AN INVESTIGATION INTO NEW SCIENCE CURRICULUM IMPLEMENTATION AT PRIMARY LEVEL

Theingi Aung [1], Phyu Zar Zar Theint[2] and Su Chan Myae[3]

Abstract

This study investigated new science curriculum implementation at primary level. The specific objectives were: to investigate the extent of teachers' practices in new science curriculum implementation in terms of planning, teaching, managing classrooms and assessing. Explanatory mixed method was used, quantitative study first and qualitative study follows to explain quantitative findings deeply. In pilot study, instrument validity and reliability were conducted with the samples of 380 primary teachers from Nga Pu Taw Township and Kyaik Ma Yaw Township. In the main study, the samples of 530 teachers were selected from Yangon Region by using multi-stage cluster sampling method. Questionnaire validated in pilot study, was used in the main study. Quantitative data was analyzed by descriptive and inferential statistics and qualitative data was analyzed by thematic analysis. Although quantitative findings indicated that teachers practiced to a moderate extent in curriculum implementation, observation results indicated that there were many requirements for successful implementation. There were statistically significant differences according to gender, age, position, service, qualification, course (related to science). The interview results and open-ended responses highlighted that resources (staff, time, space, teaching aids, teacher's quality and refresher courses) should be adequately and efficiently supported for effective curriculum implementation.

Keyword: Science Curriculum Implementation

Introduction

Education is vital for individual and societal development, and in today's global economy, nations thrive by investing in education. Myanmar's National Education Strategic Plan (2016-2021) initiated reforms, including a new primary science curriculum designed to foster 21st century skills, critical thinking, and scientific literacy. This curriculum, rooted in inquiry-based learning, equips students with essential scientific process skills through hands-on activities. Effective implementation of this curriculum is key to promoting equity, preparing students for a rapidly evolving world, and fostering responsible citizenship. Teachers play a crucial role in ensuring the success of this curriculum, as their involvement is essential for translating educational reforms into meaningful classroom practice.

The importance of curriculum reform and implementation cannot be overstated. A well-designed and effectively implemented curriculum is critical for ensuring that all students, regardless of their backgrounds, have equal access to quality education and learning opportunities. In Myanmar, the implementation of the new primary science curriculum is expected to play a vital role in achieving these goals, particularly as science education serves as a foundation for nurturing scientific literacy, problem-solving skills, and responsible citizenship. Teachers are central to the success of this curriculum implementation, as they are responsible for translating planned curriculum into practical classroom activities. Their role is vital in fostering students' scientific inquiry and critical thinking skills, which are necessary for preparing students to thrive in an ever-changing society. The importance of teacher involvement in the curriculum

[1] Department of Educational Theory and Management, Yangon University of Education
[2] Department of Educational Theory and Management, Yangon University of Education
[3] Department of Educational Theory and Management, Yangon University of Education

process has been highlighted by scholars such as Dr. Khin Zaw (2001b) and Gupta (2023), who emphasize that the effectiveness of any education system is heavily reliant on its teachers.

Research Objectives

The general objective of this study was to investigate new science curriculum implementation at primary level. The specific objectives were

- To examine the planning practices of primary school teachers and the difficulties they face when designing science lessons based on the new science curriculum.
- To explore the teaching practices employed by primary school teachers and the instructional difficulties encountered during the implementation of the new science curriculum.
- To investigate classroom management practices used by teachers and the difficulties they experience in managing student behavior and learning environments under the new science curriculum.
- To analyze the assessment practices adopted by teachers and the difficulties they encounter in evaluating student learning outcomes according to the new science curriculum guidelines.
- to describe suggestions for improving curriculum implementation through teachers' perceptions

Theoretical Framework of the Study

The theoretical framework of this research is grounded in several educational theories that support effective curriculum implementation, particularly in the context of primary science education. Democratic educational philosophy (Hopkins, 2014; MacMath, 2008) underscores the importance of fostering an inclusive and participatory learning environment where students engage actively in their own learning. Constructivism (Schunk, 2012) emphasizes that students construct their own knowledge through hands-on experiences and reflection, which aligns with inquiry-based science education. Additionally, cognitive theories (Fetsco & McClure, 2005; Schunk, 2012) highlight the role of mental processes in learning, where students need scaffolding and guidance to develop critical thinking and scientific understanding. The multimodal model (Khin Zaw, 2001a) also plays a critical role, recognizing the importance of various teaching and learning strategies that accommodate different modes of human cognition, including analysis, synthesis, and exploration.

In applying these theories, primary science teachers must engage in practices that enhance curriculum implementation. This involves careful **planning** that aligns with curriculum objectives and adapts to the diverse needs of students (Alake-Tuenter et al., 2012). **Teaching** strategies should facilitate active student participation, promote the development of science process skills, and foster cognitive growth through scaffolding (Schunk, 2012). **Classroom management** is equally important, as a supportive and well-structured environment enables effective learning (Belgeonne et al., 2003). Finally, **assessing and monitoring** students' progress through reflective practices and alternative assessments ensure that students' understanding is continuously evaluated and that teaching methods are adjusted accordingly (Mamlok-Naaman, 2017). This comprehensive theoretical framework supports the primary science curriculum's goals of equipping students with the skills and knowledge they need to live in a modern, science-driven world.

