THE EFFECTIVENESS OF E-LEARNING INTEGRATION MODEL IN THE TEACHING OF MIDDLE SCHOOL SCIENCE

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Abstract

This research aimed to examine the effectiveness of an e-learning integration model in teaching middle school science. The study employed an experimental research design, utilizing quantitative methodologies. Specifically, a non-equivalent control group design, a type of quasi-experimental design, was implemented for the quantitative research methodology. The participants of the study consisted of Grade Six science teachers and Grade Six students selected from four different schools: No. 3 BEHS, Bahan, No. 1 BEHS, Sanchaung, No. 2 BEHS, South Okkalapa, and No. 1 BEHS, Latha. The study involved an experimental group of teachers who received the proposed e-learning integration model, while the control group received a formal teacher guide book. Then, the intact groups of Grade Six students were divided into the experimental and control groups. Pretests and posttests were administered to both groups to assess science knowledge. The data analysis utilized one-way analysis of covariance (One-Way ANCOVA) to compare posttest scores, controlling for pretest scores as a covariate. The study revealed a significant increase in science achievement among students whose teachers received instruction using the proposed e-learning integration model compared to those whose teachers did not. Furthermore, the researchers employed the Wilcoxon Signed Rank test to assess the change in students' attitudes towards science learning before and after the instruction. The results indicated a positive impact of the proposed e-learning integration model on students' attitudes. The overall findings of this research support the notion that the integration of e-learning in middle school science instruction has a beneficial effect on both student achievement and attitudes towards learning science.

Keywords: Science, e-Learning, Flipped Classroom, Blended Learning, e-Learning Integration Model

Introduction

National education strategic plan emphasizes that upgrading education system is the keystone to improve the country and the quality of teacher must be prioritized in education reform movements of Myanmar. Curriculum reform progresses continuously in recent years and as a result in-service teachers have being polished with curriculum update training. However, it seems limited training time for their proficiency on new curriculum and it was also finite to train face to face on their compass because of many constraints. In recent years, pressures have emerged from policymakers and other stakeholders to embed e-learning technologies in ordinary basic education sector. However, Myanmar teachers are often limiting their classroom teaching and it is seemed that the use and development of e-learning approaches has limitations and teachers have insufficient support and training to use e-learning at the basic education level. Although MOE has started the curriculum reform movement, there are some challenges lying ahead for its implementation in basic education sector, in ensuring how to implement that new curriculum on the role of teachers, background knowledge of teachers, and resources available to adopt and adapt international standard in new curriculum.

Purposes of the Study

The main purpose of the study is to investigate the effectiveness of e-learning integration model in science teaching at the middle school level. The specific objectives are as follows:

- To find the effect of e-learning integration model on the achievement of students in learning science

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- To investigate the attitudes of students towards learning science as the effect of e-learning integration model before and after intervention
- To make suggestions for the improvement of e-learning in teaching learning process based on the results of this study

Research Questions

This study is intended to answer the following research questions.

- To what extent does the e-learning integration model have any effect on the achievement of students in learning science?
- Is there a change on the attitudes of students towards learning science as the effect of e-learning approach before and after intervention?

Scope of the Study

The scope of the study is as follows:

- This study is geographically restricted to Yangon Region.
- Participants in this study are junior and senior assistant teachers who teach Grade Six science subject and (211) Grade Six students from the selected schools in the academic year (2021-2022).
- The content area is limited to eight chapters such as Chapter 1: Nature of Science, Chapter 2: Matter, Chapter 3: Force, Chapter 4: Living Things, Chapter 5: Cell and Cell Structure, Chapter 6: Reproduction, Chapter 7: Planet Earth, and Chapter: 8 Ecosystem from Grade Six science textbook and the study is conducted in four sample schools in Yangon Region.

Definition of Key Terms

The definitions of key terms used in this study are described as follows.

