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EVALUATING THE IMPLEMENTATION OF THE MODULAR APPROACH IN GRADE 6 SCIENCE EDUCATION IN SRI LANKA: A PILOT STUDY

Anthoni Durage Asoka De Silva[i],
Thisara Malshan Wijesinghe
National Institute of Education,
Sri Lanka

Abstract:
The Sri Lankan secondary education system is undergoing reform to meet global demands, necessitating a crucial shift in science education towards active, student-centered learning. This pilot study, conducted across 15 public schools, observed the implementation and investigated the strengths and weaknesses of the newly prepared Grade 6 science modules, the modular approach, and authentic assessment tasks. Adopting an interpretivism paradigm, data was gathered from 472 students, teachers, and principals using interviews, observations, and questionnaires. Findings indicated high student satisfaction, with students reporting the module format, content, and activities to be fun, active, and collaborative. Stakeholders praised the printed materials for their user-friendliness, the promotion of 21st-century skills, and the improved transparency of formative assessment via rubrics. However, weaknesses were identified, notably insufficient allocated time for activities, difficulty accessing English web resources, and managerial challenges related to material logistics. Crucially, the success of the reform was challenged by prevalent teacher-centered practices and insufficient teacher training, particularly on rubric usage. The study recommends prioritizing the development and systematic utilization of e-modules as a sustainable, cost-effective alternative to printed modules. To address these core teacher-related limitations, the study strongly recommends prioritizing continuous, practical professional development. It advocates that the drawbacks of the current cascade model of teacher training be overcome by leveraging online platforms to extend national expertise directly to regional training. Furthermore, the provision of online micro-credential courses is proposed as a flexible, competency-based alternative for continuous upskilling in areas like STEM/STEAM, inquiry-based learning, and formative assessment. Furthermore, continuous awareness programs are vital for educational administrators, school leaders at all levels, parents, and the general public to facilitate the transition to student-centered pedagogy and secure the successful implementation of the reform.

[i] Correspondence: email adasoka@nie.edu.lk, adasoka@gmail.com

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1. Introduction

Many countries have transitioned to modern teaching methods that empower students to think critically and solve real-world problems. Particularly, to move beyond the current teacher-centered science instruction—where students mainly accept the teacher's explanations—educators around the world attempt to implement strategies that provide ample opportunities for students to develop knowledge independently (Sunaryatin, Siregar, & Wahyudi, 2022). However, students in Sri Lanka continue to rely on rote memorization and regurgitation during exams. Many Sri Lankan students graduate from the public schools without acquiring fundamental skills in mathematics, language, science, and digital literacy (De Soysa, 2021). Alawattegama (2020) highlights significant criticisms raised by various stakeholders regarding the outdated nature of the school curriculum, which does not align with the evolving world. The present Sri Lankan school education is primarily teacher-centered, which restricts students' opportunities for active and participatory learning. Multiple researchers have presented evidence (McCaul, 2007; Sedere *et al.*, 2016) indicating that the current centralized school curriculum is overly extensive, insensitive to local needs, and offers minimal room for active learning. While teaching methodologies remain stagnant and lack innovation, the existing assessment methods lack flexibility and rely heavily on traditional examinations that encourage rote memorization of facts. The strong emphasis on examinations in Sri Lanka has had detrimental effects on the overall development of students, as highlighted by Sedere *et al.* (2016). Public examinations come with their share of drawbacks, such as falling short in assessing higher-order thinking skills that foster creativity and metacognition, distorting the curriculum, teaching solely for the purpose of passing exams, grade retention, early dropouts, and various forms of malpractice (Kellaghan & Greaney, 2019).

Sri Lanka is reforming secondary education to meet global demands for skilled workers. This initiative aims to equip youth with crucial STEM and commerce skills for the national economy. To achieve the above aim, science education in the country can play a pivotal role. However, current pedagogy in Sri Lanka is often teacher-centric, limiting student development. Further, passive learning, rote memorization, and traditional assessments hinder critical thinking and creativity.

