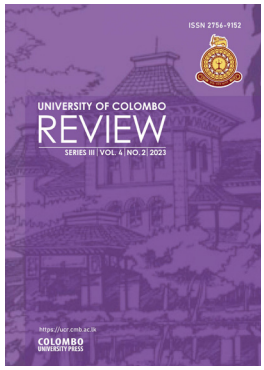

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Student perceptions of formative assessment practices implemented by teachers of science subject in selected secondary schools in the Western Province of Sri Lanka

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ABSTRACT

Formative assessment has become a widely adopted approach in the assessment process of many educational systems. While significant research has been conducted on teacher-related studies of formative assessment, it is important to further focus on student-related studies of formative assessment. Therefore, this study examined the student responses on formative assessment practices implemented by the teachers in science classrooms. The survey method was employed in this study, and data obtained from the respondents were analyzed using IBM Statistical Package for the Social Sciences (SPSS version 20.0). The stratified random sampling method was employed, and the sample comprised 720 students from grades 8 and 10 in schools of three different types: 1AB, 1C, and type 2 in the Western province of Sri Lanka. The objectives of this study were threefold: to investigate the formative assessment practices implemented by science teachers in their classrooms and to examine whether differences exist in the implementation of these practices based on the grade and the type of school. Data collection was primarily based on twelve formative assessment practices, identified through a comprehensive literature review. The results of the study revealed that among twelve practices, the most frequently implemented practice by the science teachers was the practice: "advising about the facts that students should be concerned about when evaluating a lesson by the teacher". Furthermore, the results indicated significant differences in the implementation of certain formative assessment practices between grade 8 and grade 10. Moreover, there were noteworthy differences in the implementation of all formative assessment practices across different types of schools.

KEYWORDS:

Formative assessment; Assessment practices; Science classrooms; Teaching-learning environment

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Introduction

Throughout the world, formative assessment has emerged as a prominent method of assessment that can be considered as one of the most effective educational strategies. Assessment inside the classroom is a powerful process for enhancing student learning. Formative assessment (FA) is considered as a tool to empower students to 'learn how to learn' by emphasizing the process of teaching and learning and involving students as partners in the learning process (Swaffield, 2011).

Literature emphasizes that educational policymakers, teachers, and researchers are increasingly interested in formative assessment as it focuses to support student learning (William, 2011). According to the Organization for Economic Co-operation and Development (2005), many Western countries including Canada, Australia, Finland, England, Italy, Spain, and South Asian countries such as Pakistan, India, Bangladesh, and Nepal have already integrated formative assessment into their teaching-learning process. Countries such as China, Hong Kong, Kenya, and Malaysia have integrated formative assessment practices with their examination systems to strengthen the teaching-learning process more effectively. The literature illustrates that there is a positive relationship between formative assessment practices and student performance (Yan, et al., 2021). Therefore, most of the countries are presently adopting formative assessments in their education systems (Mwebeza, 2010; Birhanu, 2013).

Formative assessment is a process where teachers and students provide feedback during instruction to structure the teaching and learning process to increase student achievement (McManus, 2008). The literature reveals that in many countries, teachers are encouraged to use formative assessment as an essential strategy for achieving the learning targets in their teaching-learning process (Asian Development Bank, 2017). For instance, in New Zealand, the national assessment strategy was established and implemented based on formative assessment in 2000 (Ozan & Kıncal, 2018). Similarly, in England, teachers are encouraged to use formative assessments in their classrooms from pre-school and primary school levels (Hill, 2013). different assessment methods are used for each student in countries such as Finland, Germany, Sweden, and Spain and they emphasize the necessity of constant assessment in the teaching-learning process (Hill, 2013). In Singapore, teachers employ a range of assessment activities and strategies in their classrooms to gain a comprehensive insight into how much students learn as part of formative assessment (Asian Development Bank, 2017). Furthermore, many countries have developed guidebooks to assist teachers in systematically implementing formative assessment practices in the classroom (Marope et. al, 2013).