Science: Science is the study of knowing about the universe through data collected by observation and controlled experimentation (Carin & Sund, 1985).

e-Learning: e-Learning is an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction and that facilitates the adoption of new ways of understanding and developing learning (Sangra, Vlachopoulos & Cabrera, 2012).

Flipped Classroom: Flipped classroom is a student-centered learning method consisting of two parts with interactive learning activities during lesson and individual teaching bases directly on computer out of lesson (Bishop & Verleger, 2013).

Blended Learning: Blended learning can be defined as the organic integration of thoughtfully selected and complementary face to face and online approaches and technologies (Graham, 2006).

e-Learning Integration Model (Operational Definition): The e-learning integration model is intended to guide teachers with the integration of e-learning approach to enhance the conceptual understanding on science teaching and to ensure the effective teaching-learning process.

Review of Related Literature

Philosophical Foundations

Behaviorism, cognitivism, and constructivism are deeply taken into philosophical consideration.

The behaviorist school of thought views the mind as a ‘black box,’ focusing on observable behavior rather than internal mental processes. This approach disregards the influence of cognitive processes occurring in the mind. Early computer learning systems were designed based on behaviorist principles. Therefore, when implementing the proposed model, activities were designed to stimulate students and elicit desired responses. The model takes into consideration the use of stimuli to encourage students to achieve the desired outcomes.

According to Alzaghoul (2012), cognitive theories go beyond behavior and aim to understand the brain-based processes involved in learning. These theories emphasize the role of memory, motivation, and thinking in the learning process. In line with this perspective, the proposed model incorporates multimedia presentations to support student motivation and memory. The use of multimedia engages learners cognitively and aligns with the principles of cognitive theories.

Constructivism is a learning theory that emphasizes the active construction of new ideas or concepts by the learner. Scott (2010, as cited in Sabri, 2017) explains that constructivist learning theory highlights the importance of student's actively connecting new information with their existing knowledge and modifying their previous understanding to accommodate new insights. However, it is noted that much of the current e-learning content available is simply a digitized version of traditional materials, lacking the incorporation of constructivist principles (Tavangarian, Leypold, Nolting, Roser, & Voigt, 2004). Consequently, the customization of learning materials becomes imperative in order to effectively support the principles of constructivist learning theory.

Psychological Foundations

The e-learning integration model takes into consideration additional theories, including situated cognition theory, sociocultural learning theory, and information processing theory. These theories offer valuable perspectives for guiding the design and implementation of the model.

The situated cognition theory asserts that knowledge and action are interconnected, emphasizing the significance of applying learned concepts within relevant contexts. It highlights the social nature of learning, promoting collaborative activities and discussions that enable individuals to expand their understanding through group problem-solving tasks.

The sociocultural learning theory focuses on three key components: culture, language, and the zone of proximal development. This theory emphasizes the significance of the learner's environment in their development. For instance, peers can significantly influence a learner's thoughts and emotions related to a specific subject or topic.

Information theory, also known as communication theory, finds application in the field of pedagogy. It encompasses concepts such as the amount of information, channel capacity, and redundancy (Khin Zaw, 2001b). The information processing theory, on the other hand, posits that the mind acts as a receiver of information rather than simply responding to stimuli. It views the mind as a computer-like system responsible for analyzing information obtained from the environment.

Description of Proposed e-Learning Integration Model

e-Learning integration model was developed with four components based on the related theories and models. In accordance with the objectives of the research, this study is intended to guide and practice teachers by using e-learning approach and how to use e-learning to enhance the conceptual understanding on middle school science teaching. The proposed e-learning integration model includes four components:

(1) Analyse
(2) Develop
(3) Implement
(4) Evaluate

Phase (1) Analyse

The priority component of the proposed model is "analyse" phase that needs to be conducted to investigate the core characteristics and expectations of the participants. The stages of this phase include characteristics and expectation.

