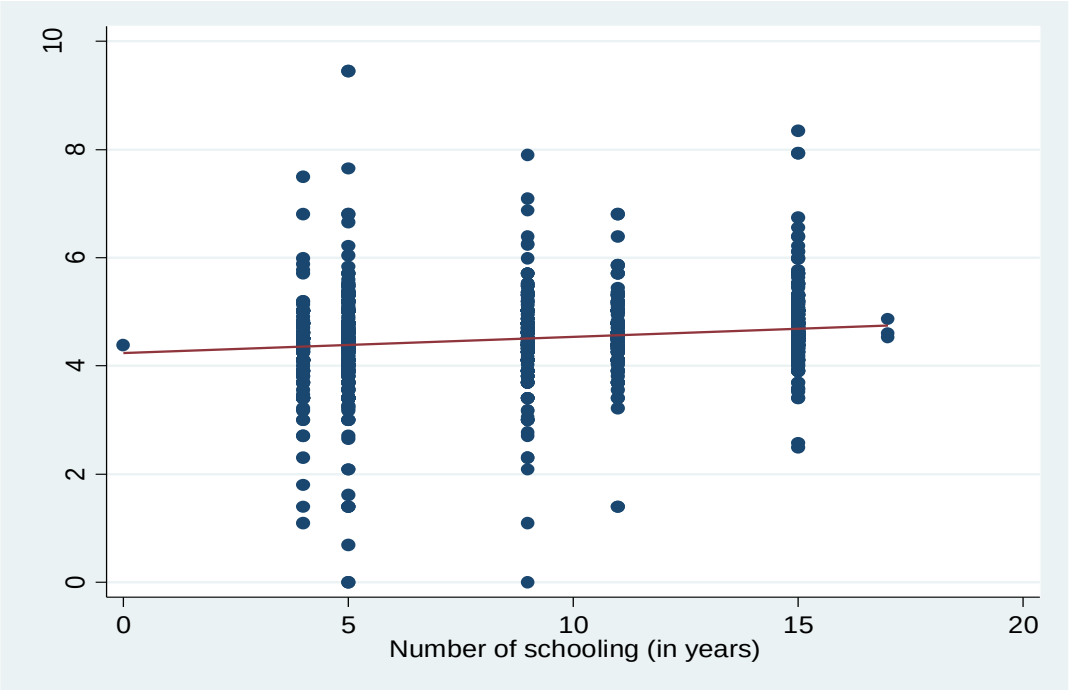
Variables	**n**	**Mean**	**Median**	**SD**	**Min**	**Max**
Wage (‘000 kyats per month)	2,134	123.86	90	420.80	1	12750
Education (Years)						
Experience (Months)	2,134	8.57	9	3.90	0	17
Age (Years)	2,134	32.08	24	33.56	2	120
Father Education (Years)	2,134	23.38	22	5.97	15	50
	2,134	6.28	5	2.89	0	21

Source: Labour Force Survey (2015)

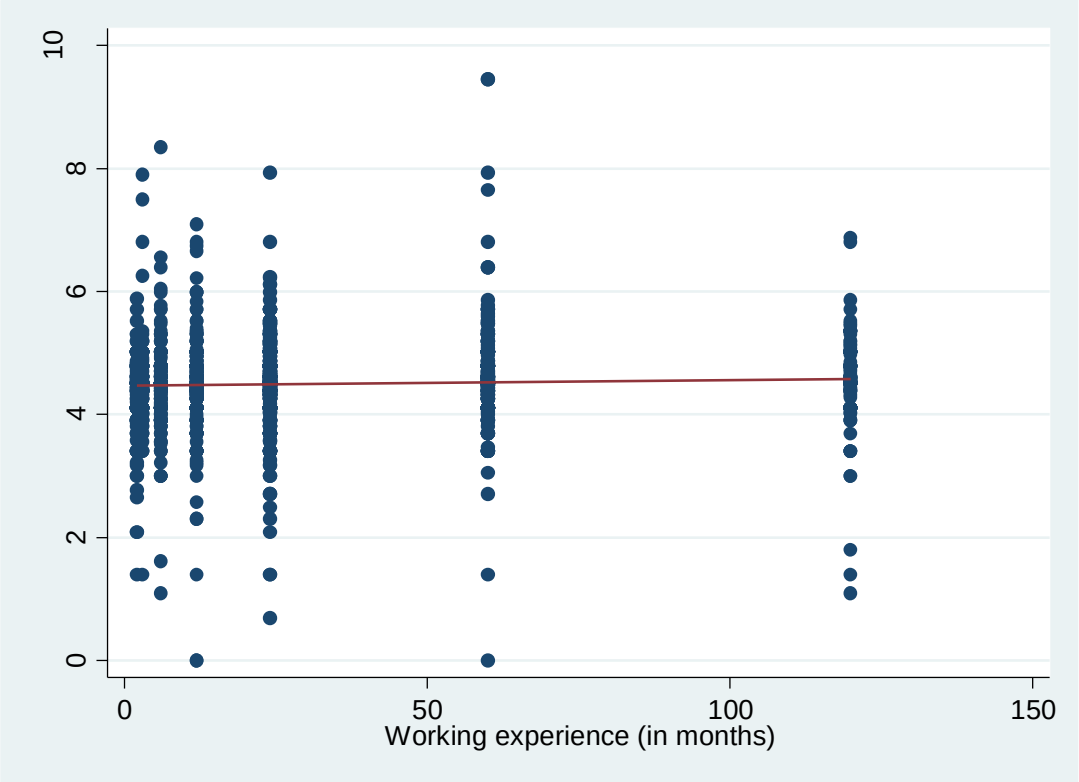


Appendix Figure 1 (a) Histograms of Monthly Wage

Appendix Figure 1 (b) Histograms of Monthly Wage



Appendix Figure 2 (a) Scatter Diagram of Log Monthly Wage and Education



Appendix Figure 2 (b) Scatter Diagram of Log Monthly Wage and Experience

Table (3) Correlation Matrix

	Lnwage	**educ**	**exp**
lnwage	1		
educ	0.1801***	1	
	(0.000)		
exp	0.0485**	-0.0354	1
	(0.025)	(0.102)	

Note: **=significant at 5% level, and ***=significant at 1% level

INFLUENCE OF SOCIAL MARKETING ON BEHAVIOUR CHANGES OF DIABETIC PATIENTS

၂-၈၊ INFLUENCE OF SOCIAL MARKETING ON BEHAVIOUR CHANGES OF DIABETIC PATIENTS

Hein Latt*

Abstract

The main objective of the study is to evaluate the influence of social marketing tools on behaviour changes of diabetic patients. The descriptive and analytical research methods are used to meet the objective of the study. A sample of 390 diabetic patients was selected from diabetic clinics and hospitals. The primary data is gathered from personal interview and structured questionnaires by using multiple regression model for analysis. In this study, it was found that five social marketing tools, product, price, promotion, professional, and performance have positive significant effect on behaviour changes of diabetic patients. The findings of moderating effects demonstrated among demographic characteristics, education has positive moderating effect on the relationship of social marketing tools and behaviour changes. Moreover, change in knowledge, change in attitude, intention to change and willingness to spend have affected on health status and change in behaviour, belief and willingness to spend have significant effect on quality of life. The results of this study encourage policy makers to emphasize on improving behaviour changes of diabetic patients in health industry, Myanmar. The results suggest and the best ways to diabetic patients for behaviour changes and improving the results of their outcomes such as health status and quality of life. According to the findings of this survey, use of social marketing tools can change the behaviour of diabetic patients, prevent the complications of diabetes and improve the quality of life of diabetic patients. Moreover, it can achieve the aim of the fourth Social Objective "Uplift of health, fitness and education standards of the entire nation" pronounced by the State. It partially contributes to the accomplishment of Nation's health and social objective. This study contributes to the benefits of human resource development because it improves the health status and quality of life not only at individual and family level but also at organizational and national level. Finally, another beneficial result is that it relieves the monetary burden of the country by reducing the cost for health care sector.

Introduction

Attention toward social marketing is escalating both in the developing and developed countries. The main aim of social marketing is to change harmful individual behaviour and solve social problem. It focuses to lead about voluntary behaviour change that is sufficiently adaptable to bring about broader social or cultural change by means of marketing techniques and principles (Kotler &Zaltman, 1971). The behaviour changes start from their awareness, knowledge, attitudes, and then change practices. If the knowledge, attitude, and practice of diabetic patients are enhanced and the quality of health services is improved, it leads to solve their problems of diabetes. As the world becomes more modern, people's lifestyles become more modern and diseases become more and more modern, including diabetes. Using this issue as an explanation for the failure of many behaviour changing initiatives, McKenzie-Mohr and Schultz (2014) suggested an alternative approach that has proven to be effective with a broad set of behaviours.

In Myanmar, facilities for early detection of the disease are lacking especially in rural areas, where nearly 70% of the population lives among whole country. In Yangon Region, a survey about diabetes prevalence done in 2003-2004 showed 12% of population are suffering diabetes and another survey done in 2014 showed diabetes prevalence of 18%. Therefore, diabetes prevalence in Yangon region has increased by 6% in a decade. The findings in this survey are very useful not only for planning healthcare projects but also for other developmental projects in Myanmar (Latt, T. S., *et al.,* 2019).

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Therefore, it is required to find the ways and means to be able to disseminate diabetes knowledge effectively and efficiently to the target adopters.

1.1 Rationale of the Study

Nowadays, non-communicable diseases are threatening and challenging the health of human beings. The major cause of mortalities in the world is analyzed and found out to be non-communicable diseases. Among several non-communicable diseases, ischaemic heart disease (IHD), cancers, diabetes and chronic lung diseases are regarded as major non-communicable diseases by WHO. Worldwide prevalence of diabetes is about 347 million and WHO predicted that mortality due to diabetes will become seventh highest in 2030. Between 50% and 80% of diabetic patients are also detected of dying due to coronary vascular diseases (Singh, D. P. K, 2016).

High prevalence among Myanmar population and risky behaviours of IHD, cancers, chronic respiratory diseases are also discovered widely. In order to prevent these non-communicable diseases effectively, prevention activities for cigarette and tobacco use, much alcohol drinking, lack of physical exercise, infrequently having fruits and vegetables, obesity, hypertension, hypercholesterolemia are needed to function in nationwide progressively. According to Diabetes Prevalence and NCD Risk Factors Survey in 2014 in Myanmar, it was discovered that prevalence of diabetes among 25 to 64 years of age was about 10.5%. Calculating with this rate, there were about 2.5 million expected of patients with diabetes in Myanmar. Comparing prevalence, it was also higher than other neighborhood countries. As there may be 8 IHD in every 10 diabetic patients, there would be many individuals with risk of ischaemic heart disease (Latt, T. S., *et al.,* 2016).

Diabetic health care education is very important in developing countries. Diabetes represents one of the biggest public health challenges facing people in Myanmar. Thus, diabetes health campaigns are delivered to diabetic patients. Therefore, this study aims to analyze the social marketing tools to promote the acceptability of the social idea or practice of diabetic health care and influence of social marketing on behaviour changes and its outcomes of Diabetes Mellitus patients in Yangon Region, Myanmar.

1.2 Problem Statement of the Study

Diabetes Mellitus now becomes the greatest world's health problem of 21stcentury. About 415 million people worldwide are suffering from diabetes according to the latest statistics issued by International Diabetes Federation in 2015. It is estimated that the total number of diabetic patients would be 642 million globally in 2040.