When considering the education system in Sri Lanka, the literature reveals that the prevailing secondary education system in Sri Lanka is heavily exam-oriented and that public examinations are conducted as the paper-pencil type, only focusing

on the cognitive domain (National Education Commission, 2009). Therefore, it is a significant challenge to shift from an examination-oriented culture to an assessment culture that supports learning. However, it is important to investigate the extent to which teachers use formative assessment in Sri Lankan classrooms, as the literature emphasizes that formative assessment is an integral component in the student's learning progression (Furtak et al., 2016; Kingston & Nash, 2011). Therefore, School Based Assessment (SBA) has been introduced to the secondary education system in Sri Lanka as a continuous assessment system even though there were some misunderstandings among the teachers about this assessment system. However, the combination of SBA in public examinations was introduced as an important aspect of assessment. Since SBA has been identified as one of the best international practices, it can be applied to strengthen the Sri Lankan evaluation system (Sedare et al. 2009). Another survey study conducted by NIE (2015) in Sri Lanka aimed to determine the nature of the school-based assessment in G.C.E. (O/L) classes (National Institute of Education, 2015), It examined teachers' perceptions of this assessment system and investigated the issues that arises during its implementation. The sample of this study consisted of 180 teachers and 180 students from Western, Central, Sabaragamuwa, and Eastern provinces representing 36 schools. The sample was selected using a stratified random sampling technique. The findings of this study revealed that every teacher is aware of the school-based assessment programme. Further, teachers emphasized popular assessment methods used by them under the School-Based Assessment such as short written tests, group activities, open-book examinations, and assignments. According to teacher responses, projects, explorations, discussion panels, debates, exhibitions, seminars, double-entry journals, concept maps, and surveys were reported as infrequently used assessment methods under the SBA. NIE study further revealed that most of these assessments were implemented in science (87%), Mathematics (82%), and History (82%). Several issues related to the implementation of this assessment system in classrooms were identified, such as the heavy workload due to the complexity of syllabi, overcrowded classrooms, and additional paperwork. However, student participants in this study reported that they were satisfied with this assessment system because it contributed to their marks in the G.C.E. (O.L) examination. Despite the introduction of the SBA system as a formative assessment approach aimed at enhancing the quality of the classroom teaching-learning process in Sri Lankan classrooms, curriculum developers in this study emphasized that the objectives of the SBA programme have yet to be realized.

Thusarika & Nawastheen (2019) investigated the problems that emerged during the implementation of the SBA programme and the perceptions of both the students and the teachers regarding the SBA process in the Minuwangoda education zone schools in Sri Lanka through a survey study. The findings of this study indicated a lack of student interest in SBA and perceived it as excessive workload

in their learning process. While numerous studies focus on formative assessment in general, only a limited number of studies focus on Sri Lanka, particularly those focused exclusively on the SBA system (Sedere et. al, 2009). Furthermore, those studies did not primarily focus on the formative assessment practices implemented by the teachers. Therefore, the current study primarily investigates the formative assessment practices employed by science teachers in selected secondary schools in the Western province of Sri Lanka.

Understanding learners' insights into the use of formative assessments in their classrooms is crucial for effective learning. Equally essential is the understanding and skills of the teachers in using formative assessments during instruction, contributing to the success of student learning (Beach, 2006). Formative assessment informs teachers on how to progress, ask more questions, provide more examples, and what responses to student questions are most appropriate. Most importantly, the use of formative assessment can promote self-assessment by students as a practice to develop their ability to take responsibility for their own learning (Black, P. et al. 2003). As highlighted by Beach (2006), various specific strategies related to formative assessment can be employed. These strategies encompass sharing criteria, effective questioning, the formative utilization of summative tests, delivering feedback (both oral and written), promoting peer and self-assessment by students, and encouraging reflective journaling. Notably, these strategies have been highlighted in numerous prior research studies, emphasizing their importance in classroom assessment (Yan et.al, 2021).

Various key practices on formative assessment can be identified through the literature, especially from 2004 to 2020. Researchers, including Chappuis and Chappuis (2004), Willliam and Thompson (2008), Magno & Lizda (2015), Chappuis (2017), Moss and Brookhart (2019), and Figa et al. (2020), have presented diverse formative assessment strategies and emphasized the importance of formative assessment in continuously supporting teaching-learning process to create an effective educational environment.

Basic practices that they have emphasized can be presented as follows.

- Recognizing learning goals according to the lesson and assisting students to make connections among lessons.
- Sharing a clear and comprehensible vision of the learning with students.
- Planning the classroom discussion focusing on advanced learning through the student responses, using examples and models to understand the difference between strong and weak work.
- Collecting evidence of learning related to the objectives that can be acquired through formative assessment strategies such as oral questioning, group and

creative activities observation, classroom tasks, homework and portfolios, assignments, performance-based assessment, self-assessment, peer-assessment, and co-operative group assessment.