The new goals of science education in many countries have prompted the need to connect science to the broader social context and real-world problems. This also requires a corresponding transformation in assessment practices (Azim & Khan, 2012). Linking science to the broader social context and real-world problems through curriculum and instructional reform is an urgent requirement within the general education system of Sri Lanka. To address this burning need, authentic learning and assessment are planned to be introduced into the science curriculum through a modular approach. However, teachers and students are expected to encounter various challenges in adapting to these

innovations. This situation is exacerbated because many teachers, the current cohort of students, and other education stakeholders are products of the existing examination-driven general education system and hold strong beliefs in the public examination system. Consequently, to facilitate the effective island-wide adoption of the reformed science curriculum, a preliminary pilot study to evaluate potential strengths and weaknesses encountered by teachers, students, and relevant stakeholders is deemed essential before national implementation.

Based on the background described above, the current study particularly focusses on observing the implementation process of the newly prepared grade 6 science modules in selected schools during the pilot study and investigating the strengths and weaknesses of the proposed grade 6 science modules, the modular approach, and authentic learning and assessment tasks from the perspectives of different stakeholders. This study also aims to gather stakeholder feedback for revising the proposed grade 6 science modules before island-wide implementation and to provide recommendations for their successful adoption across the island.

2. Literature Review

2.1 Modular Approach in Teaching Science

Modular teaching stands as one of the most prevalent and acknowledged teaching and learning methodologies in the United States, Australia, and numerous Western countries, as well as within the Asian region. Modules find applications across a wide spectrum of subjects, including the natural sciences as well as in the realms of social sciences, mathematics, and computer education. Modules have been integrated into the teaching of various subjects (Alban & Alieto, 2022; Crodua, 2023; Rahmawati, Lestari, & Umam, 2019; Mensan, Osman, & Majid, 2020; Sadiq & Zamir, 2014; Sejpal, 2013; Vallespin, 2021). A module is a self-contained unit of instruction within a course, presenting a method of teaching that focuses on the progressive development of skills and knowledge through discrete units (Sejpal, 2013). Additionally, it is characterized as a meticulously organized teaching resource designed to enable students to attain specific learning objectives (Hasbie *et al.*, 2023). In the context of a curriculum founded on modular principles, a module represents an independent unit of learning, which can be interconnected with other modules to establish a coherent and comprehensive learning program (Mines & Cajucom, 2022).

A module is an instructional package dealing with a single conceptual unit of subject matter and affords the opportunity to develop, evaluate, and use a variety of media to optimize instruction for students on a given topic (Russell, 1974). It also emphasizes the direct involvement of students with learning materials. This provides real and meaningful experience directly to the students (Mensan, Osman, & Majid, 2020).

The purpose of these modules is to equip instructors with the necessary tools to transform their classrooms into dynamic, student-centered learning environments (Sadiq & Zamir, 2014). Module-based education is an instructional approach that centers on the

delivery of content through well-structured units of study. This approach enables students to advance through the curriculum at their own pace while delving into specific topics or concepts. Modules can take various forms, including lectures, readings, online resources, collaborative projects, and individual assignments. This method of teaching and learning frequently prioritizes hands-on, experiential learning that fosters problem-solving and critical thinking skills. Additionally, the utilization of modules can promote active learning, as students are often required to engage with the material to complete assignments or assessments. Overall, module-based education offers a versatile and adaptable framework for delivering effective instruction across a variety of settings (Dejene, 2019).

The implementation of the modular learning approach resulted in a significant enhancement of students' academic performance (Betlen, 2021; Hairida, 2016). Moreover, it has been observed that this approach brings about noteworthy improvements in academic performance across various subjects, including Mathematics, Science, and English. This positive trend has been documented in the studies conducted by many researchers (Amandaa, Fajrinaa, Razaka, & Darussyamsu, 2025; Ambayon & Millenes, 2020; Baring & Berame, 2022; Fitri *et al.*, 2023; Hasbie *et al.*, 2023; Rahmawati, Lestari & Umam, 2019; Valencia, 2020).

In the context of secondary school science education, the modular approach involves delivering science instruction through discrete modules or units of study, each tailored to cover specific topics or themes. This approach allows students to complete these modules independently or as part of a broader curriculum (Fitri *et al.*, 2023; Valencia, 2020).