Characteristics

The characteristics of the participants impact on the design and delivery of e-learning system. The background knowledge and skills of the learner on the course content, geographical provenience, internet access and electrical devices, have a significant impact for the course designer to develop an effective and efficient course that save costs, time and resources.

Expectation

The expectations of the participants need to be considered to fulfill their desire on the lesson: what the participants thought of the lesson, and what the participants expect from the lesson.

Phase (2) Develop

The next component is to develop the course. In this step, the instructors and administrators have to consider and prepare the course that need to align with the expectation of the participants. To implement the course, context and tools become important in their respective roles.

Context

The context defines the curriculum or course content that will shape the objectives of the model or the needs of the participants. Moreover, the management context referred to e-learning management that means technology skills of the instructors.

Tools

The instructors and the participants must communicate face to face or virtual environment or both. Therefore, the instructor had to encourage and motivate the participants to take part in activities using both internal and external reinforcement. And also need to support interaction between the instructors and the learners and, between the learners. Constructing positive relation between the instructors and the learners will be the key to succeed the programme.

Tools to enhance the knowledge and skills of the participants accommodate learning management system. Learning management system contains tools and elements for instructors, learners and administrators that depend on the lesson objectives, and the desired outcomes including course management system, content delivery system, and communication tools. Media can be used to deliver content via electronic media so that the learner can study anytime and anywhere. The instructor record and share lecturer notes and information, and uploaded to the learning management system to easily accessible for the remote learners.

Phase (3) Implement

The third component of the model is to implement the model and the instructors have to choose appropriate ways to deliver context based upon socio-economic status of the participants. Wholly online mode of e-learning model will be applied to deliver context to achieve the desired outcomes. Wholly online mode of e-learning model can be divided into two parts: collaborative learning and individualized learning. And then, collaborative learning can also be divided into two parts: synchronous and asynchronous modes.

Phase (4) Evaluate

The last phase of the model is evaluating whether the objectives of the model that accommodate the needs and expectations of the participants at the first step of the model might be fulfilled or not. To evaluate the effectiveness of the model, it is divided into two parts: apply and reflect.

Apply

The first one is to evaluate whether the participants can apply or not what they have learned directly or indirectly. Instructors need to observe their students to check how they progress and record class activities of the participants to assist them.

Reflect

Reflection means final assessment of what the participants learned and how they applied in their situation. Instructor allows participants to consider and reflect the process and become aware of what they learned from the whole discussion and what are their strengths and weaknesses.

Feedback Loop

If the expectations of the participants were not accomplished at the end of the discussion, feedback loop could be inserted to adjust the second step and third step of the model. Each part of these steps needs to be checked and modified again to reach the desired outcomes. If the discussion can fulfill the expectations of the participants, the instructor can move to the next lesson. The e-learning integration model can be described as follows in Figure 1.