Definitions of Key Terms

Curriculum Implementation

Curriculum implementation refers to "how the planned or officially designed course of study is translated by the teacher into syllabuses, schemes of work and lessons to be delivered to students" (Bediako, 2019, p.1).

Operational Definition

Curriculum Implementation

In this study, curriculum implementation assumes the practices of primary teachers in terms of their lesson planning, teaching, managing the classroom, and assessing and monitoring students' learning. Levels of curriculum implementation practices were measured by the mean values of the teachers who taught primary science. The greater the mean values, the more the teachers practise in curriculum implementation.

Methodology

In order to connect the quantitative results to the qualitative data in order to explain the quantitative results in more depth (Creswell & Creswell, 2018; Creswell & Plano Clark, 2018), an explanatory sequential mixed-methods design was used to investigate the research problem for this study.

There were 10344 primary teachers in four districts of Yangon Region. The quantitative sample of 553 teachers (who were teaching primary science) from 114 schools were selected using the multistage cluster sampling method. For a qualitative study, participants were selected using the purposive sampling method. Eight teachers from basic education schools were selected for observation and interviews based on the quantitative results.

In the pilot study, questionnaire for science curriculum implementation was constructed by using exploratory factor analysis (EFA) because one of the uses of EFA was "to construct a questionnaire to measure an underlying variable" (Field, 2017, p.991). The questionnaire was construct with appropriate variables and items to be included in the multivariate analyses in the pilot study. Curriculum implementation practices were explored with data summarization without interpretation. The reliability coefficient for planning, teaching, managing classrooms and assessing and monitoring were 0.9`,0.94,0.89,0.94 respectively. The content validity indices for planning, teaching, managing classrooms and assessing and monitoring were 0.98, 0.98, 0.90 and 0.93 respectively. This validated questionnaire was used in the study. Interview questions and observation checklist were developed based on literature review, theoretical framework and the quantitative results.

In pilot study, factor analysis was used to construct the variables into appropriate components related to primary science curriculum implementation practices. Descriptive and inferential statistics were used to investigate the extent of teachers' practices in new science curriculum implementation at primary level and their variations. Qualitative data was analyzed by thematic analysis, both inductive and deductive coding. Interview records were analyzed by inductive coding and observation records were analyzed by deductive coding.

Findings

Quantitative Findings

Investigating the Extent of Teachers' Practices in New Science Curriculum Implementation at Primary Level

Teachers' practices in the new science curriculum implementation at primary level were investigated in terms of planning, teaching, managing classrooms and assessing and monitoring. Table 1 showed mean values and standard deviations of teachers' practices in the new science curriculum implementation at primary level (teachers' curriculum implementation practices).

Table 1 Mean Values and Standard Deviations of Teachers' Curriculum Implementation Practices (N=553)

Curriculum Implementation Practices	Mean	SD	Remark
Planning	4.08	0.51	practice to a moderate extent
Teaching	4.15	0.57	practice to a moderate extent
Managing Classrooms	4.24	0.53	practice to a great extent
Assessing and Monitoring	4.33	0.55	practice to a great extent
Grand Mean	**4.20**	**0.49**	**practice to a moderate extent**

Scoring Direction:

1.00-1.80= do not practice at all 2.61-3.40=practice to some extent 4.21-5.00=practice to a great extent
1.81-2.60= practice to a small extent 3.41-4.20= practice to a moderate extent

Generally, teachers practiced to a moderate extent in overall curriculum implementation as its mean value was 4.20. Teachers practiced to a moderate extent in planning and teaching as their mean values were 4.08 and 4.15 respectively. Furthermore, they practiced to a great extent in managing classrooms and assessing and monitoring, because their respective mean values were 4.24 and 4.33.

Qualitative Findings

Results of Classroom Observation

The researcher conducted classroom observation based on the theoretical framework and five stages of the inquiry-based method: stage 1 (Answering questions), stage 2 (Exploration), stage 3 (Reading), stage 4 (Elaboration) and stage 5 (Summary and Evaluation), that were prescribed in Primary Science Curriculum. The observation checklist included five parts. Table 2 presented brief information of classroom observation.