- Providing efficient descriptive feedback during learning.
- Developing students using effective student peer feedback.
- Guiding students on effective self-assessment practices and direct them to self-evaluate the next steps in their learning.
- Using varied instruction methods to meet diverse student needs.
- Practicing students to self-assess and providing goals for next steps in teaching.
- Designing focused instruction according to the feedback.
- Involving students in self-reflection.
- Letting students to keep track on their learning.
- Creating supportive classroom culture that inspires interaction and using varied assessment tools to collect information on student learning.
- Using varied approaches to assess student understanding.
- Giving feedback on the performance of student and using instructions to meet identified needs, participating students actively in the learning process.
- Acting students as instructional resources for one another.
- Exploring students their own learning, using continuous and multiple forms of assessment and using instructions to the next stage of learning.

The fundamental concept behind formative assessment is that evidence of student learning is used to adjust instructions to better meet students' learning needs (Wafubwa & Ochieng, 2021). According to Black and William (2009), teachers, learners, and their peers are the key agents of learning in the formative assessment framework. Therefore, students play a pivotal role in the formative assessment classroom, creating an effective teaching-learning environment. Some theories, such as meta-cognitive theory (Mahdavi, 2014), socio-cultural theory (Vygotsky, 1978), and self-regulation theory (Berry, 2008) have explained that students have a significant role in the assessment process. Wylie and Lyon (2016) identified ten dimensions of formative assessment practices that emphasize the student's role in creating an effective formative assessment environment. They emphasize practices such as involving students in the learning activities throughout the lesson, engaging in questioning to share their current understanding among peers, exploring more ideas for better learning, applying teachers' feedback to improve the next step in learning, and providing feedback on their peers' work. It is evident that integrating active participation of both teachers and students in the learning activities in a formative assessment classroom is crucial. The literature shows that the quality and the success of effective implementation of the formative assessment depend on teacher-student interactions. Moss and Brookhart (2019)

also emphasize that both teachers and students become enthusiastic participants in the formative assessment process when there is a powerful and effective association between them in the teaching-learning environment. Therefore, it is essential to investigate formative assessment practices that can be useful in the classroom assessment.

Moreover, the literature emphasizes several studies that have investigated the implementation of formative assessment in different types of classrooms. Figa, Tarekegne, and Kebede (2020) have conducted a descriptive cross-sectional survey study to examine formative assessment practices in secondary schools of the West Arsi zone of Ethiopia. Data were collected from secondary school supervisors, principals, teachers, and students through questionnaires, interviews, observations, and document analysis. The results revealed that some of the assessment practices, such as communicating learning objectives to students, integrating formative assessment strategies, and providing formative feedback, were occasionally implemented by teachers in their classrooms.

Another study focused on students' responses to the use and value of formative assessment approaches and this research involved a survey of 1079 K–12 students and portfolio-based interviews with 12 intentionally selected students (DeLuca et al., 2018). Quantitative data were analyzed using descriptive and inferential statistics, while interview data were analyzed using a thematic coding process. According to the findings, the most frequently used practice by students was receiving teacher feedback and success criteria to support their learning. On the other hand, the least valued formative assessment approach for all students was peer feedback. This study also emphasized that implementation of formative assessment requires constant focus, research, and support in schools and classrooms to ensure that students can fully benefit from assessment-based teaching.

Wafubwa and Ochieng (2021) conducted a study on the perceptions of Kenyan secondary school students regarding the use of formative assessment practices by their mathematics teachers. Data were collected from 1000 students in 30 public secondary schools. The findings of the study showed that students generally had a negative perception of their mathematics teachers' use of formative assessment. ANOVA tests revealed school categories as having significant effect on the implementation of formative assessment practices by mathematics teachers. These findings also emphasize the need to explore the reasons for mathematics teachers' limited use of formative assessment and how formative assessment can be introduced into classrooms.

Johnson, Sondergeld, and Walton (2019) conducted a study on the implementation of formative assessment by administrator-selected master teachers in large, urban, public school districts in three regions of the United

States. This study was primarily focused on how teachers effectively implement formative assessment strategies in their classrooms and how they perceive formative assessment in general. The findings of this study revealed that some aspects of formative assessment were effectively implemented by the teachers, while others were used less effectively in their classrooms. Furthermore, the study discussed implications for research and practice in formative assessment.