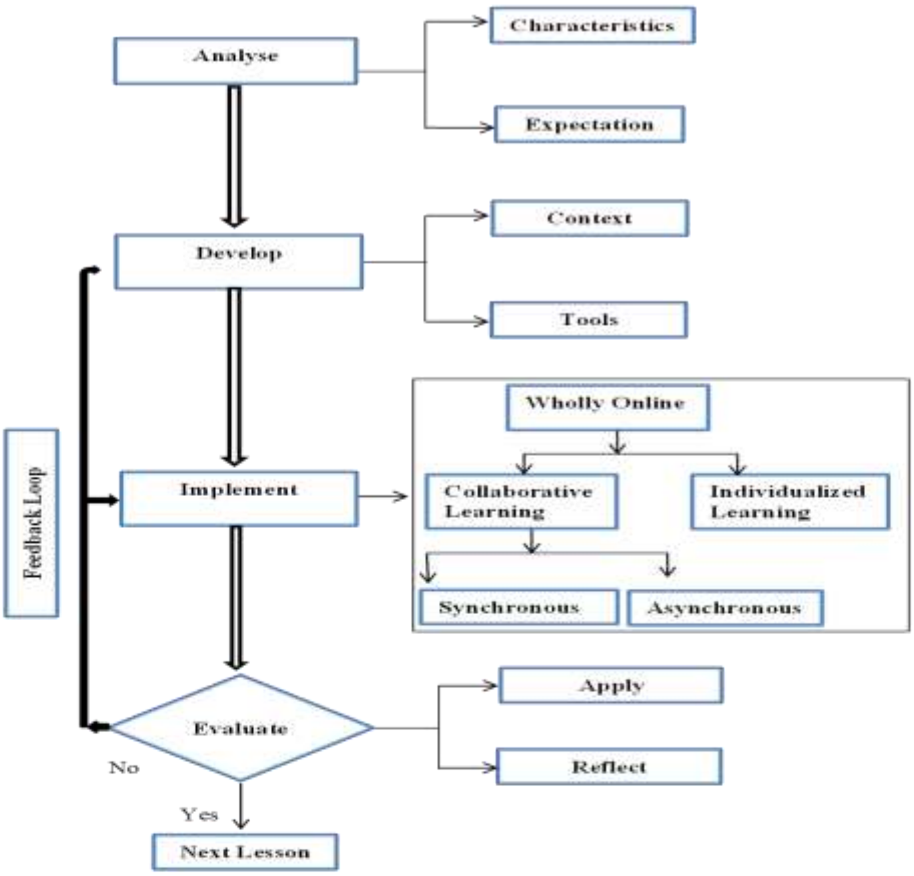

Figure 1: e-Learning Integration Model

Method

The research design for this study was the experimental research design. Therefore, quantitative methodologies were used in this study. For the quantitative research methodology, the adopted design was non-equivalent control group design, one of quasi-experimental designs. From the intact groups, the two measures: pretest (before) and posttest (after) can be compared and any differences in the measures are assumed to be the result of the treatment. All participants in this study were Grade Six science teachers and Grade Six students, and this study was conducted in Yangon Region. The teachers from experimental group received instruction on e-learning integration model. Before the treatment period, the students from experimental group were administered pretest before the instruction. Then, all the students in the experimental and control groups were administered posttest after the instruction. Quantitative data will be analyzed by applying inferential statistics (ANCOVA) to determine whether there are significant differences in the science scores of experimental groups before and after instruction. And then, Wilcoxon Signed Rank test was used to investigate the attitude of students on science learning before and after instruction. Thus, teachers and students from selected schools were participants for the quantitative research methodology.

Instruments

The study employed pretest, posttest, and attitude questionnaires as instruments. These instruments were developed with guidance from the supervisor and validated by thirteen experts. A pilot study was conducted with 32 Grade Six students from Practicing Middle School, Yankin, to evaluate the effectiveness of their achievement. After the pilot study, the reliability of the instruments was determined by the value of Cronbach’s Alpha coefficient. Pretest was .765 and posttest was .731. A pretest was used to measure the entry behavior of the students. A posttest was used to measure the students’ science achievements after treatment as the effects of e-learning integration model. The questions were constructed based on Bloom’s taxonomy of cognitive domain (remembering level, understanding level, and applying level). The pretest items were derived from the content covered in Chapter 1, Chapter 2, Chapter 3, and Chapter 4 of the Grade Six science textbook. Similarly, the posttest items were constructed based on the content covered in Chapter 5, Chapter 6, Chapter 7, and Chapter 8 of the same textbook.

The pretest and posttest consist of 40 multiple-choice question items, with three options each. Each item is assigned one mark. The test covers 10 items from each chapter of the Grade Six science textbook. Participants are required to answer all the questions, and there is no choice of items in the test. The allocated time for the test is 45 minutes, and a total of 40 marks are available.

For the questionnaire assessing students' attitudes towards learning science, it was constructed with 20 items organized as five-point Likert-type items. The questionnaire covered four dimensions: improving personality, connection with real life, attitude towards the science teacher, and attitude towards science learning. The questionnaire was administered to the students in the experimental group before and after the treatment. The internal consistency of the questionnaire, as measured by Cronbach's alpha, was found to be .782, indicating a satisfactory level of internal consistency.