Table 2 Brief Information of Classroom Observation

Teacher		Grade	Topic	Time allowed	Actual Teaching Time	Days	Class Size	Remark	
								Time	Contents
Lower Primary	Teacher 1	2	Heat and Light from the Sun	6*40 min	• 2*40 min • 2*40 min • 50 min	3	60	✓	✓
	Teacher 2	2	Heat and Light from the Sun	6*40 min	• 46 min	1	120	×	✓
	Teacher 3	3	Sink and Float	4*40 min	• 2*40 min • 43 min	2	32	✓	✓
	Teacher 4	3	Using Magnet and Compact(Searching Cardinal Points)	5*40 min	• 42 min	1	33	×	×

Teacher		Grade	Topic	Time allowed	Actual Teaching Time	Days	Class Size	Remark	
								Time	Contents
Upper Primary	Teacher 5	5	Force and Work Done	5*40 min	• 3*40 min + 60 min	1	14	✓	✓
	Teacher 6	5	Kinetic Energy and Potential Energy	5*40 min	• 48 min • 47 min • 45 min • 44 min	4	27-30	✓	✓
	Teacher 7	4	Phases of water	5*40 min	• 76 min	1	5	×	×
	Teacher 8	5	Force and Work Done	5*40 min	• 35 min	1	60	×	✓

Note: ✓= matched with allocated time and monthly table of contents

× = did not match with allocated time and monthly table of contents

According to the theoretical framework, primary science curriculum implementation was studied based on four areas: planning, teaching, managing the classroom, and assessing and monitoring. The codes of observation were presented in Table 3.

Table 3 Codes of Classroom Observation

Code	Sub-Code	Definitions
Planning		Planning involves preparing physical environment (including teaching aids, seating arrangement, etc.) and lessons according to the guidelines of teacher's guide.
Teaching	• Answering questions • Exploration • Reading • Elaboration	• Answering questions means arousing students' interests and curiosity by asking questions • Exploring means that students were given hand-on activities to develop their scientific understanding and science process skills. • Reading included further reading sections that extend students' understanding and knowledge. • Elaboration means students were asked much questions to elaborate their understanding and extended learning.
Managing the Classroom		Time management, physical situation (resources) and students' involvement and security were managed.
Assessing and Monitoring	• Summary and Evaluation • Monitoring	• Assess students' knowledge, understanding and application by asking questions (not only doing exercises involved in the student's book but also rubric items developed by teachers).

Code	Sub-Code	Definitions
		• Students' involvement in activities and students' learning were monitor during teaching periods and provide constructive feedback.

The results of lower primary teachers were discussed first according to these areas.

Relating to **planning**, although teachers 1 and 3 prepared lessons according to the allocated time and prepared the required teaching aids for all activities, teachers 2 and 4 did not prepare according to the allocated time. Teacher 1 and 3 prepared lessons in an orderly manner to arouse students' interest by preparing teaching aids (available resources) adequately and attractively. Teacher 2 prepared teaching aids for the activities, but they were not sufficient for all students. Although teacher 4 did not prepare teaching aids (guided by the teacher's guide), she used the telephone as a teaching aid. Teacher 1 prepared a seating arrangement that was appropriate for lessons, activities, and group work, but the size of the class was too small for 60 students, and one student did not get a seat (only on one day). Teacher 2 class size was so big (120 students) that it was not convenient for group work. Teacher 3 prepared seating arrangements that were appropriate for lessons, activities, and group work. Teacher 4 prepared seating only for the lecture and did not prepare the class for group work (although the size and seats were easy to move). Teachers 1, 2 and 3 prepared lessons related to real life and the students' prior knowledge. All teachers did not prepare further assessment types of questions (item types and rubric types) for this lesson.

Related to **teaching,** teachers 1 and 3 asked questions and stimulated students' curiosity and interests in stage 1 (Answering questions). Teacher 3 even showed real objects that could stimulate students' interest. Teachers 2 and 4 also asked questions to stimulate the students' interest, but they gave the answers to the activities before doing activities.

In stage 2 (Exploration), teachers 1 and 3 did all hand-on activities with adequate teaching aids and guidelines from the teacher's guide and allowed all students to be involved in all activities. Teacher 1 adjusted the lesson based on the condition of the activity (water and sand were not warm in 10 minutes). Teachers 1 and 3 gave students opportunities to construct scientific understanding based on their hands-on activities. Teacher 2 did three hands-on activities but limited the number of students involved in the activities. For one activity, hands-on experience was not conducted. Teacher 4 did only one hand-on activity for all four activities by using compact apparatus on the telephone (not bar magnets and compacts). Teachers 2 and 4 explained and gave answers during the introduction (Answering questions). Teachers 1 and 3 did activities that matched each of the learning objectives of the lesson.

Teachers 1 and 3 created the learning experiences that encouraged not only students' communication skills, problem-solving skills, and science process skills but also their independent skills. Although teacher 2 taught science process skills through activities, not all students had the same opportunities to observe and compare. Teacher 4 gave students the opportunity to observe cardinal points by using the phone; students did not have the opportunity to observe, measure, or compare bar magnets and compacts. Furthermore, teacher 3 taught communication skills among students, but teacher 4 did not do activities to develop students' communication skills among students. Although teachers 1, 3 and 4 made group work, they could not encourage groups of students to discuss within groups effectively.

In stage 3 (Reading), teachers 1, 2 and 3 asked and explained questions related to real life. But they did not encourage students to explain their real-life experiences. Teacher 4 skipped this part for teaching.