Scott (2018) conducted a quantitative study to investigate the formative assessment strategies implemented by classroom teachers. This survey collected information on the frequency of use of fifteen formative assessment strategies. The research questions centered around the overall usage of formative assessment strategies, their utilization as an operational structure, and the frequency of use of both student-and teacher-driven strategies. This study revealed that seven out of fifteen formative assessment strategies were used by the teachers between "Once or Twice a Week" and "Daily".

While there is a substantial body of research on formative assessment in general, there is only a few studies addressing classroom assessment in Sri Lanka (National Education Commission, 2009). Available studies have not focused especially on the formative assessment practices implemented by teachers. Therefore, the current study will be significant in making awareness among policymakers, researchers, and practitioners to make informed decisions, conduct formative assessment practices in the teaching-learning environment, and further improve research studies in this area. This study also investigates the formative assessment practices employed by science teachers in their classrooms.

Methodology

The research was carried out with three objectives. First, to investigate the formative assessment practices implemented by science teachers. Second, to assess whether differences exist in implementing formative assessment practices among science teachers based on grade. Third, to examine whether differences exist in implementing formative assessment practices among science teachers based on school type.

The aim of this study was to investigate the extent to which science teachers implement different assessment practices. These main formative assessment practices were identified through literature review. The survey method was used as a part of a quantitative research methodology. Data were collected from 720 students from 35 schools using a stratified random sampling method. This study was conducted on the responses of students in grades 8 and 10 from 3 different types of schools in the Western province of Sri Lanka. The student sample consisted of 379 students from 1AB schools, 217 students from 1C schools, and 124 students from type 2 schools, with 354 students in grade 8, and 366 in grade 10.

While the present problem relates to all the schools in the whole country, the target population of this study was the Sinhala medium government schools having classes from grade 6 to 11 in the Western province. Since most of the students in this province are Sinhala medium students it is expected to generalize the findings considering only the Sinhala medium government schools. The Western province was selected because of logistical difficulties to cover the entire country within the time frame. Furthermore, the Western province represents different social, cultural, and economic backgrounds in the country compared to other provinces. As a continuous assessment, SBA has been initially started from Gampaha district in Sri Lanka. Therefore, in this study all the 3 districts in the western province are included in the sample.

According to the school classification presented by the Ministry of Education (2017), government schools are classified into four categories.

- Type 1AB: offering education from Grades 1 to 13 or 6 to 13 and GCE A levels in all subjects
- Type 1C: offering education from Grades 1 to 13 or 6 to 13 and GCE A levels in Arts and Commerce
- Type 2: offering education from Grades 1 to 11 or 6 to 11 and GCE O levels
- Type 3: offering education from Grades 1 to 5 or 1 to 8

Type 1AB schools are generally considered to be the best-equipped type of schools compared to type 1C and type 2 schools. This study considered only type 1AB, type 1C, and type 2 schools since schools having classes from grades 6 to 11 can be categorized under one of them. In this study, grade 8 was selected to represent the junior secondary section and grade 10 to represent the senior secondary section. These grades also represent a different level of exam orientation. According to the classification of the schools, both grades are included only in type 1AB, 1C, and type 2 schools.

Before the commencement of the study, approval was sought from the Ethics Review Committee (ERC), Faculty of Graduate Studies, University of Colombo. Approval was obtained from the Ministry of Education and Provincial Departments of Education to conduct the study in the selected schools in the Western province.

A questionnaire was prepared to collect data from student responses regarding the extent to which science teachers implement formative assessment practices in the classroom. The following twelve formative assessment practices included in the questionnaire were identified through a review of the relevant literature.

1.1. Discussing about the objectives expected to be achieved in the lesson by your teacher.

1.2. Advising about the facts that students should be concerned about when evaluating a lesson by your teacher.

1.3. Using different assessment methods in the classroom by your teacher. (Role playing, Creative Activities, Exhibitions / Presentations etc.).
1.4. Using appropriate assessment methods relevant to the lesson.
1.5. Using assignments, projects, group activities, practical activities for assessment.
1.6. Using other methods in addition to the above three methods. (Debates, quizzes, concept maps etc.)
1.7. Providing verbal feedback by your teacher as soon as the lesson or activity is over.
1.8. Providing descriptive written feedback by your teacher as soon as the lesson or activity is over.
1.9. Providing creative feedback to improve students' learning by your teacher.
1.10. Allowing you to correct the shortcomings as instructed by your teacher.
1.11. Giving yourself the opportunity to identify your shortcomings and talents.
1.12. Giving other students the opportunity to identify your shortcomings and talents.