Modular science teaching offers several benefits (Betlen, 2021; Dangle & Sumaoang, 2020; Mustika *et al.*, 2023; Vallespin, 2021): flexibility for diverse student needs, personalized learning aligning with interests, improved engagement through manageable units, better knowledge retention via systematic completion, and precise assessment of specific concepts within each module. In summary, a modular approach in teaching science in secondary schools can be a useful way to enhance student engagement, learning, and understanding. By breaking down complex topics into smaller, targeted units, teachers can customize their lessons and help students feel empowered to engage with scientific concepts.

2.2 Theoretical Foundation of Module-based Teaching and Learning

Educational theories, instructional design, and cognitive psychology pave the foundation for module-based teaching and learning. Constructivist learning theories underscore the active construction of knowledge and understanding by learners through their experiences and interactions within the learning environment. Module-based approaches are in line with constructivism by affording learners the opportunity to actively participate in learning, explore deeply into concepts, and construct meaning through discussions, hands-on activities, and reflective processes within modules (Valencia, 2020). According to Cognitive Load Theory, the complexity of the task influences

learner's ability to process information within their limited capacity. The division of educational content into smaller, manageable modules serves to lighten cognitive load by presenting information in well-structured and coherent segments. Modules empower learners to concentrate on one topic at a time, leading to enhanced comprehension, retention, and the application of knowledge (Sweller, 2011).

Module development, guided by backward design (Button, 2021), starts by defining learning outcomes and structuring instruction to achieve them, ensuring alignment between goals, assessments, and activities. Incorporating blended learning and technology (Hughes, 2007) allows for simulations, online discussions, interactive media, and personalized learning, providing flexible access and customized learning paths.

2.3 Different Models Used in Module Development

Globally, scholars have developed various module models based on modular principles. Mensan *et al.* (2020) used constructivism, emphasizing hands-on, collaborative structured and guided inquiry. Mustika *et al.* (2023) developed elementary science modules using the constructivist 7E model. Similarly, Mines and Cajucom (2022) proposed a constructivist, sensory stimulation framework. Their modules aim to integrate prior knowledge with new experiences through active, sensory-rich engagement for effective learning.

To ensure module content validity, scholars have employed various methods. Mensan *et al.* (2020) developed a five-condition form (based on Russell, 1974) assessing target audience achievement, application, time, performance improvement, and attitude change. Similarly, Mines and Cajucom (2022) evaluated modules across content, format, presentation, learning and evaluation activities, and information accuracy. Mensan *et al.* (2020) and Saputra *et al.* (2023) also conducted face validity testing on text, graphics, and language with experts.

3. Material and Methods

3.1 Research Approach

The broad research approach, which is described as the plan to research by Creswell (2013), consists of the intersection of three factors, namely research paradigm, research designs, and specific research procedures. Interpretive researchers employ a methodology that enables them to conduct studies in their natural settings. They employ approaches that enable them to establish personal contact with the group being studied, thereby attaining an insider's view (Wellen & Fraenkel, 2001). Accordingly, the current research is designed based on the interpretivism paradigm to interpret elements of the study. Creswell (2013) introduces research designs as types of inquiry that give a specific direction to proceed with the research study within the selected research approach. Research designs can be qualitative or quantitative. The current study is based on the qualitative approach, and specifically, it follows a non-experimental (observational)

qualitative research design. The current research attempts to evaluate newly developed grade 6 science modules with reference to the (1) content, (2) format, (3) presentation and organization, (4) learning activities, and (5) evaluation activities. Therefore, this type of research is education development research or Education Design Research (EDR). It uses – probably most often – mixed methods research design to answer research questions (McKenney& Reeves, 2014).

3.2 Sampling Design

Fifteen public school principals who expressed interest in piloting the proposed Grade 6 modules followed by a general awareness program conducted by the NIE on the proposed general education reforms to be implemented island-wide in 2026. Since the respondents volunteered to be a part of the current study, more specifically sampling design can be named as non-probability volunteer sampling (Murairwa, 2015). This approach was appropriate because the study required principals who were willing to implement the modular approach in real classroom settings and provide detailed feedback on its effectiveness. Although the sample is not statistically representative of all schools in Sri Lanka, it provided rich, practice-based insights relevant to the exploratory nature of the study. Therefore, the sample of the current research study comprised of principals, deputy/assistant principals, grade 6 science teachers, and grade 6 students at the 15 schools who volunteered to participate in the pilot study.