In Myanmar, the main issues of diabetic patients are lack of knowledge on health literacy, not doing annual medical check-up, not knowing the side effects of anti- diabetes drugs; lack of knowledge on importance of physical exercise, lack of knowledge on complication of diabetes mellitus, unavoiding the food concerning the issue of hyperglycemia, and not taking the diabetes drugs regularly. To analyze Myanmar’s culture and situations, it is essential to survey the influence of social marketing tools on behaviour changes of diabetic patients. Therefore, this study intends to find out the influence of social marketing on behaviour changes of diabetic patients in Yangon Region.

1.3 Research Aim and Questions

According to the research problem, research questions emerged.

(1) What tools of social marketing are influencing the behaviour changes of diabetic patients in Yangon Region, Myanmar?

(2) Is there moderating effect of demographic characteristics of diabetic patients regarding the relationship between social marketing tools and behaviour changes?

(3) How do behaviour changes affect on diabetic patients' outcomes?

1.4 Objectives of the Study

The general objective of the study is to analyze the influence of social marketing on behaviour changes and its outcomes of diabetic patients in Yangon Region. The specific objectives of the study are:

(1) To examine the influence of social marketing tools on behaviour changes of diabetic patients in Yangon Region.

(2) To identify the moderating effects of demographic characteristics on the relationship between social marketing tools and behaviour changes of diabetic patients in Yangon Region.

(3) To analyze the effect of behaviour changes on outcomes of diabetic patients in Yangon Region.

1.5 Method of Study

The respondents were selected from charity clinics, public medical outpatient departments (OPD) and private medical outpatient departments (OPD) healthcare centers because it was easier to recruit diabetic respondents on consultation days. As a sampling design, two-stage sampling procedure was utilized to collect the data for evaluating research objectives of this study. At first stage, the medical hospitals and clinics providing treatment to diabetes in Yangon Region are divided into three strata, such as government hospitals, private hospitals and charity clinics. The strata contain 26 government hospitals in first stratum, 56 private hospitals in second stratum and 55 charity clinics in third stratum. A stratified random sample of 3 hospitals is equally chosen from each stratum. At the second stage, each of 130 patients from endocrinologist's medical hospitals and clinics were selected by systematic random sampling from selected medical hospitals and clinics chosen in first stage. As a systematic sampling, every fifth patient were chosen as sample units to become the sample size of 390 patients from the selected sampled medical hospitals and clinics. The questions are to be measured with five-point Likert Scale, close and open ended as well as interview schedules.

Literature Review

This chapter presents the theoretical background which will be applied and used to analyze collected data and information and review of the relevant literature on social marketing and the conceptual framework of the study.

2.1 Background of Social Marketing

Social marketing was first defined by Kotler and Zaltman (1971) as "the design, implementation and control of programme calculated to influence the acceptability of social ideas and including considerations of product planning, pricing, communications and market research". The history of social marketing comes from the marketing, or academic, perspective in developed countries. This tradition overlooks the international contributions to the advancement of social marketing; it also omits an essential dynamic of social marketing. That dynamic is the tension between the practitioners who continue to push the practice of social marketing to solve numerous health and social puzzles and the academic marketers who debate whether these applications it their definitions of social marketing (Lefebvre, 2011).

2.2 Social Marketing Tools

In social marketing, the marketing mix is the tactics to set the strategies of social marketing. This tool may be handled at any time with the purpose of fitting the eight Ps.

(a) Product

Product is the first P in social marketing tools. In social marketing, the product is the behaviour or health idea that the campaign planners would like the targeted individuals to adopt. The product must be situated, presented and modified in such a way as to maximize benefits and minimize costs (Kotler & Lee, 2008; Kotler& Roberto, 1989; Lefebvre & Flora, 1988; Lefebvre, 2011; Peattie, 2009; Weinreich, 1999 and Wood, 2012).

(b) Price

Price is the second P in social marketing tools. Price means all costs involved in a concept of change, since the mains including non-monetary ones: physical, time, social, and psychological. Bernhardt, Mays and Hall (2012) perceived that the role of social marketers is to look for alternatives to decrease the costs and barriers for individuals.

(c) Place

Place is the third P in social marketing tools. Place means where, when, and how products are available for a target audience. Place is related to distribution channels and, because of their intangibility, product should be easily accessed everywhere (Bernhardt et al., 2012; Kotler& Lee, 2008).

(d) Promotion

Promotion is the fourth P in social marking tools. This is the most popular tool among health professionals. Promoting products is awareness and providing knowledge about the attitudes, intentions, and behaviour expected from the target audience and explaining how the campaign will support them (Glanz et al., 2008; Waisbord, Shimp, Ogden, &Morry, 2010).

(e) Process

Process is the fifth P in social marketing tools. Processes are the visible and non-visible activities to produce a social campaign. Lovelock and Wirtz (2011) believed that a poorly designed process will produce a slow, bureaucratic, and ineffective delivery, and then it will cause dissatisfaction to target audience regarding service quality.

(f) Professional

Professional is the sixth P in social marketing tools. According to Andreasen (1994), Brenkert (2002), Kotler and Lee (2008), and Wymer (2011), the skills of the staff team in social marketing campaign must be lined up in order to: (i) know or dominate the entire cycle of service processes from the start to finished with the purpose of delivering the quality of service to the target audience; (ii) manage conflicts between organization (sponsor) and target audience, in particular, the frontline team; and (iii) respect the moral and ethical patterns relative to their commitment and responsibility. Lefebre (2011) explained that the professional's skills make the difference in a health campaign.

(g) Performance

Performance is the seventh P in social marketing tools. The quantitative and qualitative indices are required to measure performance and quality. The performance aims to measure the provider's ability to deliver the benefits in a health campaign, respecting the individual's free-will and ethical patterns. Lovelock and Wirtz (2011) described five dimensions to evaluate the service quality in commercial marketing, which can be appropriated to health campaigns: tangibility the appearance of physical elements (facilities); reliability accuracy of performance, i.e., the guarantee; responsiveness, quickness and helpfulness; security credibility, expertise, safety, and understanding of the requirements of individuals.

(h) Program

Program is the last P in social marketing tools. Program should contain all activities required to develop a health campaign. Kotler and Roberto (1989), Kotler and Lee (2008), and Weinreich (1999) defined program of social marketing plan helps professionals to get performance and quality in social campaigns, introduce the consumer orientation in each step to ensure benefits; prioritize actions.

2.3 The Outcome Model for Health Promotion

Health promotion is an activity directed towards enabling people to take action. Participation and partnership are valuable processes in health promotion (Nutbeam & Harris, 1999). This in turn leads to Social Outcomes (an improved quality of life), and this finally will provide a Health Outcome: good health.

(a) Health Status

The state of health of a person or population evaluated with reference to morbidity, impairments, anthropological measurements, death rate, and indicators of functional status and quality of life. The WHO health indicators provide internationally accepted standards for various aspects of health status. World Health Organization guides health policy in its Member States toward priority health problems, the use of solutions known to them, and relevant directions for problem-orientated research to improve the efficiency for health development.

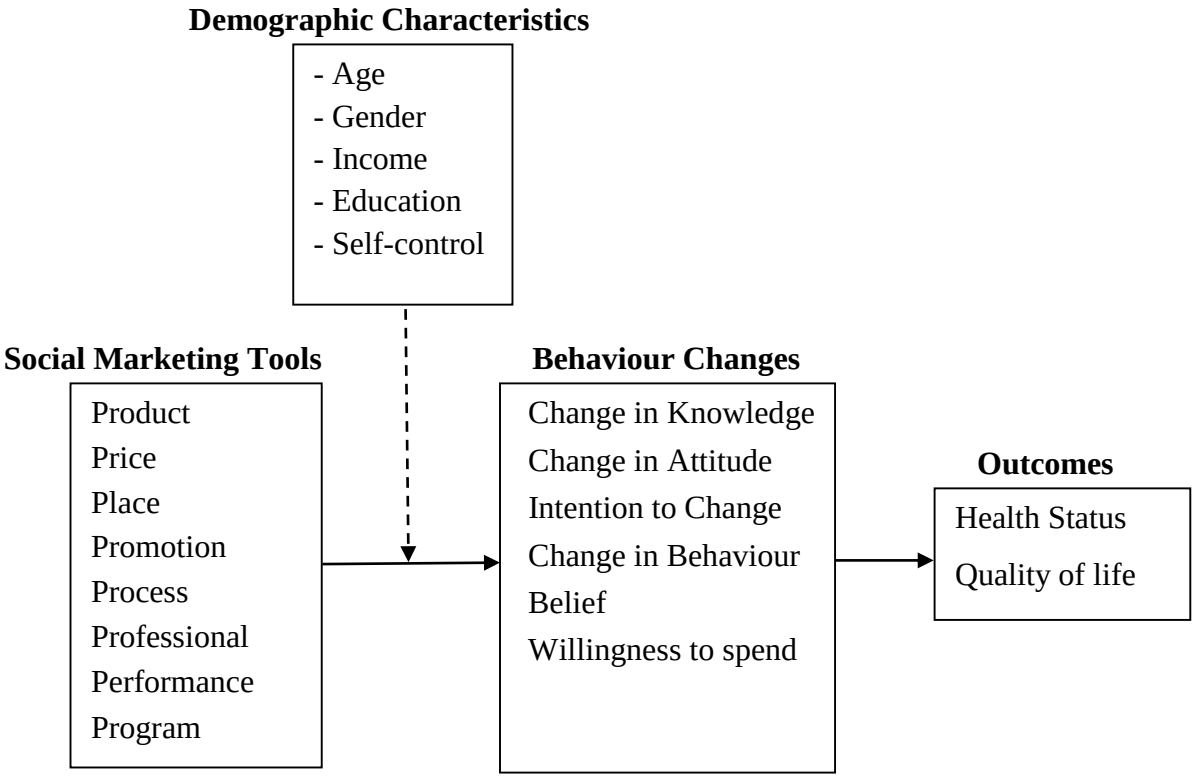
(b) Quality of Life

The concept of quality of life broadly encompasses show an individual measures the 'goodness' of multiple aspects of their life. The see valuations include one's emotional reactions

to life events, disposition, sense of life fulfillment and satisfaction, and satisfaction with work and individual relationships (Diener, Suh, Lucas, & Smith, 1999).

2.4 Conceptual Framework of the Study

Based on the various theories and concepts found in contemporary literatures, the present study attempts to analyze the influence of social marketing on behaviour changes of diabetic patients. In Figure (2.1), the conceptual framework of the study is presented. In this framework, valid measures are used to measure the behaviour or action of diabetic patients in Yangon Region.



Source: Own Compilation, 2020

Figure 2.1 Conceptual Framework of the Study

According to the research objectives, this conceptual framework uses to solve the research questions. There are four groups of variables in this study: Social marketing tools, Demographic characteristics, Behaviour changes and Outcomes. In the conceptual framework, the first part of independent variables of social marketing tools; there are product, price, place, promotion, process, professional, performance and program based on marketing mix theory. The moderating factors are age, gender, income, education and self-control. The mediating factors are change in knowledge, change in attitude, intention to change, change in behaviour, belief and willingness to spend and the dependent variables are outcomes; such as health status and quality of life based on Logic Model on the Effects of Social Marketing (Rebecca Firestone, Cassandra J. Rowe, Shilpa N. Modi& Dana Sievers, 2016), The DSM-IMB Model(Tingting Liu, Dongmei Wu, Jing Wang, Changwei Li, Rumei Yang, Song Ge, Yan Du &Yanyan Wang, 2018) and PSI's PERForM Framework (PSI's Research and Metric Department, 2004).

According to the conceptual framework of the study hypotheses were occurred. The following are hypotheses of this study;

H_1: Social marketing tools have positive and significant effect on behaviour changes.

H_2: Demographic characteristics have moderating effect on the relationship between social marketing tools and behaviour changes.