In stage 4 (Elaboration), although the teacher guide intended to express students' understanding of all activities related to the lesson by communicating and presenting their understanding in their own words, teachers 1, 2 and 3 let students read and only asked answers for the lesson. Teacher 4 skipped this stage.

Concerning **managing classrooms**, although teacher 1 gave the required teaching aids attractively, students were very crowded, and students harmed each other (sand entered the eye of one student because of another student). Teacher 3 gave adequate teaching aids, and the classroom was quiet (no external noise) and wide. Teacher 2 could not provide adequate teaching aids, and the classroom was too small for 120 students. Although teacher 4 had a wide classroom with moveable desks and chairs, she did not manage to do effective group work.

Teacher 1 and 3 managed time effectively (giving adequate time and adjusting the timeline), especially for all activities. Teacher 2 and 4 did not manage time for the students learning (not teach according to the allocated time and given instructions). Teacher 1 and 3 made pair work, group work, and class work as directed by the teacher's guide and observed them. But, teacher 2 did not make group work, and teacher 4 made group work, but it did not achieve learning objectives. Teachers 1, 2 and 3 encouraged students' integrity and to respect other students. While teachers 1 and 3 considered all students to take part in learning opportunities, teachers 2 and 4 were weak in considering individual student's learning.

In **assessing and monitoring**, teachers 1 and 3 answered all questions in the exercise of the lesson that assessed students' remembering, understanding, and application. Teacher 1 encouraged students' creativity in doing exercise. Teacher 2 gave homework for one question in the exercise (the teacher's guide requested not to give homework) that encourages student's application and creativity. Teacher 4 did not assess the student's application. During activities and exercises, all teachers heard student's variety and incorrect or wrong answers; teacher 1 considered all answers and gave constructive feedback; then teacher 1 redirected, prompted, and probed the questions to get correct answers. Teachers 2, 3 and 4 accepted correct answers and neglected wrong or incomplete answers. Teacher 1 and 3 observed, checked students answers to the activities and exercises, and gave accurate and timely feedback to students during the activities and exercises.

Teachers 1 and 3 prepared better for the lesson than teachers 2 and 4. Although teachers 1 and 3 created learning opportunities for student's interest, engagement, scientific understanding, science process skills, and other 21st century skills through activities, teachers 2 and 4 were weak in creating these learning opportunities. All four teachers were weak in stages 3, and 4 of the inquiry-based method; they did not follow the instructions in the teacher's guide. Teachers 1 and 4 managed classrooms not only in time management and seating arrangements but also in students' engagement. Teachers 2 and 4 were still needed to manage classrooms well. All teachers needed to develop and use rubric items or verbal questions that could assess student's understanding and application.

The results for upper primary teachers were as follows.

Relating to **planning**, although teachers 5 and 6 prepared lessons according to the allocated time and required teaching aids for all activities, teachers 7 and 8 did not prepare according to the allocated time. Teacher 5 and 6 prepared lessons in an orderly manner to arouse students' interest by preparing teaching aids (available resources) adequately and attractively. Teacher 7 prepared teaching aids for an activity. Teacher 8 prepared teaching aids for an activity, but just for demonstration. Teacher 5 prepared seating arrangements that were appropriate for lessons, activities, and group work. Teacher 6's classroom was small; students were crowded, and the teacher could not rotate and observe because the lane between rows and columns was narrow. Teachers 7 and 8 prepared seating arrangements that were appropriate for the lecture. Teacher 6 prepared lessons related to real life and the students' prior knowledge. All teachers did not prepare further assessment questions (item types and rubric types) for this lesson.

Related to **teaching,** all teachers asked questions and stimulated students' curiosity and interests in stage 1 (Answering questions). Teacher 8 asked questions to stimulate the students' interest, but she explained and gave the answers to the activities before doing them.

In stage 2 (Exploration), teachers 5 and 6 did all hand-on activities with adequate teaching aids and guidelines from the teacher's guide and allowed all students to be involved in all activities. Even though teacher 5 prepared and did all hands-on activities, she gave the wrong concept from the first activity. Therefore, students constructed a misunderstanding and the wrong concept. Teacher 6 gave opportunities for students to construct scientific understanding based on their hands-on activities. Teacher 7 gave only one opportunity for one activity to construct students' scientific understanding based on their hands-on activity. Teacher 6 did activities that matched each of the learning objectives of the lesson. Teacher 8 demonstrated an activity that matched the learning objective of the lesson. Teachers 7 and 8 lectured and discussed the rest activities by asking questions.

Teachers 5, 6 and 7 created the learning experiences that encouraged not only students' communication skills, problem solving skills, and science process skills but also their independent skills. Although teacher 8 taught communication and problem-solving skills, not all students had the opportunity to take part in the activity. Although teachers 5, 6 and 7 did group work, teacher 8 did not do group work or pair work. Teachers 6 and 7 encouraged students to discuss within the groups.