Responses were collected using a five-point Likert scale from "Always" to "Never". This scale was used to get the responses from students to investigate how far science teachers implement each practice in their classrooms. The scale indicates how far teachers use each practice by selecting one response out of five responses (Always – 5, Very often – 4, Sometimes – 3, Rarely – 2, Never – 1). Furthermore, 5 indicates the highest usage of the practice, and 1 indicates the lowest usage of the practice.

The data were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequencies, percentages, means, and standard deviations were employed to analyze the student responses regarding the extent to which science teachers implement formative assessment in the classroom. ANOVA tests were conducted to investigate the potential differences in implementing formative assessment practices by the teachers based on the grade and the type of school. ANOVA tests are used to test the effectiveness of an independent variable which is categorical on the dependent variable which is in the continuous variable. In this study student perceptions are considered as the dependent variable that belongs to continuous variable and grade of the students and school type are considered as independent variables that belongs to categorical variable. Therefore, data analysis was done using ANOVA tests. Thus, the objective of this section using ANOVA tests was to examine whether the influence of student-related factors on the effective implementation of Formative Assessment practices is different according to the grade level and the school type.

Results and Discussion

The data collected from various instruments and sources are presented according to the research objectives of this study. The first objective of this study was to investigate the formative assessment practices implemented by science teachers in their classrooms. Throughout the literature, twelve formative assessment practices were identified as mentioned in the sections above, and data were collected to assess the extent to which science teachers implemented these practices in their classrooms.

Formative assessment practices implemented by science teachers

Table A1 in the annexure shows the extent to which each formative assessment practice is implemented by teachers, according to student responses. In this study, the student sample consisted of 720 students from respective schools in all districts in the western province.

When considering the first practice, 58% of students mentioned that Science teachers always discuss the expected lesson objectives. According to the student responses on the second practice, 63% of students reported that teachers provided guidance on what aspects to consider when evaluating a lesson by the teacher. A majority of the students in the sample (31%) mentioned that most of the teachers frequently used different assessment methods in the classroom including role-playing, creative activities, and exhibitions/presentations. For the fourth factor, 36% of students reported that teachers always used appropriate assessment methods relevant to the lesson and another 36% of the student responses mentioned that teachers very often implement the respective practice in the classroom. A total of 38% of students emphasized that teachers always used assignments, projects, group activities, and practical activities for assessment.

When considering the sixth practice, most of the students (29%) responded that teachers sometimes use other methods in addition to the above three methods (Debates, quizzes, concept maps, etc.). According to the student responses on the seventh practice, 57% of the students reported that teachers always provide immediate verbal feedback following a lesson or activity. Further, 54% of students mentioned that teachers always provide immediate descriptive written feedback following a lesson or activity. Additionally, 46% of students reported that teachers always provide creative feedback to improve students' learning.

As for the tenth practice, most of the students (61%) reported that teachers always allow them to correct their shortcomings based on the teachers' instructions. Furthermore, 51% of the students mentioned that teachers always give students the opportunity to identify their shortcomings and talents. According to the student responses on the last practice, 29% of students responded that teachers always give other students the opportunity to identify their strengths and weaknesses. According to the student responses shown in Table A1, the second practice: "advising about

the facts that students should be concerned about when evaluating a lesson by your teacher" was the most frequently implemented practice among the twelve practices.

Table 1 shows the mean values and the standard deviations of each practice that presents the extent of implementation of formative assessment practices by science teachers. When comparing these formative assessment practices, the second practice indicated the highest mean value among the other practices (M = 4.49, SD = .76). Conversely, the sixth practice received the lowest mean score of 3.38 (SD = 1.14). There were six FA practices with mean ranges from 4.21 to 5.00 which indicated as highly implemented FA practices. Those six practices were:

1.1. discussing the objectives expected to be achieved in the lesson by the teacher;

1.2. advising about the facts that students should be concerned about when evaluating a lesson by the teacher;

1.7. providing verbal feedback by the teacher as soon as the lesson or activity is over;

1.8. providing descriptive written feedback by the teacher as soon as the lesson or activity is over; and

1.10. allowing you to correct the shortcomings as instructed by the teacher and giving students the opportunity to identify the shortcomings and talents.