H_3: Behaviour changes have positive and significant effect on diabetic patients' outcomes.

Research Methodology

3.1 Research Design

This study is conducted based on the descriptive and analytical research method to arrive at finding and conclusion. Descriptive method is used to present the diabetic patients' demographic characteristics, psychological characteristics and behaviour. The analytical research method is used to analyze the characteristics which explain the impact of demographic, psychological characteristics and social marketing strategies on the behaviour of diabetic patients.

3.1.1 Sample Size Determination

In this study, populations of diabetic patients in Yangon Region were unknown. To identify the sample size, the following formula of Cochran's (1977) method was applied:

$$n = \frac{Z^2 pq}{E^2}$$

where; n =sample size

z =table value for selected alpha level at 95% confidence interval

p =0.5 is the estimated proportion of an accredit that is present in the population

q=1-p = 0.5

E=acceptable margin of error for proportion being estimated = 0.05

$$N = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2} = 384.16$$

Thus, the required sample size of this study is at least 385.

3.1.2 Sampling Procedure

The unit of analysis of this study was diabetic patients in charity clinics, government hospitals, and private hospitals. For all of the objectives, two stages sampling procedure was used to sample the respondents with diabetes mellitus. As the first stage of sampling, the stratified random sampling method was applied to collect the hospital for the treatment of diabetes mellitus from each stratum. In the stratified random sampling, strata were classified into three stratum such as government hospitals, private hospitals, and charity clinics. After choosing these selected hospitals and charity clinics for the treatment of diabetes, 130 patients who were taking treatment from endocrinologists were selected by using systematic sampling from each selected stratum that already chosen in first stage. In the second stage, every fifth diabetic patients who enter those

selected hospitals or clinics were chosen by using systematic sampling method. Although the required sample size for this study was computed as at least 385, a sample of 390 patients was selected in this stage.

3.2 Reliability and Validity Test

The validity and reliability of research measures are crucial parts of any survey, which must be assessed and examined in order to make sure of the goodness of the measures used in the research. A reliable research instrument may not be necessarily valid. The reliability is in need but it isn't a sufficient condition for validity. The reason for this is that a reliable measure may be reliable, but it can be measuring something else other than what it is originally designed to measure. This suggests that assessing the validity of a research instrument is more difficult than assessing its reliability. However, both validity and reliability are crucial aspects for measures that are interconnected and overlap to some degree (Sekaran & Bougie, 2003).

3.3 Multiple Regression Analysis

In this research, descriptive statistics is used to describe demographic background of respondents' profile, social marketing tools such as product, price, place, promotion, process, professional, performance, and program, and behaviour changes factors, and outcomes of diabetic patients. Multiple regression analysis was used to analyze the social marketing tools and explain the influencing on the independent variable- product, price, place, promotion, process, professional, performance, and program on dependent variable behaviour changes. Moreover, regressed the analysis of independent variable behaviour changes on dependent variable.

The multiple regression analysis was applied to influencing factors such as product, price, place, promotion, process, professional, performance, and program, and behaviour changes factors, and outcomes of diabetic patients. To explore the product, price, place, promotion, process, professional, performance, and program were used the independent variable and behaviour changes were used dependent variables. Moreover, behaviour changes were used independent variable and outcomes were used dependent variables. The statistical packages for social science (SPSS) Version 23 were used to analyze the multiple regression analysis.

Analysis on Social Marketing Tools, Behaviour Changes and Outcomes of Diabetic Patients in Yangon Region

This chapter presents the analysis of outcomes of diabetic patient that consists of research design including research variables used in this research and multiple linear regressions.

4.1 Demographic Characteristics of Respondents

The initial phase of analysis is to determine the characteristics of the respondents involved in the study. The sample includes 252 females and 138 males indicating that the female is the majority with the response rate of (64.6 %) while the remaining is male (35.4%). Age of respondents is divided into three groups such as between 28 and 48 years old, between 49 and 69 years old, and above 69 years old. The age level between 49 and 69 years old is largest group (59.2%) while diabetic patients with above 69 years old are the smallest group (18.7%).

Marital status of respondents is classified into four groups; married, single, divorced and widowed. About 70% of the respondents are married. Occupation of respondents is classified into six groups; government staff, private staff, owns business, manual workers, dependent and others.

Nearly half of the respondents are dependent. Income level of diabetic patients is classified into seven groups ranking from no income to 11,00,001 kyats & above. Among them, diabetic patients the largest with 46.4% (between 300,001kyats to 500,000 kyats) and diabetic patients the smallest with 2.8%(no income, between 500,001 kyats to 700,000 kyats between 700,001kyats to 900,000 kyats, and between 900,001 kyats to 11,00,000 kyats).

Education levels of diabetic patients are divided into eight groups; primary, middle, high school passed, diploma, graduate, master, PhD and others. About 40% of the respondents are high school pass. To know the self-control of diabetic patients, these patients are asked the questions related to whether avoiding food, testing blood sugar level, taking medicine regularly, doing exercises, and follow up doctors regularly.

4.2 Influence of Social Marketing Tools on Behaviour Changes of Diabetic Patients, Yangon

Multiple regression analysis was performed to observe the relationship between the independent variables (social marketing tools) and dependent variable (behaviour changes).

Influence of Social Marketing Tools on Behaviour Changes

In the following analysis, the independent variables are social marketing tools and dependent variable is behaviour changes. The results of the relationship between social marketing tools and behaviour changes are presented in the Table (4.1).

Table 4.1 Influence of Social Marketing Tools on Behaviour Changes

Dependent Variable: Behaviour Changes	Unstandardized Coefficients		Standardized Coefficients	t	Sig	VIF
	B	SE	Beta			
(Constant)	.036	.282		.126	.900	
Product	.124**	.056	.102	2.240	.026	2.361
Price	.120**	.048	.136	2.500	.013	3.378
Place	.011	.043	.009	.249	.803	1.486
Promotion	.320***	.053	.311	6.014	.000	3.049
Process	-.044	.035	-.047	-1.271	.205	1.570
Professional	.157**	.070	.100	2.247	.025	2.250
Performance	.296***	.057	.301	5.195	.000	4.072
Program	.085	.055	.060	1.536	.125	1.740
R^2	0.666					
Adjusted R^2	0.659					
F statistics	94.775***					

Source: Survey data (2021)
Statistically significant indicate ***at 1%, ** at 5%, * at 10% level respectively

In Table (4.1) the value of the F test statistics shows the overall model is highly significant at 1% level. In this analysis, social marketing tools variables of promotion and performance strongly influence on behaviour changes of diabetic patients at 1% level of significant. Moreover, social marketing tools variables of product, price and professional influence on behaviour changes of diabetic patients at 5% level of significant. According to the Table (4.1), standardized coefficient

(Beta) of promotion is highest, performance is second highest, price is the third highest and then product and professional are fourth and last highest influencing power on behaviour changes of diabetic patients.

Hypothesis 1 tried to test the relationship between social marketing tools and behaviour changes of diabetic patients. Relating to the promotion of social marketing tools, it is found in this study that the role of promotion has influence on behaviour changes of diabetic patients because the doctors give add on health knowledge to diabetic patients that uncontrolled diabetes can lead to complications such as loss of vision, kidney damage, stroke, myocardial infarct and hypertension, government hospitals and charity clinics give treatment, blood tests and some kinds of drugs free of charge and consequently, the diabetic patients also go regular clinic visits, take medicines regularly and follow the guidance of doctors in diet and lifestyle modification and also achieved improvement in behaviour changes. Concerning the performance of social marketing tools, it is found in this study that the role of performance has influence on behaviour change of diabetic patients because the doctors repeatedly give health knowledge about diet and lifestyle habits to diabetic patients, the patients also follow the guidance of doctors in their diet and lifestyle habits and achieved improvement in behaviour changes.

4.3 Moderating Effect of Demographic Factors

The moderating effect analyzed using SPSS multiple regression and the results are as follow by model 1, model 2, and model 3. Before the analysis the moderating effect analyzed of multiple regression, firstly correlation analysis the relationship between social marketing tools and behaviour changes, secondly analysis the relationship between behaviour changes and moderating variables (demographic factors: Age, Gender, Education, Income, Self -control), and then thirdly analysis the multiple regression of moderating effect of social marketing tools and behaviour changes Table (4.2).

Moderating Effect of Education and Self Control on the relationship between Social Marketing tools and Behaviour Changes

The analysis on moderating effect of education and self-control on the relationship between social marketing tools and behaviour changes is shown in Table (4.2). According to the Table (4.2) results, social marketing tools are correlated with behaviour changes (Model 1) and social marketing tools, education and self-control within diabetic patients are related to behaviour changes (Model 2). Other demographic factors such as age, gender, and income are not correlated in relationship between social marketing tools and behaviour changes of diabetic patients. Social marketing tools, education and the interaction between social marketing tools and education are related to behaviour changes of diabetic patients (Model 3).

Table 4.2 Moderating Effect of Education and Self-control on the Relationship between Social Marketing Tools and Behaviour Changes

Dependent Variable: Behaviour Changes	Model 1				Model 2				Model 3			
	B	SE	t	Sig	B	SE	t	Sig	B	SE	t	Sig
(Constant)	1.139	.248	4.587	.000	.671	.277	2.421	.016	3.890	1.404	2.770	.006
Social Mkt Tools	1.370***	.063	21.808	.000	1.299***	.063	20.787	.000	2.125***	.360	5.899	.000
Education					.035***	.009	3.905	.000	.515***	.155	3.323	.001
Self-Control					.215***	.052	4.109	.000	1.317	.964	1.367	.172
Social Mkt- Education									.123***	.040	3.104	.002
Social Mkt- Self-Control									.395	.249	1.587	.113
R^2	0.551				0.594				0.605			
Adjusted R^2	0.550				0.591				0.599			
F statistics	475.595***				188.289***				117.396***			

Source: Survey data (2021)
Statistical significance Indicate *** at the 1% level, ** 5% level and * 10% level

Hypothesis 2 proposed that demographic characteristics have moderating effect on the relationship between social marketing tools and behaviour changes. From the Table (4.2), it can be seen that the education of demographic characteristics has positive and significant relationships with social marketing tools and behaviour changes of diabetic patients were accepted. The results suggest that the education level of respondents has a significant moderating effect on the relationship between social marketing tools and behaviour changes.

4.4 Effect of Behaviour Changes on Outcomes of Diabetic Patients

This section presented the multiple regressions analysis performed to observe the relationship between the independent variable (behaviour changes) and dependent variable of outcomes such as health status and quality of life of diabetic patients.

The multiple regressions analysis of dependent variable health status and independent variable behaviour changes is shown in the Table (4.3).

Table 4.3 Effect of Behaviour Changes on Health Status of Diabetic Patients

Dependent Variable: Health Status	Unstandardized Coefficients		Standardized Coefficients	t	Sig	VIF
	B	SE	Beta			
(Constant)	4.398	.208		21.174	.000	
Change in Knowledge	.238***	.071	.295	3.340	.001	3.124
Change in Attitude	.240***	.063	.298	3.796	.000	2.479
Intention to Change	.115*	.059	.144	1.925	.055	2.249
Change in Behaviour	.096	.059	.132	1.626	.105	2.663
Belief	.110	.071	.145	1.557	.120	3.494
Willingness to Spend	.095**	.039	.162	2.430	.016	1.788
R^2	0.046					
Adjusted R^2	0.031					
F statistics	3.044***					

Source: Survey data (2021)
Statistically significant indicate ***at 1%, ** at 5%, * at 10% level respectively

In Table (4.3), behaviour changes variables of change in knowledge and change in attitude strongly effect on health status of diabetic patients at 1% level of significant and willingness to spend effect on health status of diabetic patients at 5% level of significant. In addition, intention to change effects on health status of diabetic patients at 10% level of significant effect. According to the results, two behaviour changes factors, change in knowledge and change in attitude have 1% significantly positive effect on health status of diabetic patients.