A total of six Grade 6 science modules were piloted across the above-mentioned 15 Sri Lankan public schools. The module "From the Universe to Our Home" representing the theme Universe, Earth and Environment, received interest, with five schools volunteering to pilot it. The module "Things Around Us" under the theme Matter and Energy was piloted in two schools, while "Energy, Light and Sound", which is also under the same theme, was trialed in one school. Under the theme Life and Its Continuity, the module "Wonders of the Living World" was implemented in two schools. The module "Little Scientist", representing the theme Science, Technology and Society, was tried out in five schools.

3.3 Method of Instrument Development and Data Collection

Mainly, qualitative data were gathered to achieve the objectives of the research. Semi-structured interviews were conducted to gather view of key stakeholders, namely students, teachers, and principals/deputy principals/assistant principals, on strength and weaknesses of the proposed grade 6 science modules and their classroom implementation. Here, 2-4 selected students representing the good performers and weak performers in the grade 6 class selected from each school, all the science teachers who delivered one of the proposed science modules to the selected class in each school, and principals/deputy principals/assistant principals who worked as the in-charge of the module implementation in each school participated in these semi-structured interviews on the day researchers from NIE visited each school.

The number of module copies requested by each school was prepared and sent by post to the 15 schools involved in the pilot. During online orientation programs conducted by the researchers from NIE, teachers were instructed to maintain reflective notes on each day they delivered the module. Simultaneously, principals/deputy principals/assistant principals who observed module delivery at their respective schools were requested to maintain records of their observations. In addition, both parties were requested to take photos and video clips of the module delivery. Apart from that, portfolios of students' performance were also requested to be displayed in the classroom on the day the respective school was visited by the researchers. Hard copies of modules completed by students were also checked.

At least one hour lesson was observed by the researchers on the day they visited each school. These observations were made with a focus on the five conditions proposed by Russell (1974) for content validation of modules. With permission from the principal and the class teacher, photos and video clips were also taken by the NIE officers during the module delivery on their visit paid to each school.

A questionnaire was developed for students to get their perceptions on the proposed modules and the modular approach. Through the questionnaire it was intended to get students' opinions on five dimensions namely (1) format, content, and presentation of the printed students' module, (2) proposed learning-teaching activities in the module, (3) proposed assessment tasks and evaluation, (4) availability of infrastructure facilities, and (5) experience gained by following the module. These dimensions of the questionnaire were decided by referring to a similar study conducted by Mines and Cajucom (2022). On the day researchers visited respective schools, the questionnaire was administered to the students who had almost completed the module. This questionnaire comprises of two main parts A and B, which were designed to gather demographic data of the students and their perspectives on the module and module delivery, respectively. Part B of the questionnaire comprises 31 items developed with a Likert scale ranging from "Strongly Disagreed" to "Strongly Agreed".

Finally, each school was requested to make an online presentation on the experiences they gathered through the delivery of the proposed grade 6 science module of their choice in their respective school. Each school used a PowerPoint presentation, video clips and other relevant evidence to share their experiences in doing 15 minutes online presentation. These presentations were made by either principal/deputy principal/assistant principal, and/or respective science teachers who delivered the module.

3.4 Methods of Data Analysis

The qualitative data were analyzed using an iterative and interpretive approach commonly used in qualitative research. The researchers first engaged in data reduction, sorting and organizing the raw data through systematic coding. These codes were then grouped into categories, which were further refined into broader themes that captured patterns and meanings across the data. Throughout this process, the researchers

maintained a close connection to the original data by using direct quotations to illustrate categories and themes, preserving depth and context. This approach aligns with the models described by Punch (2009) and Richards & Morse (2007), where data transformation, interpretation, and continuous verification occur simultaneously to develop a rich and grounded understanding of the findings.

Quantitative data gathered through the student questionnaire were analyzed using SPSS 17.0. The data were first classified into categorical data (nominal and ordinal items) and quantifiable data (interval and ratio items). Categorical data were summarized using frequencies, percentages, modes, and medians, presented through bar charts and pie charts to illustrate demographic distributions. For interval-type items, the researchers calculated arithmetic means and measures of dispersion, including minimum, maximum, range, standard deviation, variance, and coefficient of variation, providing a detailed statistical description of student responses. To enhance the reliability of the overall findings, the study applied methodological triangulation, combining multiple methods of data collection and analysis.