Table 1: Mean (M) and Standard deviation (SD) values of the extent of implementation of formative assessment practices

Formative Assessment Practices	Mean	SD	Standard error of mean
1.1	4.37	.86	.03
1.2	4.49	.76	.03
1.3	3.66	1.09	.04
1.4	4.00	.95	.04
1.5	3.97	1.00	.04
1.6	3.38	1.14	.04
1.7	4.33	.94	.04
1.8	4.23	.98	.04
1.9	4.16	.98	.04
1.10	4.41	.85	.03
1.11	4.25	.92	.03
1.12	3.60	1.18	.04

It could be observed from the mean scores of each practice in Table 1 that all the formative assessment practices are often implemented by the teachers in their actual teaching-learning environment. This indicates that generally, science teachers in selected secondary schools in the Western Province of Sri Lanka engage in implementing formative assessment practices in their classrooms. The positive contribution of these teachers to implement the formative assessment in their classrooms emphasized the usefulness of classroom assessment during the teaching-learning process in exam-oriented classrooms. As Boston (2002) suggested, formative assessment practices can help classroom teachers gain an understanding of what students know or do not know. Therefore, the classroom with formative assessment can support to improve student performance in various ways. Although the results show that science teachers frequently implement these practices in their classrooms, it remains important to investigate whether the implementation of these practices varies significantly according to the grade of the students and the type of the school. The following section of this article discusses these differences using ANOVA tests.

Implementing formative assessment practices by teachers according to grade

The second objective of this study was to examine whether there are differences in implementing formative assessment practices by teachers according to grade. The ANOVA tests were conducted for this purpose. The results of these ANOVA tests are presented in Table A2 in the annexure.

When considering the first practice in Table A2 in the annexure, the ANOVA results indicate that the mean values of each grade were not equal. Specifically, the highest mean value (for grade 8) was 4.43 and the lowest value (for grade 10) was 4.32. However, the ANOVA results show that the P value is higher than 0.05 for this first practice, indicating that these differences are not statistically significant. The highest mean for the second practice was 4.53 (for grade 8) and the lowest mean was 4.45 (for grade 10). Despite the variations, the ANOVA results show that the difference between the two grades were not statistically significant ($P = .14$).

The highest mean score of the third practice was 3.76 (for grade 8) and the lowest was 3.56 (for grade 10). The results of the ANOVA test ($P < 0.05$) suggests that the difference in these two grades for implementing the third practice was statistically significant. When considering the fourth practice, grade 8 had the highest mean score ($M = 4.01$), and grade 10 had the lowest mean score ($M = 3.99$). As can be seen from ANOVA results, there was not a statistically significant difference in the mean values of this practice between the two grades ($P = .82$). The highest mean value for the fifth practice was for grade 8 ($M = 4.14$) and the lowest mean value was for grade 10 ($M = 3.81$). The ANOVA results highlight that there was a statistically significant difference in the mean values of this practice between two grades ($P = .00$).

When comparing the mean values of two grades in the sixth practice, the highest mean score was 3.58 (for grade 8) and the lowest mean score was 3.19 (for grade 10). According to the ANOVA results, the P value was less than 0.05 for this practice. Therefore, there was a significant statistical difference in implementing this practice between the two grades. The mean values of each grade for the seventh assessment were not equal (grade 8 = 4.43, grade 10 = 4.23). The ANOVA results (P = .01) implies a significant statistical difference among the mean scores. When considering the eighth practice, grade 8 had the highest mean score (M = 4.24), and grade 10 had the lowest mean score (M = 4.22). According to the ANOVA results, the P value (P = .74) was higher than 0.05 for this practice suggesting no statistical significance in the difference among the mean scores. The highest mean value of the ninth practice was for grade 8 (M = 4.25) and the lowest mean value was for grade 10 (M = 4.06). The difference among the means is statistically significant since the P value was less than 0.05 for this practice (P = .01).