Hypothesis 3 tried to test the relationship between behaviour changes and health status of diabetic patients. About the change in attitude of behaviour changes factors, it is found in this study that the role of change in attitude has effect on health status of diabetic patients because the mindset of diabetic patients has improved that doing regular physical exercise and weight reduction to prevent obesity can lower the risk of diabetic complications and save lives and consequently, their health status becomes better. As regards the change in knowledge of behaviour changes factors, it is found in this study that the role of change in knowledge has effect on health status of diabetic patients because the knowledge of diabetic patients has improved that one of the causes of diabetes is improper diet and lifestyle leading to increased blood glucose level and they get the knowledge of having balanced diet (half of plate is vegetable, one fourth is rice and another one fourth is meat) and consequently, their health status becomes better. The multiple regressions analysis of dependent variable quality of life and independent variable behaviour changes is shown in the Table (4.4).

Table 4.4 Effect of Behaviour Changes on Quality of Life of Diabetic Patients

Dependent Variable: Quality of Life	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig**	**VIF**
	B	**SE**	**Beta**			
(Constant)	1.813	.162		11.195	0.000	
Change in Knowledge	.084	.055	.103	1.511	0.132	3.124
Change in Attitude	.049	.049	.060	.997	0.319	2.479
Intention to Change	.041	.046	.050	.877	0.381	2.249
Change in Behaviour	.100**	.046	.136	2.169	0.031	2.663
Belief	.233***	.055	.303	4.219	0.000	3.494
Willingness to Spend	.086***	.030	.144	2.812	0.005	1.788
R^2	0.436					
Adjusted R^2	0.427					
F statistics	49.331***					

Source: Survey data (2021)

Statistically significant indicate ***at 1%, ** at 5%, * at 10% level respectively

In Table (4.4), behaviour changes variables of belief and willingness to spend strongly effect on quality of life of diabetic patients at 1% level of significant and change in behaviour effects on quality of life of diabetic patients at 5% level of significant. The coefficient of change in knowledge, change in attitude and intention to change are not significant. According to the results, two behaviour changes factors, belief and willingness to spend have 1% significantly positive effect on quality of life of diabetic patients.

Hypothesis 3 tried to test the relationship between behaviour changes and quality of life of diabetic patients. Regarding the belief of behaviour changes factors, it is found in this study that the role of belief has effect on quality of life of diabetic patients because they believe that the factors such as living away from stress, anxiety and anger, proper dietary habit and doing regular physical exercise are more beneficial than oral drugs and insulin and consequently, their quality of life becomes better. In view of the willingness to spend of behaviour changes factors, it is found in this study that the role of willingness to spend has effect on quality of life of diabetic patients because they take time to do regular blood glucose tests as advised by doctor and they also willingly take time to go to doctors as quickly as possible to get prompt treatment in case of neuropathy and foot ulcers and consequently, their quality of life becomes better.

Conclusion

Based on the results of the data analysis, the last chapter is devoted to draw the conclusion on the results of this study.

5.1 Findings and Discussions

After carrying out this study, the conclusion is that social marketing tools are important factors to behaviour changes because they help them to adapt better and smooth social changes that are rapidly occurring and leads to improving respondents' (diabetic patients) health status, quality of life and satisfaction in community.

In selected diabetic patients (respondents), this study selected from the population of 390 who were treated in charity clinics, government hospitals, and private hospitals in Yangon. Among the respondents, female was higher than male and most of the respondents of diabetic patient age was 49-69 years. Moreover, most of the respondent income was 300,001-500,000 kyats (46.4%).

According to analysis results, eight variables in social marketing tools such as (product, price, place, promotion, process, professional, performance, and program), among them performance, promotion and process have positive effect on change in knowledge, product and performance have positive effect on change in attitude, promotion tool has positive effect on intention to change, promotion, performance, product and program have positive effect on change in behaviour, performance, promotion, price and professional have positive effect on belief, performance and promotion have positive effect on willingness to spend and promotion and performance have positive effect on behaviour changes of diabetic patients.

This study shows that the change in knowledge of diabetic patients is mainly due to the influence of social marketing tools (performance, promotion and process) than other social marketing tools. The diabetic patients get much health knowledge and they also possess change in knowledge because the doctors treat the patients patiently, share health knowledge, give add on health knowledge about the diabetic complications as health promotion and also give systematic treatment with planning.

This study exhibits that the change in attitude of diabetic patients is mainly due to the influence of social marketing tools (product and performance) than other social marketing tools. The diabetic patients achieve change in attitude on diabetes because doctors and social marketers repeatedly give health knowledge to diabetic patients to get good glycemic control such as to avoid improper diet, smoking and alcohol and to have healthy diet and to do regular physical exercise.

This study reveals that the intention to change of diabetic patients is mainly due to the influence of social marketing tool (promotion) than other social marketing tools. The diabetic

patients achieve intention to change for diet and lifestyle modification because the doctors give add on health knowledge to patients as health promotion that uncontrolled diabetes can lead to its complications such loss of vision, kidney damage, myocardial infarct and hypertension.

In this study, it is found that the change in behaviour of diabetic patients is mainly due to the influence of social marketing tools (promotion, performance, product and program) than other social marketing tools. The diabetic patients get much health knowledge and achieve change in behaviour because doctors and health staffs do health education campaigns to deliver diabetic information to patients effectively and quickly and Myanmar Diabetes Association holds memorial ceremonies to give opportunities to patients such as free consultation with diabetes specialists, arranging health talks, sharing health education pamphlets and doing mass public physical exercise.

This study conveys that the belief of diabetic patients is mainly due to the influence of social marketing tools (performance, promotion, price and professional) than other social marketing tools. The diabetic patients attain belief that they can live full life-span if they have healthy dietary and lifestyle habits and good glycemic control because the doctors give treatment and guide to prevent further attacks of rare and mild side effects of some anti-diabetic drugs and advise to do necessary blood tests to get early detection and prompt treatment.

This study points out that the diabetic patients have willingness to spend for diabetes is mainly due to the influence of social marketing tools (performance and promotion) than other social marketing tools. As advised by doctors, the diabetic patients willingly spend time and money for regular follow up visits to clinics, for using FDA approved glucometer and for doing necessary blood tests for early detection and prompt treatment of diabetic complications.

This study proves that the behaviour changes of diabetic patients are mainly due to the influence of social marketing tools (promotion and performance) than other social marketing tools. The diabetic patients attain healthy dietary and lifestyle habits as advised by doctors and behaviour changes because the doctors give add on health knowledge that uncontrolled diabetes can lead to deadly complications, free medical treatment, blood tests and drug supply at government hospitals and charity clinics, sharing diabetic health knowledge on social media and treatment to patients with patience, responsibility and safety.

To analyse the moderating factors of demographic characteristics of the respondents (diabetic patients) include gender, age, income, education, and self-control effect on relationship between social marketing tools and behaviour changes. Among the respondents, there were more female than male, but gender imbalance did not influence the study in any way. According to the analysis, gender, age and income also did not effect on relationship of social marketing tools and behaviour changes. From the data on education level of the respondents, most of them passed a high school. Education factor and self-control factor are the correlated between relationship of the social marketing tools and behaviour changes. The result of the moderating analysis shows that the education level of respondents has effect on the relationship between social marketing tools and behaviour changes.

Finally, behaviour changes are positively related to outcomes such as health status and quality of life. According to results, six variables in behaviour changes among them change in knowledge and change in attitude have positive effect on health status and belief, and willingness to spend also have positive effect on quality of life.

In this study, it is found that the improvement of health status of diabetic patients is mainly due to the effect of change in attitude and change in knowledge of diabetic patients under the

influence of social marketing practices. The health status of diabetic patients has improved because they attain change in attitude and change in knowledge that healthy dietary and lifestyle habits, regular physical exercise and weight reduction to prevent obesity can protect them from diabetic complications and save their lives.

This study exhibits that the improvement of quality of life of diabetic patients is mainly due to the effect of belief and willingness to spend of diabetic patients under the influence of social marketing practices. The diabetic patients become healthier and attain good quality of life because they believe that practices such as living away from stress and anxiety, controlling dietary habits and regular physical exercise are more beneficial in treatment of diabetes than oral and injectable drugs and furthermore, as advised by doctors, they also willingly take time to do regular blood glucose test and to get prompt treatment for neuropathy and foot ulcers.

In conclusion, the health industry should focus on social marketing tools by giving most effort in conferences and discussions, without ignoring the workshops and seminars for sharing information of diabetes mellitus. Therefore, the effectiveness of the social marketing tools can be improved if the health industry could emphasize more in sharing information base on diabetes application as wiki.

5.2 Suggestions and Recommendations

Based on the findings of the study, the following factors including behaviour changes through social marketing tools are needed for better outcomes.

This study recommends that selected diabetic patients should mainly focus on influencing of social marketing tools on behaviour changes. It also shows that the needs of the behaviour changes and social marketing tools should be valued and health industry should take more effort to make better health development via improving social marketing tools. It is also recommended that diabetic patients should take into account both individual and operational needs when carrying out organizational assessment for behaviour changes.

Identification of needs of social marketing tools such as product, price, place, promotion, process, professional, performance, and program should be done more professionally with responsible person as well as the individuals involved together with influencer in society and social marketing specialist. Health sector should identify the social marketing tools needs in the organization that also covered departmental or team and individual plans. Only when the expectations of the patients and the action of health sector meet, the organization is more sustainable.

Another suggestion in social marketing on health education program should be focused on individualized or diabetic patient centered education that can enhance diabetic patients' self-management on their treatment regimen. As a result, patients can adhere to treatment regimen and manage their blood glucose level in normal limit or control level. A better structured education programme of social marketing intends not only to improve knowledge of diabetic patients but also to change their knowledge, attitude, intention, behaviour, belief and practice towards drug therapy, diet & lifestyle modification and regular exercise should be enhanced. Physical activity is one of the options of diabetes management, which increases insulin sensitivity, improves glycogen storage, allows for use of glucose in muscles more efficiently and reduces mortality. As doing physical exercise is very important for controlling blood sugar level and preventing of diabetes complications, every patient need to know about the implications of exercises and be encouraged for doing exercise regularly.

Individuals are influenced by factors acting at all stages of their life span and risk of developing diabetes including diabetes is more susceptible with increasing age. Diabetes and its risk factors are best addressed throughout the course of people's lives, through promotion of healthy behaviours and early diagnosis test and treatment through childhood, adolescence, adult life to old age. Thus, screening for diabetes is so costly, but it should be implemented in all high-risk groups in order to detect early diagnosis test and provide effective treatment. These should be done effectively at government level, private level and NGO level by using social marketing practices and individual level should participate in these programs.

5.3 Needs for Further Research

This section will attempt to explain the requirements of the further studies for the influence of social marketing on behaviour changes of diabetic patients in Yangon. Hence, the need for further research is to encourage the study on the social marketing tools and to give attention on the study on behaviour changes and outcomes of health status and quality of life of all places of charity clinics, government hospitals, and private hospitals in Myanmar. If so, the data obtained from the whole nation of charity clinics, government hospitals, and private hospitals will generate the result more accurate and comprehensive picture to capture the key factors of social marketing tools from the diabetic patients in health industry. Another need for further research is to focus on using other social marketing tools such as public, pure string, people, partnership, polices, physical evidence, physical environment and other related factors and so on. The main factors in this research are social marketing tools, behaviour changes, and outcomes. Although diabetic patients from government hospitals, private hospitals and charity clinics are studied altogether in this study, further research can be done by separating specific types of hospitals and clinics in different layers. In addition to diabetes mellitus, TB, malaria, HIV, CA, Covid-19 and so on can be studied in further research. Therefore, this study can be further investigated by adding other variables which contributes for health industry.