In stages 3 and 4, teachers 5, 6 and 7 requested that students read and teachers explained. But they did not encourage students to explain their real-life experiences. Teacher 8 skipped this part for teaching. They all did not follow the instructions of teacher's guide.

Concerning **managing classrooms,** teacher 5 gave the required teaching aids attractively, and the classroom was convenient for students. Teacher 6 gave adequate teaching aids and managed the classroom well, but the classroom was so noisy (other classes' voices overwhelmed the class) that students could not hear well and repeated their findings. Teacher 7 had to co-teach with other grades, which could delay and interrupt the flow of teaching. Techer 8 did not manage to do effective group work or pair work.

Teacher 5 gave more time for students' thinking and answering questions that caused student' disengagement and led to wrong answers. Teacher 6 managed time well (giving adequate time and adjusting the timeline) for all activities, but she gave unnecessary time (reading the question four times), and external disturbance (noise) made it take more time to delay their teaching. Teachers 7 and 8 did not manage time for student's learning (not teach according to allocated time and given instructions). Teacher 5, 6 and 7 made pair work, group work, and class work as directed by the teacher's guide and observed them. But teacher 8 did not do group work or pair work. Teachers 5 and 6 encouraged students to respect each other. While teachers 5 and 6 considered all students to take part in learning opportunities, teachers 7 and 8 were weak in considering individual student's learning.In **assessing and monitoring,** teachers 5, 6 and 7 answered all questions in the exercise of the lesson that assessed students' remembering, understanding, and application. Teacher 8 asked students questions related to real life to engage in lessons. Teacher 8 did not exercise. Teacher 6 asked more questions than the exercise requested. Teachers 6, 7 and 8 made peer assessments. During activities and exercises, all teachers heard student's variety and incorrect or wrong answers; they accepted correct answers and neglected wrong or incomplete answers. They did not give constructive feedback and did not help students reach the right answer. All teachers observed the class, but only teacher 6 checked students' answers to exercises.

Teacher 6 prepared better for the lesson than teachers 5, 7, and 8. Although teacher 6 created learning opportunities for student's interest, engagement, scientific understanding, science process skills, and some 21st century skills through activities, teachers 5, 7 and 8 were weak in creating learning opportunities. All four teachers were weak in stages 3 and 4 of the inquiry-based method; they did not follow the instructions in the teacher's guide. All teachers must manage time effectively in order for students to learn effectively. All teachers needed to develop and use rubric items or verbal questions that could assess student's understanding and application.

Results of Interview

The results of six interview questions were presented as follows:

1. What are the **strengths and weaknesses of the new primary science curriculum?**

As **strengths of the new primary science curriculum**, matching with students' needs and daily life or society's needs, qualities of activities, and knowledgeable contents emerged as the results of interviews with twelve teachers.

New science curriculum -

- matched students' needs (n =8).
- matched daily life and society's needs (n =7).
- was good for student and made students more interested and curious about learning (n =4).
- involved activities that were specific and gave students opportunities to explore and cooperate (n =6).
- had more knowledgeable contents for both teachers and students (n =3).

As **weaknesses of the new primary science curriculum,** inadequacy of time and teaching materials, as well as difficulty of content and assessment, were explored.

- Teaching aids were not adequate for all students (n =2).

- Time allowed was not sufficient for doing activities (n =1).
- They did not know well some of the contents involved in the new curriculum, and some were difficult for students to understand (n=2).
- There was no clear instruction on how to assess lower primary students (n =1).

2. What are the **differences between the old and new primary science curricula?**

Two of the teachers said that they were not quite different because one teacher explained that he taught old and new curriculum with CCA approaches and another teacher said that most experienced teachers taught new curriculum in old ways. There were **differences between the old and new primary science curricula** in the areas of contents, teaching methods, nature of activities, students' interests, and assessment.

- New curriculum involved more activities than the old curriculum (n =11).
- These activities were specific, related to real life, and motivated students not only to learn but also to cooperate among themselves (n =5).
- New curriculum content structure was more attractive than the old because of its structure (activities, figures, etc.) are attractive (n =1).
- New curriculum involved more and new contents, and teachers needed to learn more than the old curriculum (n =4).
- Teaching new curriculum was easier than teaching new curriculum with the help of a teacher's guide (n =2).
- Old curriculum focused on rote learning and lecturing by teachers; that was different from the new curriculum, where real objects and teaching aids were used to teach students (n =4).
- Assessment for the old curriculum was focused on examination, whereas in the new curriculum, students were assessed based on their performance (n=2).

3. How do you do **assessment practices in the new science curriculum implementation?**

Related to **assessment practices used in the new science curriculum implementation**, students were assessed monthly or in chapter-end tests four times per year.