Findings

For the quantitative research findings, the data were recorded and analyzed systematically. According to the selected quantitative research design, the data from the pretest question were analyzed by using the one-way analysis of covariance (One-Way ANCOVA) to compare the differences between the experimental and the control groups (see Table 1).

Table 1 Analysis of Covariance (ANCOVA) Results on the Pretest Question

School	Group	*N*	*M*	*SD*	*MD*	*F*	*p*
S1	Experimental	16	20.56	1.71	-2.04	5.43	.027 *
	Control	15	22.60	3.02			
S2	Experimental	15	20.27	1.98	1.58	5.81	.023*
	Control	16	18.69	1.66			
S3	Experimental	42	22.33	2.66	1.57	7.59	.007**
	Control	45	20.76	2.68			
S4	Experimental	31	20.35	1.92	-1.52	5.42	.023*
	Control	31	21.87	3.07			

Note. S1 = No. 3, BEHS, Bahan; S2 = No. 1 BEHS, Sanchaung; S3 = No.2, BEHS, South Okkalapa; S4 = No. 1 BEHS, Latha.
$*p < .05$, $**p < .01$.

The results showed that there was a significant difference between the entry behavior of experimental groups and control groups in each school. It can be interpreted that there were initial differences between the experimental groups and the control groups. Therefore, the data from posttest questions were analyzed by using a one-way analysis of covariance (see Table 2).

Table 2 Analysis of Covariance (ANCOVA) Results on the Posttest Question

School	Group	*N*	*M*	*SD*	*MD*	*F*	*p*
S1	Experimental	16	33.63	3.18	3.56	8.92	.006**
	Control	15	30.07	3.19			
S2	Experimental	15	33.41	2.1	3.73	22.39	.000***
	Control	16	29.68	2.1			
S3	Experimental	42	31.69	3.35	2.73	13.88	.000***
	Control	45	28.96	3.35			
S4	Experimental	31	32.04	2.87	3.43	21.14	.000***
	Control	31	28.61	2.87			

Note. ns = not significant, $**p < .01$, $***p < .001$.

The results showed that there was a significant difference between the science achievement of experimental groups and control groups in the four selected schools. It can be interpreted that the proposed e-learning integration model has a significant effect on the students' science achievements. According to the results, the comparison of mean scores on science achievement is described in Figure 2.

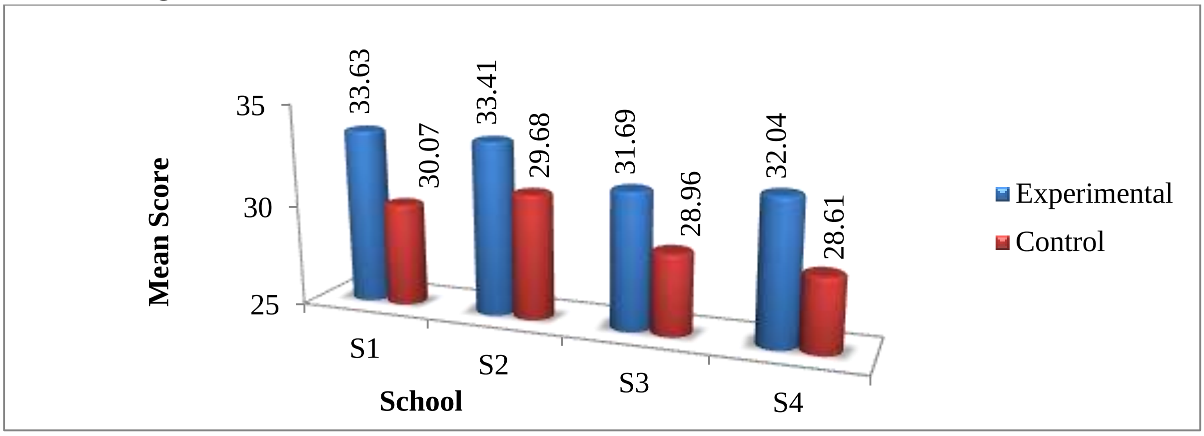

Figure 2 The Comparison of Mean Scores on Science Achievement

The results of one-way analysis of covariance (One-Way ANCOVA) indicated that e-learning integration model had a significant effect on the achievement of Grade Six students in all selected schools (see Table 3).