It is evident that the mean values for the tenth practice were not equal between the two grades. The P value of 0.00 which is less than 0.05 suggests that the difference between the two grades is statistically significant. The P values for the eleventh practice was 0.44 which is higher than 0.05 implying no significant statistical difference between the mean scores. The last practice also had a P value of 0.85 which is higher than 0.05. This implies that the difference observed between the two mean scores was not statistically significant.

The ANOVA results indicated that the following six practices among the twelve practices were implemented by the teachers independent of the grade level: grade 8 or grade 10.

1.1. Discussing the objectives expected to be achieved in the lesson by the teacher,

1.2. Advising about the facts that students should be concerned about when evaluating a lesson by the teacher,

1.8. Providing descriptive written feedback by the teacher as soon as the lesson or activity is over,

1.11. Giving themselves the opportunity to identify their shortcomings and talents, and

1.12. Giving other students the opportunity to identify the shortcomings and talents of others.

Even though findings revealed that all the teachers of science subject very often implemented formative assessment practices in their classrooms, the following six practices had been implemented statistically more frequently in grade 08 than in grade 10.

1.3. Using different assessment methods in the classroom by the teacher. (Role-playing, Creative Activities, Exhibitions / Presentations etc.).

1.5. Using assignments, projects, group activities, practical activities for assessment.

1.6. Using other methods in addition to the above three methods. (Debates, quizzes, concept maps, etc.).

1.7. Providing verbal feedback by the teacher as soon as the lesson or activity is over.

1.9. Providing creative feedback to improve students' learning by the teacher.

1.10. Allowing students to correct their shortcomings as instructed by the teacher were implemented by the teacher more frequently in grade 8 than in grade 10.

It is evident from these findings that the assessment methods used to collect information about students' learning are more frequently employed by science teachers in grade 8 than in grade 10. Since the teaching-learning process is more exam-oriented in grade 10 than in grade 08, formative assessment practices such as those mentioned above are less implemented in grade 10 than in grade 8.

Implementing formative assessment practices by teachers according to school type

The third objective of this study was to examine the extent to which implementing formative assessment practices by the teachers differ between school types: 1AB, 1C, and type 2. The results of the ANOVA tests conducted to assess the differences are presented in Table A3 in the annexure.

When considering the first practice in Table A3, according to the ANOVA results the mean value of each type of school is not equal. Accordingly, the highest mean value was for type 2 schools (M = 4.56) and the lowest value was for grade 10 (M = 4.33). According to the ANOVA results, the P value was less than 0.05 for this first practice. This means that these differences are statistically significant differences. The second practice was on advising about the facts that students should be concerned about when evaluating a lesson by the teacher. The highest mean value was for type 2 schools (M = 4.66) and the lowest mean value was for 1AB schools (M = 4.42) of this practice. ANOVA results show that there is a significant difference in mean values between the two grades for the second practice (P = .01). As shown in Table A3, the third practice is related to using different assessment methods in the classroom by the teacher (Role playing, Creative Activities, Exhibitions / Presentations, etc.). The highest mean score of this practice was for 1C schools (M = 3.80) and the lowest mean score was for 1AB schools (M = 3.55). According to the ANOVA results, the P value is also less than 0.05 for this third practice (P = .02). Therefore, it is obvious that there is a statistically significant difference in these types of schools for implementing this practice. When considering the fourth practice, type 2 schools had the highest mean score (M = 4.12), and 1AB schools had the lowest