- Students' performance was assessed (viva) monthly with item types and rubric types, and they were recorded for each subject (n=5).
- Students' performance was assessed by using exercises included in the lessons (n=3).
- Students' performance was assessed after two chapters (n=1, Private).
- Students were assessed four times per year for both the lower and upper primary levels, then report cards were sent to parents. (n=12).
- Peer assessment was also made in her class (n=1, Grade 5).
- There was no verbal assessment for Grade 5 students (n=1).
- Grade 5 students were assessed by the district at the end of the academic year (n=3).

4. What are the **difficulties faced during implementing the new science curriculum and how to overcome these difficulties?**

Some teachers answered that there were no difficulties for curriculum implementation.

- There were no difficulties in planning lessons with the help of teachers' guides (n=6).
- There was no difficulty in time allocation for the lessons and activities (n=3).

- There was no difficulty in her teaching because she had an assistant teacher (n=1, Private).

The **difficulties faced during implementing the new science curriculum and strategies to overcome these difficulties** were difficulties in teaching aids, the insufficiency of teachers, and difficulty in motivating students' interests and communication problems.

- Ten teachers faced difficulties with teaching aids (n =10).
- They solved some of these difficulties by making teaching aids themselves and by requesting others to help in setting up apparatus and sharing resources.
- Since teachers were not sufficient, they could not do activities involved in the contents and could not make all students involved in activities (n=4).
- Some students were not interested in lessons, so they encouraged them to get involved (n=7).
- There was a difficulty in communicating with their students, who were Pa-oh and Shan.
- Some students helped her with translation and communication with their classmates (n=1).

5. Express the **support groups that provided for the implementation of the new primary science curriculum**.

They received support from the government, other organizations, the school, colleagues, parents, and students.

- Government provided teacher's guides, student's books, and teaching aids once per grade, not yearly (n =10, except private).
- Schools provided teacher's guides and teaching aids (n =2, private).
- UNICEF supported some books for school (n =1).
- There were support from colleagues (n =8).
- Parents supported their teaching by donating teaching aids (n =3).
- Students took teaching aids from their homes for teaching (n =8)

6. Please give the **suggestions for successful implementation?**

Teachers suggested in the areas of class size, allocated time, teaching aids, teachers, refresher courses, and professional learning communities.

- Class size should be small (30–35, 25–30 students), or if class size is large (above 60 students), two teachers should be responsible for one class (n=6).
- Adequate time for science teaching should be allocated (n=2).
- Teaching aids should be supported adequately, timely, and annually (n=9).
- A laboratory room for science subjects should be in each school (n=1).
- Refresher courses for the new curriculum should solve teachers' difficulties in implementing the new curriculum (through practical teaching, explaining how to use teaching aids, and providing required resources such as a teacher's guide and teaching materials (n=4).
- Primary teachers should be more knowledgeable and teach according to the guidelines laid down in the teachers' guides (n=4).
- One teacher responsible for the class was suitable for students because she or he could know and manage the class well (n=1, lower primary).

- Teachers should be responsible for specialized subjects in order to teach well in their subjects (n=1, upper primary).
- Principal should hold meetings for sharing teaching strategies or how to use teaching aids among colleagues (n=1).

Results of Documentation

Documents in twelve schools were observed. Documentation related to teacher's guides, notes of lessons, student's books, and reference books related to science, subject wide meetings, books related to assessment (National Assessment Policy, National Assessment Guidelines, etc.), assessment questions, records for students' performance and assessment records, and records for parent meetings were analyzed.

Related to the teacher's guide, all teachers (n=12) had teacher's guides, but a teacher's guide for grade 5 was recently provided (n=5). There were no notes of lesson for the new primary science teachers (n=12), they only had daily diaries. There were student' books adequately for all students (n=12). There were reference books in two schools (n=2), but not in ten schools (n=10).

There were records related to subject-wide meetings in all schools (n=12) but teachers did not do subject wide meetings as well as continuous professional development (CPD) program (n=11), except in one school (n=1). In the last academic year (2021-2022), they held subject wide meetings (n=2). Teachers discussed, especially for assessment; which contents and questions were made for the assessment (n=4). Teachers were provided required courses according to school-based programs and meeting if required (n=2).

There were books related to assessment supported for the school but not for the specific grades (n=10), except in private schools (n=2). Although one school had both rubric items and item types for each chapter (n=1), other schools (n = 11) only had item types for assessment (four times per year).

Students were assessed four times per year and made report cards (n=12). Students' performance was recorded for each chapter (n=2). Student's performance was recorded for all subjects monthly as performance records: teachers assessed student' performance by observing during the lessons (n=5). Teachers did not meet parents twice a year, and they met when needed (n=11), except at one school where parents were met after each exam (n=1). Table 4.88 showed the summary results of documentation from 12 schools.

Conclusion and Discussion

Generally, teachers practiced to a **moderate extent in planning**. With respect to the highest and lowest mean values of twelve items, teachers **practiced to a great extent** in preparing to select the sequence of lesson to cover the topic systematically and they **practiced to some extent** in planning lessons for further study in science. **As the observation results showed,** most teachers prepared according to teacher's guide, but they were all not prepared for further studies in science. Although some teachers prepared teaching aids adequately for all students and for all activities, most teachers did not prepare teaching materials for students and activities (students did not access teaching material and were involved in learning activities, and as a result, they did not get the required skills by studying science).