Table 3 ANCOVA Results for Posttest Scores on Students' Science Achievement

School	Test of Between- Subject Effects					Unadjusted Mean		Adjusted Mean	
	Source	*df*	*F*	*p*	Partial Eta Squared	EG	CG	EG	CG
S1	Pretest	1	1.87	.182 (ns)	.06	33.31	30.4	33.63	30.07
	Group	1	8.92	.006**	.24				
	Error	28							
S2	Pretest	1	0.75	.395 (ns)	.03	33.27	29.81	33.41	29.68
	Group	1	22.39	.000***	.44				
	Error	28							
S3	Pretest	1	17.47	.000***	.17	32.14	28.53	31.69	28.96
	Group	1	13.88	.000***	.14				
	Error	84							
S4	Pretest	1	20.74	.000***	.26	31.55	29.1	32.04	28.61
	Group	1	21.14	.000***	.26				
	Error	59							

Note. EG = Experimental Group, CG = Control Group.
ns = not significant, $**p < .01$, $***p < .001$.

In school 1, after adjusting the pre-intervention scores (pretest scores) as the covariate, there was a significant difference between the two groups on post-intervention scores (posttest scores) on science achievement according to the adjusted mean scores (33.63, 30.07) and F (1, 28) = 8.92, p = .006, with the small effect size (partial eta squared = .24). There was no significant relationship between the pretest scores (covariate) and posttest, F (1, 28) = 1.87, p = .182. In school 2, after adjusting the pre-intervention scores (pretest scores) as the covariate, there was a significant difference between the two groups on post-intervention scores (posttest scores) on science achievement according to the adjusted mean scores (33.41, 29.68) and F (1, 28) = 22.39, p = .000, with the medium effect size (partial eta squared = .44). There was no significant relationship between the pretest scores (covariate) and posttest, F (1, 28) = 0.75, p = .395.

In school 3, after adjusting the pre-intervention scores (pretest scores) as the covariate, there was a significant difference between the two groups on post-intervention scores (posttest scores) on science achievement according to the adjusted mean scores (31.69, 28.96) and F (1, 84) = 13.88, p = .000, with the small effect size (partial eta squared = .14). There was a significant relationship between the pretest scores (covariate) and posttest, F (1, 84) = 17.47, p = .000. In school 4, after adjusting the pre-intervention scores (pretest scores) as the covariate, there was a significant difference between the two groups on post-intervention scores (posttest scores) on science achievement according to the adjusted mean scores (32.04, 28.61) and F (1, 59) = 21.14, p = .000, with the medium effect size (partial eta squared = .26). There was a significant relationship between the pretest scores (covariate) and posttest, F (1, 59) = 20.74, p = .000. Therefore the results indicated that e-learning integration model had a significant effect on the science achievement of Grade Six students in all selected schools.

The attitudes of students who participated in the experimental groups before and after the intervention were investigated in terms of Wilcoxon Signed Rank Test. The questionnaire was constructed based on four dimensions: improving personality, connection with real life, attitudes for science teachers, and attitudes for science learning. The results of Wilcoxon Signed Rank Tests for students' attitudes towards learning science are described in Table 4.