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နောက်ဆက်တွဲများ

၂၀၂၂ ခုနှစ်အတွက် မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့် သိပ္ပံပညာရှင်အဖွဲ့ဆုအတွက် ပြိုင်ပွဲဝင် ပါရဂူကျမ်း/ သုတေသနအစီရင်ခံစာများစာရင်း

စဉ်		ပါရဂူကျမ်း/ သုတေသနအစီရင်ခံစာ အမည်	ဘာသာရပ်	ကျမ်းပြုစုသူ
၁	၁	Preparation, Characterization and Application of Carboxymethyl Cellulose-Polyvinyl Alcohol Composite Film *	ဓာတုဗေဒ	ဒေါက်တာထက်ထက်သန်းစိန် ကထိက၊ ဓာတုဗေဒ ရန်ကုန်တက္ကသိုလ်
၂	၁	Study on Pollution Monitoring Parameters of the Water Quality from Mandalay Area	ရူပဗေဒ	ဒေါက်တာမေဇင်ဦး ကထိက၊ ရူပဗေဒ မန္တလေးတက္ကသိုလ်
၃	၁	Assessment and Analysis of Landslides in Mawchi Mine Area, Pasawng Township, Bawlakhe District, Kayah State, Myanmar*	ဘူမိဗေဒ	ဒေါက်တာဇော်ဇော်သိန်း လက်ထောက်ဘူမိဗေဒအရာရှိ ဘူမိဗေဒလေ့လာရေးနှင့် ဓာတ်သတ္တု ရှာဖွေရေးဦးစီးဌာန၊ သယံဇာတနှင့် သဘာဝပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဝန်ကြီးဌာန
၄	၁	Childlessness among Marriage Women in Myanmar	အသုံးချ စာရင်းအင်း	ဒေါက်တာဝင်းနိုင်ဦး တွဲဖက်ပါမောက္ခ အသုံးချစာရင်းအင်း ရန်ကုန်စီးပွားရေးတက္ကသိုလ်
၅	၂	Estimation of Rate of Returns on Investment in Education in Myanmar*	အသုံးချ စာရင်းအင်း	ဒေါက်တာခင်မို့မို့ တွဲဖက်ပါမောက္ခ အသုံးချစာရင်းအင်း ရန်ကုန်စီးပွားရေးတက္ကသိုလ်
၆	၁	Influence of Social Marketing on Behaviour Changes of Diabetic Patients*	ဝါဏိဇ္ဇဗေဒ	ဒေါက်တာဟိန်းလတ် ကထိက၊ ဝါဏိဇ္ဇဗေဒ ရန်ကုန်အဝေးသင်တက္ကသိုလ်
၇	၂	Factors Affecting the Performance of Private High School Teachers in Yangon	ဝါဏိဇ္ဇဗေဒ	ဒေါက်တာခင်ဥမ္မာပပနိုင် ပါမောက္ခ၊ ဌာနမှူး၊ ဝါဏိဇ္ဇဗေဒ မြစ်ကြီးနားတက္ကသိုလ်
၈	၃	The Effect of Supply Chain Management Practices on Competitive Advantage and Organizational Performance of Wine Making Firms	ဝါဏိဇ္ဇဗေဒ	ဒေါက်တာသန်းသန်းဝင်း ပါမောက္ခ၊ ဌာနမှူး၊ ဝါဏိဇ္ဇဗေဒ ကျိုင်းတုံတက္ကသိုလ်

စဉ်		ပါရဂူကျမ်း/ သုတေသနအစီရင်ခံစာ အမည်	ဘာသာရပ်	ကျမ်းပြုစုသူ
၉	၄	The Effect of Social Media Marketing on Brand Equity of Myanmar Cosmetics*	ဝါဏိဇ္ဇဗေဒ	ဒေါက်တာချိုမာလွင် တွဲဖက်ပါမောက္ခ၊ ဝါဏိဇ္ဇဗေဒ ရန်ကုန်အဝေးသင်တက္ကသိုလ်
၁၀	၅	An Analysis on the Technical Efficiency of Paddy Production in Ayeyarwaddy Region (A Case Study of Danubyu Township)	စီးပွားပညာ	ဒေါက်တာသိန်းကို ပါမောက္ခ၊ ဌာနမှူး ၊ စီးပွားပညာ ထားဝယ်တက္ကသိုလ်
၁၁	၁	The Development of a Pedagogic Facilitating Model in Promoting Primary Students' Critical Thinking Skills*	ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှု	ဒေါက်တာအိအိဖြိုး ကထိက၊ ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှု ရန်ကုန်ပညာရေးတက္ကသိုလ်
၁၂	၂	An Analytical Study of Principal Leadership Practices and Teacher Collegiality in Basic Education Schools	ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှု	ဒေါက်တာခင်မြတ်နိုးဦး ကထိက၊ ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှု ရန်ကုန်ပညာရေးတက္ကသိုလ်
၁၃	၁	The Relationship among Work Environment, Psychological Capital and Work Engagement of Teacher Educators	ပညာရေးစိတ်ပညာ	ဒေါက်တာတင်ဇာအောင် ကထိက ၊ ပညာရေးစိတ်ပညာ ရန်ကုန်ပညာရေးတက္ကသိုလ်
၁၄	၂	The Impact of Metacognitive Awareness on English Reading Comprehension Ability of High School Students*	ပညာရေးစိတ်ပညာ	ဒေါက်တာဝင့်ဝါဝါထွန်း လက်ထောက်ကထိက ပညာရေးစိတ်ပညာ ရန်ကုန်ပညာရေးတက္ကသိုလ်
၁၅	၁	Integrating Collaborative Learning Techniques and Concept Mapping in Teaching Physics*	သင်ရိုးညွှန်းတမ်းနှင့်သင်ပြနည်း	ဒေါက်တာနန်းယဉ်ယဉ်မိုး ကျောင်းအုပ်ကြီး၊ အမှတ်(၈)အခြေခံ ပညာအလယ်တန်းကျောင်း မြောက်ဥက္ကလာပမြို့နယ်

* ဆုရ သုတေသနလုပ်ငန်း အစီရင်ခံစာဖြစ်ပါသည်။

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု

(ခ) ဂုဏ်ပြုလွှာမှတ်တမ်း (ဝိဇ္ဇာပညာရပ်)

ဂုဏ်ပြုလွှာမှတ်တမ်း (သိပ္ပံပညာရပ်)

ဂုဏ်ပြုလွှာမှတ်တမ်း (လူမှုရေးပညာရပ်)

နောက်ဆက်တွဲ ၃(ခ)

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ

ပညာရေးဝန်ကြီးဌာန

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု

(ဝိဇ္ဇာ ပညာရပ်)

၏ ဝိဇ္ဇာပညာရပ်ဆိုင်ရာ ----------

----------သုတေသနလုပ်ငန်းအတွက်

( ) ကြိမ်မြောက် မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုကို ချီးမြှင့်သည်။

ပြည်ထောင်စုဝန်ကြီး

ပညာရေးဝန်ကြီးဌာန

---------- ခုနှစ်၊ ---------- လ ( ) ရက်

နောက်ဆက်တွဲ ၃(ခ)

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ

ပညာရေးဝန်ကြီးဌာန

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့.

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု

(သိပ္ပံ ပညာရပ်)

၏ သိပ္ပံ ပညာရပ်ဆိုင်ရာ ----------

----------သုတေသနလုပ်ငန်းအတွက်

( ) ကြိမ်မြောက် မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုကို ချီးမြှင့်သည်။

ပြည်ထောင်စုဝန်ကြီး

ပညာရေးဝန်ကြီးဌာန

---------- ခုနှစ်၊ ---------- လ ( ) ရက်

၃ (ခ-၂) ဂုဏ်ပြုလွှာမှတ်တမ်း (သိပ္ပံ ပညာရပ်)

နောက်ဆက်တွဲ ၃(ခ)

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ

ပညာရေးဝန်ကြီးဌာန

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့.

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု

(လူမှုရေး ပညာရပ်)

၏ လူမှုရေးပညာရပ်ဆိုင်ရာ ----------

----------သုတေသနလုပ်ငန်းအတွက်

( ) ကြိမ်မြောက် မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆုကို ချီးမြှင့်သည်။

ပြည်ထောင်စုဝန်ကြီး

ပညာရေးဝန်ကြီးဌာန

---------- ခုနှစ်၊ ---------- လ ( ) ရက်

“မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အဖွဲ့ဆု” ရရှိသူ ပုဂ္ဂိုလ်များ၏ ကိုယ်ရေးအကျဉ်း

ဒေါက်တာထက်ထက်သန်းစိန်၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာထက်ထက်သန်းစိန်ကို ဧရာဝတီတိုင်းဒေသကြီး ပုသိမ်မြို့နယ် ရှောပြာကျေးရွာတွင် အဖ ဦးသန်းစိန်နှင့် အမိ ဒေါ်တင်မွေးတို့မှ ၁၉၉၁ နှစ်တွင် မွေးဖွားခဲ့ပါသည်။ ကျွန်မသည် မိသားစုထဲတွင် အငယ်ဆုံးသမီးဖြစ်၍ အကို ၂ ယောက်ရှိပါသည်။ ကျွန်မသည် မူလတန်းမှသတ္တမတန်းအထိ ပုသိမ်မြို့နယ် ရှောပြာကျေးရွာရှိ (အ.လ.က ရှောပြာ) ကျောင်းတွင် (၁၉၉၁-၂၀၀၄) ခုနှစ်ထိ ပညာဆည်းပူးခဲ့ပါသည်။ အဋ္ဌမတန်းမှ အထက်တန်းအထိကို ပုသိမ်မြို့နယ် (အ.ထ.က -၃) ကျောင်းတွင် (၂၀၀၄-၂၀၀၇) ခုနှစ်ထိ ပညာလေ့လာဆည်းပူးခဲ့ပါသည်။ ကျွန်မသည် တက္ကသိုလ်ဝင်စာမေးပွဲကို ၂၀၀၇ ခုနှစ်တွင် အောင်မြင်ခဲ့ပြီး ပုသိမ်တက္ကသိုလ်တွင် ဇီဝဓါတုဗေဒအထူးပြုဖြင့် ပထမနှစ်စတင် တက်ရောက်ခဲ့ပါသည်။ (၂၀၀၇-၂၀၁၁) ခုနှစ်ထိ ပုသိမ်တက္ကသိုလ်တွင် သိပ္ပံဂုဏ်ထူးဘွဲ့ကို ရရှိသည်အထိ တက်ရောက်ခဲ့ပါသည်။ ထို့နောက် ၂၀၁၄ ခုနှစ်တွင် မဟာသိပ္ပံဘွဲ့နှင့် ၂၀၁၅ ခုနှစ်တွင် မဟာသုတေသနဘွဲ့တို့ကို ရန်ကုန်တိုင်းဒေသကြီး၊ ကမာရွတ်မြို့နယ်ရှိ ရန်ကုန်တက္ကသိုလ်မှ ရရှိခဲ့ပါသည်။ ၂၀၁၅ ခုနှစ် ဖေဖော်ဝါရီလ ၂ ရက်နေ့တွင် ရန်ကုန်အဝေးသင်တက္ကသိုလ် ဓါတုဗေဒဌာနတွင် သရုပ်ပြရာထူးဖြင့် စတင်တာဝန် ထမ်းဆောင်ခဲ့ ပါသည်။ ဆက်လက်ပြီး ရန်ကုန်တက္ကသိုလ်တွင် ပါရဂူသင်တန်းအား ၂၀၁၆ ခုနှစ်တွင်စတင်တက်ရောက်ခဲ့ပြီး ၂၀၂၂ ခုနှစ်တွင် ပါရဂူဘွဲ့ကိုရရှိခဲ့ပါသည်။ (၁-၁၂-၂၀၁၉) တွင်သရုပ်ပြမှ လက်ထောက်ကထိကရာထူးသို့ ရန်ကုန်အဝေးသင်တက္ကသိုလ်တွင် ရာထူးတိုးခဲ့ပါသည်။ ဆက်လက်ပြီး ကထိကရာထူးကို (၁-၁၂-၂၀၂၁) မှစ၍ စတင်ထမ်းဆောင်ခဲ့ပြီး (၁၉-၁-၂၀၂၃) တွင် ရန်ကုန်အဝေးသင်တက္ကသိုလ်မှ ကလေးတက္ကသိုလ်သို့ ကထိကရာထူးဖြင့် ပြောင်းရွှေ့တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ အဆိုပါတက္ကသိုလ်တွင် (၁)နှစ် တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ ယခုလက်ရှိအချိန်တွင် ဒေါက်တာထက်ထက်သန်းစိန်သည် ကထိကရာထူးဖြင့် ဒဂုံတက္ကသိုလ် ဓါတုဗေဒဌာနတွင် (၁၃-၅-၂၀၂၄) မှစ၍ ယနေ့အထိ တာဝန် ထမ်းဆောင်လျက်ရှိပါသည်။