They still needed to understand and prepare lessons according to the teacher's guide and the students' different abilities. Furthermore, they still needed to consider how to assess students' performance based on the lesson (by preparing rubric items). The National Research Council (1996) stated that teachers of science need regular, adequate space for science, and effective science teaching depends on the availability and organization of materials, equipment, media, and technology. But teachers had difficulties in planning lessons because of inadequate teaching aids, insufficient time (most teachers were responsible for all subjects in one grade or two or more subjects in many grades or all subjects in two or more grades), an unbalanced teacher-pupil ratio, limited space for activities, etc.

In **teaching,** although teachers practiced to a moderate extent, some of them did not teach the lessons according to the guidelines of the teacher's guide. At the first stage of inquiry-based teaching (answering questions), some teachers gave the answer first and then made hands-on activities that reduced students' curiosity, interest, and learning. It was contrast with the BSCS 5E instructional model, in which teachers should create interest, generate curiosity, raise questions, and elicit student's responses (prior knowledge) related to the topic (not correct answers) at the stage of engagement (Bybee et al., 2006). Teachers should focus not only on finishing the lesson but also on developing science process skills because most teachers do not focus on learning objectives that promote students' science process skills and independent skills to get scientific understanding.

At stage 2 (exploring), some teachers did activities that generated students' scientific understanding, and science process skills. "Exploration experiences provide students with the activities in which teachers help students use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation" (Bybee et al., 2006, p. 2). But most teachers did not give all students opportunities to participate in activities. Most teachers explained science concepts through lecture or demonstration. Therefore, students did not develop required skills such as science process skills, problem-solving skills, communication skills, creativity, and etc. Shamas-Brandt (2012) also found that the students of the teacher who followed the curriculum more closely and employed more structured inquiry did not grow in their process skills, and their attitudes followed a normal distribution.

At stage 3 (Reading), although teachers' guides instructed to promote students' learning and supported further learning, at stage 4 (Elaboration), teacher's guide instructed teachers to assess students' understanding of the lessons (activities) by asking and discussing with students (their own words). If students did not understand the lessons well, teachers needed to reteach or change teaching styles. Most teachers only read and explained these two stages, and some teachers skipped this stage.

According to the BSCS 5E instructional model, the third stage (explain) aims to provide students with opportunities to demonstrate their conceptual understandings, process skills, and behaviors, and teachers need to guide students towards a deeper understanding. Varelas et al. (2014) also suggested that students should be given opportunities for discussions to connect science activities and text to resonate with their experiences. The purpose of stage 4 (extend) is to help students use their new knowledge, continue to explore its implications, develop deeper and broader understanding, more information, and adequate skills.

It was also stated as 5 strategies and tips for implementing inquiry-based learning, in which the third stage (Encourage Communication) was to encourage students' discussion of their ideas with each other. This may lead to a better understanding of the science. The fourth stage (Provide resources) aims to develop student's better understanding of the concepts and give them access to further learning, such as online learning platforms, which can enhance students' knowledge (*What Is Inquiry-Based Learning? Types, Benefits, Examples,* 2022).

Inquiry-based method used in Myanmar was in contrast with the above two methods of inquiry-based learning, especially in stages 3 and 4. They focus students' discussion or communication first and extend their understanding by providing resources. Myanmar focuses on giving resources first and students' discussions later.

Most teachers did not understand and follow the teacher's guide, especially in stages 3 and 4, and could not extend student's understandings based on the taught lesson and daily life. This could reduce students' scientific understanding, critical thinking skills, creativity, problem-solving skills, etc.

While some teachers did hands-on activities for all students with adequate teaching materials that were prepared by themselves as much as they can, most teachers did not make hands-on activities for many reasons: inadequate teaching aids (some could not be afforded and some were not easily available), insufficient time, insufficient spaces, unbalanced teacher-pupil ratio (most teachers with large class size made difficult to do activities that needed more time and more teaching aids), content difficulties for teachers and students (especially Grade 5), etc. Bradbury et al. (2018) suggested that the difficulties of inadequate resources were solved by using resources available through the university (school) and by creating their own.

The teacher's guide sometimes caused teachers' and students' misunderstandings. For example, in the lesson Work Done (Grade 5), the answer for the direction of the force (Activity 2, No. 3) was not present in the teacher's guide. The teacher interpreted that if there was no work done, there was no force. Similarly, in the lessons of Kinetic Energy and Potential Energy (Grade 5), the figure of activity 3 made students' misconceptions and caused a mismatch between the students' answers and the answers presented in the teacher's guide. A teacher's misunderstanding can also hinder successful curriculum implementation, and that may be due to the fact that teachers acknowledged a lack of awareness, familiarity, or training about the new curriculum implementation practices in the classroom (Bantwani, 2010, as cited in OECD, 2019).