Table 4 Results of Wilcoxon Signed Rank Tests for Students' Attitudes towards Learning Science

School	*N*	Dimension of Students' Attitudes towards Learning Science	*Md* (Before)	*Md* (After)	*z*	*p*	*r*
All Four Schools	104	Improving Personality	18	20	-3.056	.002**	.21
		Connection with Real Life	18	20	-2.766	.006**	.19
		Science Teachers	18	20	-4.353	.000***	.30
		Science Learning	15	19	-6.587	.000***	.45

Note. *Md* = Median.

**$p < .01$, *** $p < .001$.

Wilcoxon Signed rank Test revealed that attitudes of improving personality were significantly higher after the intervention (*Md* = 20, *N* = 104) compared to before (*Md* = 18, *N* = 104), $z = -3.056$, $p = .002$, with a small effect size, $r = .21$.

Wilcoxon Signed rank Test revealed that attitudes of connection with real Life were significantly higher after the intervention (*Md* = 20, *N* = 104) compared to before (*Md* = 18, *N* = 104), $z = -2.766$, $p = .006$, with a small effect size, $r = .19$.

Wilcoxon Signed rank Test revealed that attitudes of science teachers were significantly higher after the intervention (*Md* = 20, *N* = 104) compared to before (*Md* = 18, *N* = 104), *z* -4.353, $p = .000$, with a medium effect size, $r = .3$.

Wilcoxon Signed rank Test revealed that attitudes of science learning were significantly higher after the intervention (*Md* = 19, *N* = 104) compared to before (*Md* = 15, *N* = 104), $z =-6.587$, $p = .000$, with a medium effect size, $r = .45$. Wilcoxon Signed rank Test revealed a significantly difference in attitudes of learning science as the effects of e-learning integration model before and after intervention. According to the results, the comparison of median scores for students' attitudes towards learning science is described in Figure 3.

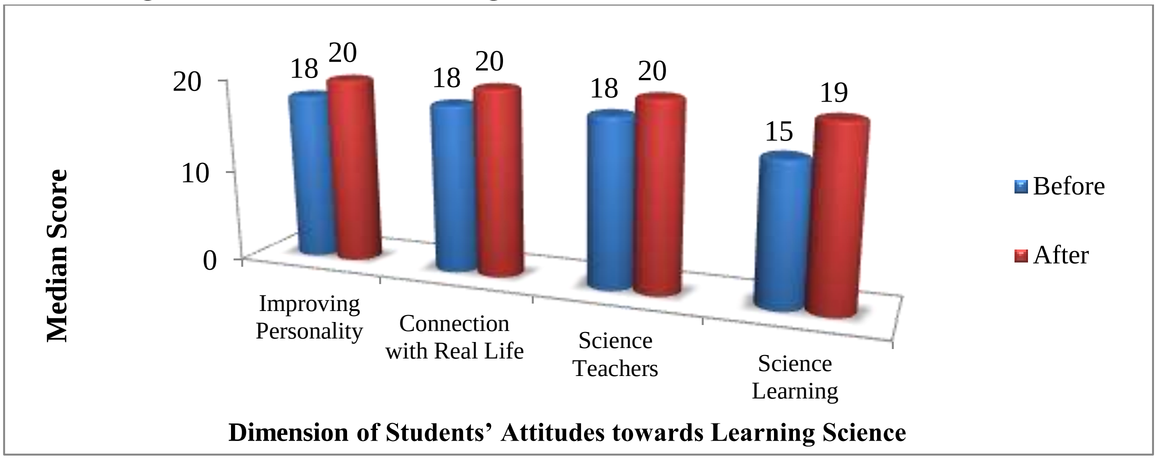

Figure 3 Comparison of Median Scores for Students' Attitudes towards Learning Science

Discussion

The comparison of mean scores on posttest questions showed significant differences between the experimental and control groups, indicating that the proposed e-learning integration model positively impacted students' science achievement. These findings align with the study conducted by Chen and Lin (2021), which found that e-learning had a positive influence on academic achievement, particularly in subjects like mathematics and science.