3.5 Ethical Consideration

Ethical guidelines were strictly followed. Consent was obtained from school principals, and respondents' anonymity was ensured by not collecting names. Students were informed that participation was voluntary, and NIE officers explained the study's purpose beforehand. These measures supported accuracy and encouraged respondents to express their views freely.

4. Results and Discussion

A total of 472 Grade 6 students from five provinces, namely Western, Central, Southern, Northwestern, and Sabaragamuwa, participated in the study. These schools represent a diverse mix of girls' (3), boys' (2), and mixed (11) schools, ensuring broad representation across school types. All participating schools followed the Sinhala medium of instruction. Overall, the sample comprised 302 girls and 170 boys, reflecting a higher proportion of female students.

4.1 Students' Views on Format, Content, and Presentation of the Printed Module

Students were highly satisfied with the format, content, and presentation of the printed module. The module was generally well-received, with a large majority of participants finding it easy to follow, attractively prepared, and noting that the included visual aids were highly helpful. They also agreed that the subject matter was described simply. Students were largely satisfied with the clarity of information regarding activity assessment, the simplicity of the assessment rubrics' language, and how well the rubrics indicated the path to higher marks. While most students agreed that sufficient space was provided for notes and exercises, a small percentage disagreed. Overall, the average score indicates strong satisfaction with the module's structure and presentation.

4.2 Students' Views on Proposed Learning-teaching Activities in the Module

Students held a largely positive view of the proposed learning-teaching activities. A very high percentage of students found the instructions easy to understand and the activities easy to complete. The vast majority also agreed that the module's activities were linked to daily life experiences. While most agreed that the time allocated for each activity was sufficient, a small percentage disagreed. The provision of internet-assisted learning opportunities and self-learning opportunities was viewed as a positive characteristic by the majority, though a noticeable minority disagreed regarding self-learning. Almost all students were willing to engage with the directed group activities. Overall, over 90% of students enjoyed the proposed learning-teaching activities.

4.3 Students' Views on Proposed Assessment and Evaluation Tasks

Students generally agreed with the proposed assessment activities and evaluation. A significant majority felt that the teacher conducted a fair assessment, and almost all agreed that the scoring rubrics guide the correct completion of activities. Most students strongly agreed or agreed that self-assessment was a good feature and helps them study better, though a small minority disagreed. Similarly, most students found peer assessment to be a good feature that helps them learn better. Most also agreed that assessments in the module relate to everyday life experiences. There were diverse views on determining pass/fail: while most agreed that only completing the module activities should be sufficient, a similar majority disagreed with considering only the term-end examination. However, a strong majority agreed that combining the completion of module activities and the term-end examination is the appropriate way to determine pass/fail.

4.4 Students' Views on the Experiences Gained by Following the Module

Students reported a highly positive experience with the science module, which was overwhelmingly successful in making learning fun. Nearly all students agreed that having a personal copy of the module was helpful. A significant majority also expressed a clear willingness to continue studying science using this module format in the future, demonstrating a high preference for the method.

4.5 Strengths and Weaknesses of the Modular Approach Encountered by the Other Stakeholders

Data collected from the other stakeholders were coded into two main categories, namely strengths and weaknesses, then further coded into five subcategories, namely printed material provided, learning-teaching activities, assessment activities, students' interactions, and development of both 21st century skills and scientific process skills are discussed in the following sections.

4.6 Strengths of the Printed Materials Provided

The printed materials, including pre-tests, post-tests, learning activities, assessment tools, and subject content, were uniformly praised. Teachers appreciated having all assignments, instructions, and assessment tasks compiled in one place, which resolved resource scarcity issues previously faced in providing copies to every student. School administrators highlighted the self-contained nature of the module as a way to minimize problems related to physical and financial resources, ultimately promoting equity among students nationwide. Key themes derived are the importance of user-friendliness (clear format, simple language, attractive visuals), helpfulness for both students and teachers, and empowering end-users while assuring equity.

4.7 Strengths of the Proposed Learning-Teaching Activities

The permission to use smartphones for research and app integration was a major motivator, making learning an inspired experience. NIE officers, teachers, and principals observed that the activities successfully fostered not only syllabus outcomes but also literacy, learning, and life skills. Model-making, in particular, was seen as a boost to student creativity. Key themes emerging here include joyful learning, active learning, and technology integration, all deemed timely for students transitioning to secondary education.