ဒေါက်တာဇော်ဇော်သိန်း၏ ကိုယ်ရေးမှတ်တမ်း

အဖ ဦးသိန်းထွန်းအောင်၊ အမိ ဒေါ်ဦးညိုစိန်တို့မှ ၁၉၇၇ ခုနှစ်၊ ဇူလိုင်လ (၅)ရက်နေ့တွင် ရန်ကုန်တိုင်း၊ ဒေါပုံမြို့နယ်၊ ဇေယျာသီရိရပ်ကွက်တွင်မွေးဖွားခဲ့ပါသည်။ မွေးချင်းညီအစ်ကို (၃)ဦး အနက် အငယ်ဆုံးသားဖြစ်ပါသည်။

သာကေတမြို့နယ်၊ အ.ထ.က(၁) ဒေါပုံမြို့နယ် စသည့်ကျောင်းများတွင် ပညာဆည်းပူးခဲ့ပါသည်။ ၁၉၉၆ ခုနှစ်တွင် အခြေခံပညာအထက်တန်း စာမေးပွဲကို (က) စာရင်းမှ အောင်မြင်ခဲ့ပါသည်။

ဒဂုံတက္ကသိုလ်၊ ဘူမိဗေဒဌာနတွင် ဘူမိဗေဒ(Geology)ဘာသာရပ်အထူးပြုဖြင့် တက်ရောက် ပညာဆည်းပူးခဲ့ပြီး ၂၀၀၃ ခုနှစ်တွင် B.Sc.(Q)ဘွဲ့ကို အောင်မြင်ခဲ့သည်။ ၂၀၀၄ မှ ၂၀၀၈ ခုနှစ်အထိ ရန်ကုန်တက္ကသိုလ်၊ ဘူမိဗေဒဌာနတွင် အင်ဂျင်နီယာဘူမိဗေဒ (Engineering Geology) ဘာသာရပ် အဓိကဖြင့် ဆက်လက်ပညာဆည်းပူးခဲ့ပြီး ၂၀၀၅ ခုနှစ်တွင် အသုံးချဘူမိဗေဒဘွဲ့လွန်ဒီပလိုမာဘွဲ့ (Dip.EG)၊ ၂၀၀၇ ခုနှစ်တွင် မဟာသိပ္ပံဘွဲ့ (M.Sc.) နှင့် ၂၀၀၈ ခုနှစ်တွင် မဟာသုတေသနဘွဲ့(M.Res.) တို့ကိုရရှိခဲ့ပါသည်။ ၂၀၁၂ ခုနှစ်တွင် ဘူမိဗေဒလက်ထောက်(၂)ရာထူးဖြင့် ဘူမိဗေဒလေ့လာရေးနှင့် ဓာတ်သတ္တုရှာဖွေရေးဦးစီးဌာနတွင် စတင်ဝင်ရောက်တာဝန်ထမ်းဆောင်ခဲ့ပြီး ၂၀၁၆ ခုနှစ်တွင် အင်ဂျင်နီယာ ဘူမိဗေဒဘာသာရပ်အထူးပြုဖြင့် ပါရဂူဘွဲ့သင်တန်းကို ရန်ကုန်တက္ကသိုလ်၊ ဘူမိဗေဒ ဌာနတွင် တက်ရောက်ခဲ့ပြီး ပါရဂူဘွဲ့ကျမ်းကိုပြုစုတင်သွင်းခဲ့သဖြင့် ၂၀၂၂ ခုနှစ်တွင် ပါရဂူဘွဲ့ကိုရရှိခဲ့ပါသည်။ ယနေ့အချိန်အထိ ဘူမိဗေဒလေ့လာရေးနှင့် ဓာတ်သတ္တုရှာဖွေရေး ဦးစီးဌာနတွင် လက်ထောက်ဘူမိဗေဒအရာရှိအဖြစ် အလုပ်တာဝန်များကို ထမ်းဆောင်လျက်ရှိပါသည်။

နောက်ဆက်တွဲ (ဂ-၃)

ဒေါက်တာအိအိဖြိုး၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာအိအိဖြိုးကို အဘ ဦးမောင်မြနှင့် အမိဒေါ်သန်းညွန့်တို့မှ (၅.၁၀.၁၉၈၆)တွင် မွေးဖွားခဲ့ပါသည်။ မွေးဖွားရာဇာတိမှာ ပဲခူးတိုင်းဒေသကြီး၊ သဲကုန်းမြို့နယ်၊ ကန်နှစ်ဆင့် အုပ်စု၊ ညောင်တန်းကျေးရွာ ဖြစ်ပါသည်။ (၂၀၀၃) ခုနှစ်တွင် တက္ကသိုလ်ဝင်တန်းစာမေးပွဲကို အောင်မြင်ခဲ့ပြီး မူလတန်းနှင့် အလယ်တန်းဆရာဖြစ် သင်တန်းကို (၂၀၀၃ နှင့် ၂၀၀၆)ခုနှစ်တို့တွင် အောင်မြင်ခဲ့ပါသည်။ ရန်ကုန်ပညာရေးတက္ကသိုလ်၌ (၂၀၀၈)ခုနှစ်တွင် ပညာရေးဘွဲ့ Bed သင်တန်းကို တက်ရောက် အောင်မြင်ခဲ့ပါသည်။ (၂၀၁၃)ခုနှစ်တွင် စတင်ဖွင့်လှစ်ခဲ့သော မဟာပညာရေးဘွဲ့ အရည်အချင်းစစ်သင်တန်းကို တက်ရောက်ခဲ့ပြီး (၂၀၁၅)ခုနှစ်တွင် မဟာပညာရေးဘွဲ့ကို ရရှိခဲ့ပါသည်။ ပါရဂူဘွဲ့ကို ၂၀၂၂ခုနှစ်တွင် ရရှိခဲ့ပါသည်။

အလယ်တန်းပြဆရာမအဖြစ် အထက (ခွဲ) မကျည်းကွင်းကျောင်းတွင် တာဝန်ထမ်းဆောင်ခဲ့ပြီး အထက်တန်းပြဆရာမအဖြစ် အထက(ခွဲ)အသရော်ကျောင်းနှင့် အထက ဝက်ပုတ်ကျောင်းတွင် (၂၀၁၀မှ ၂၀၁၅) ထိတာဝန်ထမ်းဆောင်ခဲ့ပြီး ရန်ကုန်ပညာရေးတက္ကသိုလ် ပညာရေးသဘောတရားဌာနသို့ နည်းပြရာထူးဖြင့် ၂၀၁၅ခုနှစ် အောက်တိုဘာလတွင် ပြောင်းရွှေ့တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ ယခုအခါတွင် ရန်ကုန်ပညာရေးတက္ကသိုလ်၊ ပညာရေးသဘောတရားနှင့် ပညာရေးစီမံခန့်ခွဲမှုဌာနတွင် ကထိကရာထူးဖြင့် တာဝန်ထမ်းဆောင်နေပါသည်။

ဒေါက်တာ ဝင့်ဝါဝါထွန်း၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာဝင့်ဝါဝါထွန်းကို အဖ ဦးစိုင်းမင်းမင်းထွန်း အမိ ဒေါ်မြင့်မြင့်ဦး တို့မှ ၁၉၉၁ခုနှစ် ဧပြီလ (၄) ရက်နေ့တွင် ရန်ကုန်တိုင်းဒေသကြီး၌ မွေးဖွားခဲ့ပါသည်။

(၂၀၀၇) ခုနှစ်တွင် တက္ကသိုလ်ဝင်တန်းစာမေးပွဲကို အောင်မြင်ခဲ့ပြီး (၂၀၁၁) ခုနှစ်တွင် ပညာရေးဘွဲ့ B.Ed. ၊ (၂၀၁၆) ခုနှစ်တွင် မဟာပညာရေးဘွဲ့ M.Ed. နှင့် (၂၀၂၂) ခုနှစ်တွင် ပညာရေးပါရဂူဘွဲ့ Ph.D. ကို ပညာရေးစိတ်ပညာအထူးပြုဖြင့် ရန်ကုန်ပညာရေးတက္ကသိုလ်မှ ရရှိခဲ့ပါသည်။ (၂၀၁၂) ခုနှစ်တွင် ပဲခူး မြို့နယ်၌ အလယ်တန်းပြဆရာမအဖြစ် တာဝန်ထမ်းဆောင်ခဲ့ပြီး (၂၀၁၄) ခုနှစ်တွင် အထက်တန်းပြဆရာမအဖြစ် ရာထူးတိုးမြှင့်ခြင်း ခံခဲ့ရပါသည်။

(၂၀၁၉) ခုနှစ်တွင် ရန်ကုန်ပညာရေးတက္ကသိုလ်၊ ပညာရေးစိတ်ပညာဌာနသို့ နည်းပြရာထူးဖြင့် ဌာနကူးပြောင်းတာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ ထို့နောက် (၂၀၂၁) ခုနှစ်တွင် ပညာရေးစိတ်ပညာဌာန၏ လက်ထောက်ကထိကရာထူးသို့ ရာထူးတိုးမြှင့်ခန့်ထားခြင်းခံရပြီး ယခုအခါ ရန်ကုန်ပညာရေးတက္ကသိုလ် ပညာရေးစိတ်ပညာဌာနတွင် လက်ထောက်ကထိက ရာထူးဖြင့် တာဝန်ထမ်းဆောင်လျက်ရှိပါသည်။