According to the results of qualitative findings on **managing classrooms**, most classrooms were crowded and had little space for activities. The structure of the class (no partition) made teachers' classroom management difficult. Although the classrooms were narrow for many students, they managed seating arrangements and teaching aids as much as they could so as to ensure the student's learning effectiveness. But most teachers did not manage seating arrangements if the classroom was easily manageable. They needed to prepare the physical arrangement of the class for students' learning effectiveness and to prepare teaching materials as much as possible. Some teachers used effective group work, pair work, and class work to improve student's cooperation, and communication skills. But most teachers needed to do so because they did not encourage these skills through activities.

Although most teachers answered that they had inadequate time for teaching, they taught less than the allocated time, but they had other duties such as assigning teachers to collect the list of votes, meetings, ceremonies, etc. Teachers needed to manage time effectively for the activities because most students did not have opportunities to take part in them. The teacher must give opportunities for students to take responsibility for their own learning, individually and as members of groups (NRC, 1996).

Teachers still needed to nurture students not only to take responsibility but also to develop values such as integrity, honesty, respect, etc., because nowadays students need to develop not only their intelligent quotient but also their emotional and social quotient for a successful life. Teachers should display and demand respect for the diverse ideas, skills, and experiences of all students (NRC, 1996).

Related to **assessing and monitoring**, teachers practiced to a great extent; most teachers asked questions to arouse students' interest and curiosity. But most of them did not redirect and gave constructive feedback on the students' answers.

The teacher's guide instructed to summarize the lesson for the student's understanding and assess the student's knowledge, understanding, and application. Most teachers summarized lessons by reading and explaining. They did exercises presented in the textbook. But some gave homework, and some skipped this part (because they said these were the same as questions in the activities). That made students lose their opportunities to develop their creativity and application skills. Moreover, most teachers did not prepare assessment questions related to their lessons. Although some teachers monitor students' learning and progress, most of them do not monitor students' learning.

As the qualitative results, teachers were responsible for many subjects or many grades that made it difficult to manage time in order to implement successfully. Organization for Economic Co-operation and Development (2019) indicated that teachers' stressful workloads and lack of time were obstacles to implementation. Furthermore, Lowe and Appleton (2015) found that the problems of teachers in implementing new curriculum involve time for reading and understanding curriculum, training for new curriculum and changing current educational processes.

As the result of quantitative results teachers practiced to a moderate extent in new science curriculum implementation at the primary level. But as the result of observation, teachers needed to practice in all areas of curriculum implementation to implement new science curriculum successfully. Furthermore, teachers needed to understand and practice the stages of inquiry-based learning. As the results of qualitative findings, there were many difficulties for successful curriculum implementation, such as resources: teacher's quality, adequate teachers, teaching aids, time, space, etc., and trainings that supported teacher's knowledge and skills. They also suggested to address these difficulties concerning class size, allocated time, teaching aids, adequacy of teachers, refresher courses, and professional learning communities.

Recommendations

Recommendation for teachers, principals, government and other agencies were presented here.

Recommendation for Teachers

- Teachers should try to understand the guidelines of teacher's guide and implement the curriculum according to guidelines of it: they should plan, teach, manage and assess according to it.
- Teachers should practice effective group work, pair work and class work to improve student's collaboration, cooperation, communication skills.
- Teachers should study assessment strategies to assess students' learning and give constructive feedback as required.

Recommendation for Principals

- School principals should encourage teachers to develop their knowledge about curricular, content, students, pedagogical and assessment knowledge as well as skills through training, professional learning community or self- learning.
- Principal should encourage and support teachers' collaboration and have meetings and seminars to address teachers' difficulties in implementation at school level.
- Principal should allocate teacher's teaching subjects according to their specialization.
- The principal should manage a classroom with partition between classes in order to reduce noise disturbance during teaching.
- Teaching aids should be supported adequately for all activities and for all students by requesting and taking allocated teaching materials on time.

Recommendation for Government and Other Agencies

- Difficulties (inadequacy of teachers, resources such as time, space, teaching aids) faced by teachers during implementation should be considered and addressed as much as possible in order to implement the curriculum successfully.
- Teachers' quality should be upgraded by encouraging self-learning, peer collaboration, giving them opportunities to promote their profession, such as training and appraisal systems.
- Professional development programs, especially refresher courses for curriculum implementation, should focus on teachers' needs: subject matter mastery, usage of teaching aids, etc.
- Teacher- pupil ratio should be balanced in order to implement curriculum successfully because new science curriculum emphasizes science process skills through activities.
- Teachers should be appointed according to their specialization.
- Teachers' guides should be mandated to avoid teachers' and student's misunderstandings.
- The government and others agencies should survey whether the curriculum implementation was successful or not and be revised when necessary.
- Monastic schools should be supported by teachers, adequate salary, teaching materials and other requirements similar to basic education.

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