4.8 Strengths of the Proposed Assessment Activities

The introduction of diverse assessment tasks and three modes of assessment (self, peer, and teacher assessment) was deemed a significant strength. Teachers valued the encouragement of rubrics for promoting the transparent nature, consistency, validity, and reliability of formative assessment. Teachers found that task-specific rubrics allowed them to provide more specific feedback, strengthening teacher-student relationships and helping them identify the potential of less academically inclined students. Peer assessment was noted as both enthusiastic and fair. The assessment criteria also successfully encouraged the use of environmentally friendly materials in activities. Themes include transparent formative assessment, improved student performance, improved teacher-student interactions, and opportunities for specific feedback.

4.9 Strengths in Facilitating Students' Interactions

Observations showed that students were highly active, sharing knowledge and experiences more frequently compared to regular sessions. Students who were previously silent in class came forward and performed well in group activities, utilizing their individual potential. Important outcomes included the sharing of materials and the provision of constructive comments on peer performance. Themes derived under this section were effective communication, active participation, collaboration, and caring and sharing.

4.10 Strengths in Facilitating the Development of 21st Century Skills

Almost all stakeholders noted that the student-centered activities and performance-based assessments had immense potential for developing 21st-century skills (learning, literacy, and life skills). Observations highlighted students engaging in constructive arguments for decision-making, demonstrating sharing when material was short, assigning group responsibilities based on individual potential, and displaying emerging leadership. Students showed anxiety over time management and volunteered for tasks. Creative presentations, like roleplay on the solar system or the lab model, were observed. The use of mobile apps for observation (e.g. sky, plants, birds) also underscored technology integration in skill development.

4.11 Strengths in Facilitating the Development of Scientific Process Skills

The modular approach facilitated the development of key scientific process skills. The module provided opportunities for students to visit Advanced Level labs, where they developed classification principles by observing storage systems and measured volumes using volumetric glassware. Activities helped develop the ability to design and conduct simple experiments. The "From the universe to our home" module specifically developed model-making skills by integrating STEAM knowledge. Other skills observed included observing, predicting, inferring, recording, reporting, planning, and communicating findings.

4.12 Weaknesses of the Printed Materials Provided

The main weaknesses were reported by teachers as insufficient space provided for taking notes. They also noted that students struggled to access the provided web links by typing them. A desire for a hard or laminated cover was expressed for long-term use. Teachers expressed concern about the careful handling and protection of the printed materials, while administrators pointed out the complexity of ordering, storing, and distributing them. Lastly, the provided module guide for teachers was deemed not detailed enough for effective delivery.

4.13 Weaknesses of the Proposed Learning-Teaching Activities

Teachers frequently reported that the allocated time for some activities was insufficient. Both students and teachers faced difficulties referencing supportive web resources, as most were available in English. Some teachers commented that the textual descriptions of subject content were too lengthy, making information extraction difficult for students. The lack of certain materials and equipment (e.g., Flux meter) and the inability of some students to bring necessary materials due to poor socioeconomic status posed challenges. Administrators and teachers expressed doubt about adapting the module to the existing school timetable and questioned whether the proposed syllabus could be covered due to the perceived curriculum overload. Other issues included how to manage activities for frequently absent students, the domination of gifted students in group work, and teacher-centered practices and poor time/classroom management.

4.15 Weaknesses of the Proposed Assessment Activities

Teachers found it easier to assess groups than individual students using rubrics, stating that the provided analytical rubrics were difficult to use as an individual assessment tool due to large class sizes. Teachers felt they lacked sufficient practical training or hands-on experience in rubric usage. Furthermore, the performance-based formative assessment was a totally new experience for Grade 6 students coming from a strong written exam culture, necessitating more time for both teachers and students to become familiar. Teachers requested more training on rubric usage and noted inconsistencies in level descriptors across performance levels.