ဒေါက်တာဝင့်ဝါဝါထွန်းသည် (၂၀၁၆) ခုနှစ်တွင် AsTEN Journal of Teacher Education ၏ Volume (1), Issue (2) တွင် “Impact of Teacher Training Programs on Prospective Teachers’ Professional Attitude” ဟူသော သုတေသနစာတမ်းကို ရေးသားခဲ့ပါသည်။ (၂၀၂၁) ခုနှစ်တွင် မြန်မာနိုင်ငံဝိဇ္ဇာနှင့် သိပ္ပံပညာရှင်အဖွဲ့၏ (၂၁) ကြိမ်မြောက် သုတေသနစာတမ်းဖတ်ပွဲတွင် “Constructing English Reading Comprehension Ability Test for High School Students by Using an IRT Model” အမည်ဖြင့် သုတေသနစာတမ်း ဖတ်ကြားတင်သွင်းခဲ့ပြီး ယင်းနှစ်တွင်ပင် ရန်ကုန်ပညာရေးတက္ကသိုလ်တက္ကသိုလ်၏ သုတေသနဂျာနယ်၌ “Validation Study of Metacognitive Awareness Inventory for Myanmar High School Students” ဟူ၍ သုတေသနစာတမ်းကို ရေးသားခဲ့သည်။

နောက်ဆက်တွဲ (ဂ-၅)

ဒေါက်တာ နန်းယဉ်ယဉ်မိုး၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာနန်းယဉ်ယဉ်မိုးကို ၁၉၈၇ ခုနှစ် ဖေဖော်ဝါရီလ ၂၈ ရက်နေ့တွင် အဘ ဦးစောလှမိုး အမိ ဒေါ်ခင်ဌေးတို့မှ ရှမ်းပြည်နယ်၊ တောင်ကြီးခရိုင် ရပ်စောက်မြို့၌ မွေးဖွားခဲ့ပါသည်။ ၂၀၀၃ ခုနှစ်တွင် တက္ကသိုလ်ဝင်စာမေးပွဲကို ပဲခူးတိုင်းဒေသကြီး တောင်ငူခရိုင် အုတ်တွင်းမြို့တပ်နယ် အခြေခံပညာ အထက်တန်းကျောင်းမှ အောင်မြင်ခဲ့ပါသည်။ ၂၀၀၄ ခုနှစ်တွင် ဆရာအတတ်ပညာဒီပလိုမာကို တောင်ငူပညာရေးကောလိပ်မှ ရရှိခဲ့ပါသည်။ ၂၀၀၈ ခုနှစ်တွင် ပညာရေးဘွဲ့ကို လည်းကောင်း၊ ၂၀၁၅ ခုနှစ် တွင် မဟာပညာရေးဘွဲ့ကို လည်းကောင်း ရန်ကုန်ပညာရေးတက္ကသိုလ်မှ ရရှိခဲ့ပါသည်။ ၂၀၂၂ ခုနှစ် စက်တင်ဘာလတွင် ပညာရေးပါရဂူဘွဲ့ ကို ရန်ကုန်ပညာရေးတက္ကသိုလ်မှ ရရှိခဲ့ပါသည်။

ဒေါက်တာနန်းယဉ်ယဉ်မိုးသည် ပညာရေးဌာနတွင်(၂၀၀၈)ခုနှစ်၊ စက်တင်ဘာလ (၁)ရက်နေ့မှ စတင်၍ အလယ်တန်းပြရာထူးဖြင့် အခြေခံပညာ အထက်တန်းကျောင်း နတ်သံကွင်း၊ ကျောက်ကြီးမြို့နယ်တွင် စတင်တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ အထက်တန်းပြ ရာထူးဖြင့် ပဲခူးတိုင်းဒေသကြီး (အရှေ့) ရွှေကျင်မြို့နယ်ရှိ အထက(ခွဲ)ပဒဲကော၊ အထက(တပ်နယ်)တို့တွင် လည်းကောင်း၊ ရန်ကုန်တိုင်းဒေသကြီး အရှေ့ပိုင်းခရိုင် မင်္ဂလာတောင်ညွန့်မြို့နယ်ရှိ အထက(၇)တွင်လည်းကောင်း တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။

ဒေါက်တာနန်းယဉ်ယဉ်မိုးသည် ၂၀၁၇ ခုနှစ်မှ စတင်၍ ရန်ကုန်တိုင်းဒေသကြီး မရမ်းကုန်းခရိုင် မြောက်ဥက္ကလာပမြို့နယ်ရှိ အမှတ်(၈)အခြေခံပညာ အလယ်တန်းကျောင်းတွင် အလယ်တန်းကျောင်းအုပ်အဖြစ် တာဝန်ထမ်းဆောင်လျက် ရှိပါသည်။

ဒေါက်တာချိုမာလွင်၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာချိုမာလွင်ကို ၁၉၇၆ ခုနှစ် စက်တင်ဘာလ (၁၀) ရက်နေ့တွင် အဖ ဦးထွန်းလွင်၊ အမိ ဒေါ်ခင်စိမ်းတို့မှ ဧရာဝတီတိုင်း၊ ငပုတောမြို့နယ်၊ ချောင်းဝရွာတွင် မွေးဖွားခဲ့ပါသည်။ ၁၉၉၄ ခုနှစ်တွင် တက္ကသိုလ်ဝင်တန်းစာမေးပွဲကို ပုသိမ်မြို့၊ အ.ထ.က (၂) တွင် အောင်မြင်ခဲ့ပါသည်။ ဒေါက်တာချိုမာလွင်သည် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ ၂၀၀၂ ခုနှစ်တွင် B.Com ဘွဲ့ကိုလည်းကောင်း၊ ၂၀၀၆ ခုနှစ်တွင် M.Com ဘွဲ့ကိုလည်းကောင်း ၂၀၂၂ ခုနှစ်တွင် PhD (Commerce) ဘွဲ့ကိုလည်းကောင်း ရရှိခဲ့ပြီး မြန်မာနိုင်ငံဝိဇ္ဇာနှင့် သိပ္ပံပညာရှင်များအဖွဲ့မှ ချီးမြှင့်သည့် လူမှုရေးပညာဘာသာရပ် ပညာရှင်ဆုကို ဆွတ်ခူးရရှိခဲ့ပါသည်။

ဒေါက်တာချိုမာလွင်သည် ၂၀၀၃ ခုနှစ်၊ မတ်လ (၂၅) ရက်နေ့တွင် ရန်ကုန်စီးပွားရေး တက္ကသိုလ်၊ ဝါဏိဇ္ဇဗေဒဌာနတွင် နည်းပြရာထူးဖြင့် စတင် တာဝန်ထမ်းဆောင်ခဲ့ပြီး၊ ၂၀၁၄ ခုနှစ်၊ ဇွန်လ (၂၆) ရက်နေ့မှ ၂၀၁၅ ခုနှစ်၊ ဩဂုတ်လ (၃၁) ရက်နေ့ထိ မိတ္ထီလာစီးပွားရေးတက္ကသိုလ်၊ ဝါဏိဇ္ဇ ဗေဒဌာနတွင် လက်ထောက်ကထိက ရာထူးဖြင့်လည်းကောင်း၊ ၂၀၁၅ ခုနှစ် စက်တင်ဘာလ (၁) ရက် နေ့မှ ၂၀၂၀ ခုနှစ်၊ ဒီဇင်ဘာလ (၂၈) ရက်နေ့အထိ ရန်ကုန်စီးပွားရေးတက္ကသိုလ်၊ ဝါဏိဇ္ဇဗေဒဌာနတွင် လက်ထောက် ကထိကနှင့် ကထိက ရာထူးဖြင့်လည်းကောင်း၊ ၂၀၂၀ ခုနှစ်၊ ဒီဇင်ဘာလ (၂၈)ရက်နေ့မှ ယနေ့အထိ တွဲဖက်ပါမောက္ခ ရာထူးဖြင့်လည်းကောင်း တာဝန်ထမ်းဆောင်လျက်ရှိပါသည်။

ဒေါက်တာချိုမာလွင်သည် မိတ္ထီလာစီးပွားရေးတက္ကသိုလ်တွင် တာဝန်ထမ်းဆောင်စဉ် B.Com နှင့် B. Act ကျောင်းသား၊ ကျောင်းသူများသာမက၊ MBA ကျောင်းသား၊ ကျောင်းသူများအား ဘာသာရပ်ဆိုင်ရာ သင်ကြားပို့ချပေးခြင်းနှင့် ကျမ်းစာကြီးကြပ်ခြင်းများကိုဆောင်ရွက်ခဲ့ပါသည်။ ရန်ကုန်စီးပွားရေးတက္ကသိုလ်တွင် တာဝန်ထမ်းဆောင်ခဲ့ချိန်တွင်လည်း M.Com ကျောင်းသား၊ ကျောင်းသူများနှင့် Master of Marketing (MMM) သင်တန်းနှင့် Master of Banking Finance (MBF) သင်တန်းများ တွင်လည်း ဘာသာရပ်ဆိုင်ရာ သင်ကြားပို့ချခြင်းနှင့် ကျမ်းစာကြီးကြပ်ခြင်းများကို ဆောင်ရွက်ခဲ့ပါ သည်။ Exchange Programmme ဖြင့် ထိုင်းနိုင်ငံ ချင်းမိုင်မြို့ရှိ ချင်းမိုင်တက္ကသိုလ်၊ Kasikom Bank (K Bank)နှင့် Sian Commercial Book (SCB Bank) သို့ MBF ကျောင်းသား၊ ကျောင်းသူများနှင့်အတူသွားရောက် လေ့လာခဲ့ပါသည်။ သုတေသနစာတမ်းများ ဖတ်ကြားပြုစုခြင်းနှင့် နိုင်ငံအကျိုးပြု သုတေသနလုပ်ငန်းများကို ဆက်လက်လုပ်ဆောင်လျက်ရှိပါသည်။ ယခုလက်ရှိတွင် တွဲဖက်ပါမောက္ခ ရာထူးဖြင့် ရန်ကုန်အဝေးသင်တက္ကသိုလ်၊ စီးပွားရေးပညာဌာနတွင် တာဝန်ထမ်းဆောင်လျက်ရှိပြီး ရန်ကုန်အဝေးသင်တက္ကသိုလ်၏ ဘွဲ့ကြိုတန်းများဖြစ်သည့် BA (Economics) နှင့် BA (Business Management) ၏ အတန်းများတွင် ဘာသာရပ်ဆိုင်ရာများ သင်ကြားပို့ချခြင်းနှင့် Online Post Graduate Diploma in Business သင်တန်း၏ Project Supervisor အဖြစ် ဆောင်ရွက်လျက်ရှိပါသည်။

နောက်ဆက်တွဲ (ဂ-၇)

ဒေါက်တာခင်မို့မို့၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာ ခင်မို့မို့သည် ၁၉၇၆ ခုနှစ်၊ မေလ တွင် မွေးဖွားခဲ့ပါသည်။ ၂၀၀၂ ခုနှစ်တွင် .ရက်နေ (၅) ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှB.Econ (Stats)(Hons) ဘွဲ့ကိုလည်းကောင်း၊ ၂၀၀၅ ခုနှစ်တွင် M.Econ (Stats) ဘွဲ့ကိုလည်းကောင်း ရရှိခဲ့ပါသည်။ ၂၀၂၃ ခုနှစ်တွင် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ Ph.D (Stats) ဘွဲ့ကို ရရှိခဲ့ပါသည်။

ဒေါက်တာ ခင်မို့မို့သည် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်၊ စာရင်းအင်းပညာဌာနတွင် ၂၀၀၂ ခုနှစ်၊ ဇန်နဝါရီလ ရက်နေ့မှစတင်၍ နည်းပြအဖြစ် တာ (၂၅)ဝန်ထမ်းဆောင်ခဲ့ပါသည်။ ၂၀၁၀ ခုနှစ်၊ မတ်လ ရက်နေ့မှစ၍ လက်ထောက်ကထိကအဖြစ် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်နှင့် မိတ္ထီလာစီးပွားရေး (၈) တက္ကသိုလ်၊ စာရင်းအင်းပညာဌာနများတွင် တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ ကထိကအဖြစ် ၂၀၁၇ ခုနှစ်၊ ဒီဇင်ဘာလ ရက်နေ့မှ၍ ရန်ကုန်စီးပွားရေးတက္ကသိုလ် (၁)နှင့် မိတ္ထီလာစီးပွားရေးတက္ကသိုလ်၊ စာရင်းအင်း ပညာဌာနများတွင် တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။