The findings from the attitude questionnaire further support the results of the study. Through the application of the Wilcoxon Signed Rank Test, significant differences were observed in the attitudes of students in the experimental group before and after the treatment across all selected schools. These results align with the research conducted by Tham and Tham (2016), who also found a significant influence of students' attitudes towards e-learning on their science achievement. Their study suggested a positive association between favorable attitudes towards e-learning and higher levels of science achievement. The current study's outcomes reinforce these previous findings.

Suggestions

Suggestions for Teachers: Science teachers should integrate e-learning tools, such as educational software and online resources, into their teaching to engage students and promote interactive learning. Teachers should have access to sufficient equipment, such as computers and laboratory equipment, and teaching resources, such as textbooks and curriculum materials, to support effective teaching and learning. Science teachers in Myanmar should use locally relevant resources when integrating e-learning into their teaching. This could include using videos and other resources created by local universities and research institutions, as well as utilizing local case studies and examples. Science teachers should carefully plan and prepare instructional materials, such as printed and non-printed materials, to develop problem-solving skills and scientific attitudes among students.

Suggestions for School Administrators: School administrators should prioritize providing professional development opportunities for science teachers to enhance their knowledge and skills in utilizing the latest e-learning tools and strategies for technology integration.

Suggestions for Curriculum Planners: Curriculum planners should conduct a needs assessment to evaluate the current state of e-learning integration in the school and identify areas for improvement. Based on the assessment, they should develop a customized e-learning integration plan with specific goals, a timeline, and action items. They also need to prioritize teacher training to ensure effective implementation of e-learning strategies. Curriculum planners should prioritize training teachers on incorporating technology into their teaching practices. They should also focus on creating localized content in diverse formats such as videos, articles, and social media posts to establish a stronger connection with the local culture and language, fostering greater audience engagement and comprehension. Establishing appropriate educational partnerships is essential, and involving stakeholders is crucial for developing successful strategies and implementing effective plans. Engaging stakeholders is essential for diverse perspectives, increased support, and addressing concerns. Integration of ICTs across the curriculum prepares students for the technology-driven workforce. Clear communication and goal alignment are keys for effective stakeholder involvement.

Recommendations

Some recommendations for further study are as follows:

- In this study, sample schools were randomly selected from Yangon. Thus, further research studies should be carried out in other States and Regions by using different participants for replication.
- In this study, the content areas were limited to Grade Six science textbook. So, further study should be carried out for the other content areas at the middle school level.

- In this study, the proposed e-learning integration model was developed for the middle school level. Further research should be carried out for various school levels such as primary school level and high school level.

Conclusion

This study has shown that the integration of e-learning in teaching science at the basic education level is advantageous for teachers, as it encourages students to become independent learners who actively engage with the learning process. This model aligns with constructivist principles, where students are expected to develop a range of skills, including improved science achievement and broader competencies.

To effectively address the demands of 21st century competencies and educational goals in Science education, teachers must employ innovative teaching strategies. The integration of e-learning as demonstrated in this model proves to be beneficial, as it helps teachers to foster cognitive competencies such as academic mastery, and intrapersonal competencies such as intrinsic motivation among students. By incorporating this model, teachers can better equip students with the necessary skills to thrive in the 21st century educational landscape. Therefore, this model should be considered for implementation to enhance the teaching of science at the middle school level. It is hoped that the findings of this study can contribute to the improvement of science education in middle schools in Myanmar, to some extent.

In today's rapidly changing world, educators and teachers need to acquire teaching methodologies that prepare students for a future that is largely unknown and may remain unknown, as people are finite beings in a constantly evolving and unpredictable universe of possibilities (Khin Zaw, 2001a). This emphasizes the importance of equipping students with the skills, knowledge, and adaptability to thrive in a world that is characterized by uncertainty and change. Educators must be proactive in keeping up with the evolving needs of students and aligning their pedagogical approaches accordingly, to effectively prepare students for the challenges and opportunities of an uncertain future.

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