5. Recommendations

The successful implementation of the modules hinges on science teachers and requires practical, continuous training in STEM/STEAM approaches, technology integration, inquiry-based learning, formative assessment, and 21st-century skill cultivation. It is recommended to replace the current cascade training model with continuous in-service programs. It is recommended that the National Institute of Education (NIE) leverage online platforms to extend the expertise and assistance of the national-level resource team directly to regional teacher training. This should be achieved through Training of Trainers (TOT) programs - delivered physically, but planned and supported online—to serve as a strategic alternative to overcome the inherent drawbacks of the current cascade model. Further, the provision of teachers' professional development (PD) via online micro-credential courses is proposed as a flexible, competency-based, and highly targeted alternative to traditional, generalized PD models.

Continuous awareness programs are vital for educational administrators and school leaders at all levels. Effective awareness and training programs for all relevant stakeholders are a prerequisite for the successful transition to the proposed modular approach, inquiry-based learning, small-scale projects, and formative authentic assessment in science instruction. Public and parental awareness programs using diverse media are needed to reduce resistance and ensure parental involvement in the new modular learning reforms.

A widely accepted national mechanism needs to be established to guarantee the reliability and validity of formative assessments, which will inherently reduce the over-reliance on summative evaluation. To support this shift, the NIE must prepare and disseminate relevant, high-quality online resources in both Sinhala and Tamil to equip teachers with the necessary tools and guidance. Furthermore, establishing a centralized Learning Management System (LMS) is necessary to standardize the reporting of students' formative assessment performance, thereby significantly reducing the teacher workload associated with manual data entry and analysis.

Students using the e-module significantly outperformed those using printed modules in science learning, achieving substantially higher scores (Amanda, Fajrinaa, Razaka, & Darussyamsu, 2025; Baring & Berame, 2022). It is recommended to prioritize

the development and systematic utilization of e-modules as a sustainable and cost-effective alternative to printed modules in science education. This strategic shift will not only enhance science teaching methodologies and address specific instructional challenges but will also significantly reduce the financial and logistical burden associated with the preparation and distribution of printed materials among all students across the country.

6. Conclusion

The implementation of the newly prepared Grade 6 science modules was observed through direct and indirect means. Students actively engaged in the proposed activities, particularly enjoying hands-on and fieldwork for authentic learning experiences, and expressed strong willingness to continue using the modular approach. Modules with spaces for notes were seen as an effective practice for motivating students and aiding classroom management. However, teacher practices were often less student-centered than desired, and their formative assessment and time management needed improvement.

Strengths of the modular approach include user-friendliness, end-user empowerment, and equity of printed materials, which feature attractive content and built-in note-taking space. Learning activities promoted joyful, active, and collaborative learning with technology integration. Assessment tasks improved transparency, student performance, and teacher-student interactions through specific feedback. The modules successfully fostered 21st-century skills (e.g., communication, critical thinking, IT) and scientific process skills (e.g., observing, classifying, model-making).

Weaknesses included difficulty accessing English web resources, lengthy texts, a lack of necessary materials/equipment, and insufficient note-taking space. Managerial challenges involved the complexity of ordering/storing modules and insufficient guidance in some teacher module guides. Teachers also felt time allocated for some activities was insufficient. Teacher-centered practices, poor classroom management, student absenteeism, and challenges in implementing new assessment practices were also noted.

A noticeable lack of fairness in resource sharing is a feature of Sri Lanka's schools. This means resources are not distributed equally, affecting different types of schools and various provinces, zones, and divisions (Athurupane, 2023). Stakeholders recommended revisiting the feasibility of all activities based on resource availability, class size, and student characteristics (cognitive development, socioeconomic status). They emphasized reviewing time allocation and the workload from home-based assignments. Proper awareness and training programs on the reforms and formative assessment are crucial for successful island-wide implementation, along with an external mechanism to validate school-based assessments to address potential bias. The modules require revision to be more attractive, reduce content, and ensure durability and cost-effectiveness.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. No funding was received from entities that would influence the outcomes of this study.

About the Author(s)

r. A. D. A. De Silva is an educator and researcher specializing in curriculum development and science pedagogy in South Asia. He is currently affiliated with the National Institute of Education, Sri Lanka. Mr. T. M. Wijesinghe is a lecturer at the National Institute of Education, Sri Lanka, specializing in assessment and evaluation. Their collective research focuses on modernizing traditional classroom structures and improving pedagogical frameworks within the South Asian context.

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