ဒေါက်တာ ခင်မို့မို့သည် ရန်ကုန်စီးပွားရေးတက္ကသိုလ်၊ အသုံးချစာရင်းအင်းပညာဌာနတွင် ၂၀၂၀ ခုနှစ်၊ ဒီဇင်ဘာလ ရက်နေ့မှစတင်၍ ကထိကအဖြစ် တာဝန်ထမ်းဆောင်ခဲ့ပါသည်။ ယခု (၂၅)အခါ တွဲဖက်ပါမောက္ခအဖြစ် ၂၀၂၁ ခုနှစ်၊ အောက်တိုဘာလ မှစ၍ ယနေ့အထိ တာဝန်.ရက်နေ (၁၃) ထမ်းဆောင်ခဲ့ပါသည်။

ဒေါက်တာ ခင်မို့မို့သည်Estimation of Rate of Returns on Investment in Education in Myanmar နှင့်ပါတ်သက်သည့် စာတမ်းများကိုလေ့ပြုစုရေးသား၍ စာတမ်းများကိုလဲ ဖတ်ခဲ့ပါသည်။

ဒေါက်တာဟိန်းလတ်၏ ကိုယ်ရေးမှတ်တမ်း

ဒေါက်တာဟိန်းလတ်ကို ၁၉၇၉ ခုနှစ်၊ ဧန်နဝါရီလ (၅) ရက်နေ့တွင် ရန်ကုန်မြို့၌ အဖ ဦးသန့်ဇင်၊ အမိ ဒေါ်တင်မေဦး တို့မှ မွေးဖွားခဲ့ပါသည်။ ၁၉၉၆ ခုနှစ်တွင် အ.ထ.က (၁) ဒဂုံမှ တက္ကသိုလ်ဝင်တန်းစာမေးပွဲကို အောင်မြင်ခဲ့ပါသည်။ ၂၀၀၂ ခုနှစ်တွင် ရန်ကုန်အဝေးသင်တက္ကသိုလ်မှ BA (Economics) ဘွဲ့ကိုရရှိခဲ့ပြီး မဟာအရည်အချင်းစစ်သင်တန်းတက်ရောက်ရန် အဆင့်မှီခဲ့ရာ ၂၀၀၄ ခုနှစ်တွင် ရန်ကုန်စီးပွားရေးတက္ကသိုလ် ၌ B.Com (Qualify) တန်းကို တက်ရောက်ခဲ့ပါသည်။ ၂၀၀၈ ခုနှစ်တွင် မုံရွာစီးပွားရေးတက္ကသိုလ်မှ M.Com ဘွဲ့ ကိုရရှိခဲ့ပါသည်။ ၂၀၁၆ ခုနှစ်တွင် ရန်ကုန်စီးပွားရေးတက္ကသိုလ် ဝါဏိဇ္ဇဗေဒဌာနမှ ဖွင့်လှစ်သည့် PhD (Prelim) တန်းကို တက်ရောက်ခဲ့ပါသည်။ ၂၀၂၂ ခုနှစ်တွင် PhD (Commerce) ဘွဲ့ကိုရရှိခဲ့ပြီး Influence of Social Marketing on Behaviour Changes of Diabetic Patients ပါရဂူကျမ်းခေါင်းစဉ်ဖြင့် ရေးသားခဲ့ရာ မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်များအဖွဲ့မှ ချီးမြှင့်သည့် ပညာရှင်ဆုကို (လူမှုရေးပညာ) ဘာသာရပ်ဖြင့် ဆွတ်ခူးရရှိခဲ့ ပါသည်။

ရန်ကုန်စီးပွားရေးတက္ကသိုလ်မှ ဖွင့်လှစ်သည့် ဘွဲ့လွန်ဒီပလိုမာများဖြစ်သည့် Diploma in Development Studies ဘွဲ့ကို (၂၀၀၈) ခုနှစ်တွင်လည်းကောင်း၊ Diploma in Management Accounting ဘွဲ့ ကို (၂၀၀၉) ခုနှစ် တွင်လည်းကောင်း၊ Diploma in Research Studies ဘွဲ့ကို (၂၀၁၆) ခုနှစ်တွင်လည်းကောင်း ရရှိခဲ့ပါသည်။ Landon Chamber of Commerce Industry (LCCI, UK) မှ ချီးမြှင့်သည့် Diploma in Computerized Accounting ဘွဲ့ကိုလည်း (၂၀၀၆)ခုနှစ်တွင် ရရှိခဲ့ပါသည်။

ဒေါက်တာဟိန်းလတ်သည် ရန်ကုန်အဝေးသင်တက္ကသိုလ် စီးပွားရေးပညာဌာန၌ ၂၀၁၅ ခုနှစ် ဖေဖော်ဝါရီလ (၂) ရက်နေ့တွင် နည်းပြအဖြစ် စတင်တာဝန်ထမ်းဆောင်ခဲ့ပြီး၊ ၂၀၁၉ ခုနှစ် မတ်လ (၁) ရက်နေ့ တွင် လက်ထောက်ကထိက အဖြစ်လည်းကောင်း၊ ၂၀၂၁ ခုနှစ် ဒီဇင်ဘာလ (၁)ရက်နေ့တွင် ကထိက အဖြစ် လည်းကောင်း ယနေ့အချိန်အထိ ရာထူးအဆင့်ဆင့် တာဝန်ထမ်းဆောင်လျက်ရှိပါသည်။

ဒေါက်တာဟိန်းလတ်သည် ၂၀၁၈ ခုနှစ်တွင် ထိုင်းနိုင်ငံ၌ ကျင်းပသည့် 13th International Burma Studies Conference တွင် စာတမ်းသွားရောက်ဖတ်ကြားခဲ့ပါသည်။ ၂၀၁၉ ခုနှစ်တွင်လည်း ထိုင်းနိုင်ငံတွင် ကျင်းပသည့် The 3th SEAMEO SPAFA International Conference တွင် Co-author အဖြစ်သွားရောက်ခဲ့ ရပြီး ၎င်းနှစ်တွင်ပင် ဗီယက်နမ်နိုင်ငံသို့ Study Exchange Program and Global Leadership Skill Development ကိစ္စရပ်ဖြင့် စေလွှတ်ရာ သွားရောက်ခဲ့ရပါသည်။ ယခုအချိန်တွင် မိမိတာဝန်ကျရာ တက္ကသိုလ် ရှိ စီးပွားရေးပညာ ဌာနတွင် အလုပ်တာဝန်များကို တာဝန်ကျေပွန်စွာ ထမ်းဆောင်ရင်း ရန်ကုန်အဝေးသင်တက္ကသိုလ်၊ Ethical Review Committee တွင်တွဲဖက်အတွင်းရေးမှူးတာဝန်ကိုပါ ဆောင်ရွက်လျက်ရှိပါသည်။

မြန်မာနိုင်ငံ ဝိဇ္ဇာနှင့်သိပ္ပံပညာရှင်အမှုဆောင်အဖွဲ့

ဥက္ကဋ္ဌ - ဒေါက်တာသက်လွင်

ဒုတိယ ဥက္ကဋ္ဌများ- ဒေါက်တာဒေါ်ကြည်ကြည်လှ*၊ ဒေါက်တာမောင်ကျော်

အတွင်းရေးမှူး- ဒေါက်တာ ဝင်းထွန်း

တွဲဖက်အတွင်းရေးမှူး- ဒေါက်တာတင်မောင်ထွန်း၊ ဒေါက်တာအေးအေးခိုင်၊ ဒေါက်တာတင်တင်ထွေး

အဖွဲ့ဝင်များ

ဦးသီဟ*	ဒေါက်တာတင်ညို	ဒေါက်တာလှဖေ
ဦးကျော်မြင့်ဦး*	ဒေါ်ကယ်ရယ်အင်ချစ်သာ	ဒေါက်တာဦးဝင်း
ဒေါက်တာမျိုးသန့်တင်	ဒေါက်တာခင်သန်းဦး	ဒေါက်တာမောင်သင်း
ဒေါက်တာဒေါ်သန်းနွဲ့	ဒေါ်ခင်လတ်	

ပါရဂူကျမ်း သုတေသနလုပ်ငန်း အစီရင်ခံစာနှင့် သုတေသနစာတမ်းများ ထုတ်ဝေရေး ကော်မတီ

ဒေါက်တာသက်လွင်	ဥက္ကဋ္ဌ	ဒေါက်တာမောင်ကျော်	ဒုတိယဥက္ကဋ္ဌ
ဦးသီဟ*	အဖွဲ့ဝင်	ဒေါက်တာလှဖေ	အဖွဲ့ဝင်
ဒေါက်တာဒေါ်သန်းနွဲ့	အဖွဲ့ဝင်	ဒေါက်တာမောင်သင်း	အဖွဲ့ဝင်
ဒေါက်တာတင်ညို	အဖွဲ့ဝင်	ဒေါက်တာဦးဝင်း	အဖွဲ့ဝင်
ဒေါ်ကယ်ရယ်အင်ချစ်သာ	အဖွဲ့ဝင်	ဒေါက်တာမျိုးသန့်တင်	အတွင်းရေးမှူး
ဒေါ်ခင်လတ်	အဖွဲ့ဝင်	ဒေါက်တာခင်သန်းဦး	တွဲဖက်အတွင်းရေးမှူး

စာတည်းအဖွဲ့

ဒေါက်တာမောင်ကျော်	ဥက္ကဋ္ဌ	ဒေါ်ခင်လတ်	အဖွဲ့ဝင်
ဦးသီဟ*	အဖွဲ့ဝင်	ဒေါက်တာလှဖေ	အဖွဲ့ဝင်
ဒေါက်တာမျိုးသန့်တင်	အဖွဲ့ဝင်	ဒေါက်တာမောင်သင်း	အဖွဲ့ဝင်
ဒေါက်တာဒေါ်သန်းနွဲ့	အဖွဲ့ဝင်	ဒေါက်တာအေးအေးခိုင်	အဖွဲ့ဝင်
ဒေါက်တာတင်ညို	အဖွဲ့ဝင်	ဒေါက်တာဦးဝင်း	အတွင်းရေးမှူး
ဒေါက်တာခင်သန်းဦး	အဖွဲ့ဝင်	ဒေါ်ကယ်ရယ်အင်ချစ်သာ	တွဲဖက်အတွင်းရေးမှူး

နိုင်ငံတကာ ပညာရှင်အဖွဲ့များနှင့် ဆက်သွယ်ညှိနှိုင်းရေးမှူးများ

ဒေါ်ကယ်ရယ်အင်ချစ်သာ	ဒေါက်တာမောင်ကျော်
ဒေါက်တာမျိုးသန့်တင်	ဒေါက်တာတင်မောင်ထွန်း
ဒေါက်တာဒေါ်သန်းနွဲ့	ဒေါက်တာတင်တင်ထွေး
ဒေါက်တာတင်ညို	

* ၂၀၂၂ ခုနှစ်အတွင်း ကွယ်လွန်ကြသူတို့မှာ ဒေါက်တာဒေါ်ကြည်ကြည်လှနှင့် ဦးကျော်မြင့်ဦး ဖြစ်ပါသည်။

* ၂၀၂၄ ခုနှစ်အတွင်း ဦးသီဟ ကွယ်လွန်ခဲ့ပါသည်။