mean score (M = 3.92). As can be seen from ANOVA results, there was a statistically significant difference in the mean values of this practice among the three types of schools (P = .04). Fifth practice is using assignments, projects, group activities, and practical activities for assessment. The highest mean value of this practice was for 1C schools (M = 4.12) and the lowest mean value was for 1 AB schools (M = 3.84). Accordingly, ANOVA results highlight that there was a statistically significant difference in the mean values of this practice among three types of schools (P = .00). When comparing the mean values of three types of schools in the sixth practice, the highest mean score was 3.55 for type 2 schools and the lowest mean score was 3.24 for 1AB schools. According to the ANOVA results, the P value was also less than 0.05 for this practice (P = .00). Therefore, there was a significant difference in implementing this practice among these three types of schools. The seventh formative assessment is providing verbal feedback as soon as the lesson or activity is over. The mean value of each type of school was not equal of this practice (1AB = 4.20, 1C = 4.46, type 2 = 4.49). According to the ANOVA results also, a significant difference is observed among the mean scores (P = .00). When considering the eighth practice, type 2 schools had the highest mean score (M = 4.35), and 1 AB schools had the lowest mean score (M = 4.13). According to the ANOVA results, the P value was also less than 0.05 for this practice and there was a significant difference among the mean scores (P = .02). The nineth practice is providing creative feedback to improve students' learning by the teacher. The highest mean value of this practice was for type 2 schools (M = 4.35) and the lowest mean value was for 1 AB schools (M = 4.05). According to the ANOVA results, a significant difference is observed among the mean scores since the P value was less than 0.05 for this practice (P = .01). When considering the tenth practice, it is evident that the mean values were not equal among these two grades. But the P value of the ANOVA test was less than 0.05. (P = .00). Accordingly, a significant difference is observed among the mean scores when implementing this practice in three types of schools. The eleventh practice is giving students the opportunity to identify their shortcomings and talents. According to the ANOVA results, the P value was also less than 0.05 for this practice and there was a significant difference among the mean scores (P = .00). The last practice among the other practices is giving other students the opportunity to identify their shortcomings and talents. According to the ANOVA test results, the P value was less than 0.05 for this practice, indicating a significant difference among the mean scores in the three types of schools (P = 0.00).

According to the ANOVA results presented in Table A3, implementing all the formative assessment practices were statistically different between the three types of schools. Therefore, the impact of the school type was significantly different for the implementation of formative assessment practices in science classrooms.

Conclusion

The literature emphasizes that many countries of the world are practicing formative assessment to improve student learning (Musa & Islam, 2020). Some of the South Asian countries has paid significant attention to implement formative assessment practices in their classrooms. In the light of these developments, it is evident that most of the teachers in Sri Lanka also pay their attention to implementing these practices to enhance the teaching-learning process. Therefore, this study aimed to investigate the extent to which teachers implement formative assessment practices in science classrooms. Furthermore, the study aimed to assess whether variations exist in the implementation of these practices by teachers among grade and school type.

Descriptive statistics of the formative assessment practices were presented under the first objective. According to the analysis, certain practices such as "advising about the facts that students should be concerned about when evaluating a lesson by your teacher", "allowing you to correct the shortcomings as instructed by your teacher", and "discussing the objectives expected to be achieved in the lesson by your teacher" were the most frequently implemented practices. Conversely, the findings showed that the least implemented practices were "using other methods in addition to the above three methods. (Debates, quizzes, concept maps, etc.)", "giving other students the opportunity to identify their shortcomings and talents", and "using different assessment methods in the classroom by your teacher (Role-playing, Creative Activities, Exhibitions / Presentations, etc.)".

In this study, one-way ANOVA tests were employed to compare the implementation of formative assessment practices among different grades and types of schools. As discussed above, six out of twelve practices showed no statistically significant difference with respect to implemented grade level. However, the remaining six practices were implemented by the teachers more frequently in grade 8 than in grade 10. This discrepancy can be attributed to the fact that the teaching-learning process in grade 10 leans towards an exam-centric approach, thereby reducing the frequency of employing assessment-related practices by science teachers.

Furthermore, the study revealed that all the twelve practices were influenced by the type of school. The ANOVA results emphasized that type 2 schools frequently used these practices than the other school types. Those schools, despite their limited resources, fostered an active teaching-learning environment with an abundance of activities. This may be attributed to the limited number of students in those schools allowing teachers to offer a more engaging educational experience.

As mentioned in the literature review the pivotal role of formative assessment in improving students learning, particularly in science education is well recognized. Accordingly, this study has revealed the frequent utilization of formative assessment practices by science teachers to improve student learning. Nevertheless,

the implementation of these practices in science classrooms exhibited significant statistical differences based on the grades of the students and the type of school.

Conflict of interest

The authors have no conflict of interest to disclose.

References

Beach, T. A. (2006). Using Formative Assessment to Inform Teaching Practice and Improve Student Achievement: *A Review of Literature and a Call for Collaboration*.

Berry, R. (2008). *Assessment for learning*. Hong Kong: Hong Kong University Press.

Black, P., Harrison, C., & Lee, C. (2003). *Assessment for learning: Putting it into practice*. McGraw-Hill Education (UK).

Birhanu, M. (2013). *Continuous assessment issues and practices in secondary schools of Oromia regional state, Ethiopia: The "Big Picture" of assessment mechanism*. Palgo Journal of Education Research,1,19–41.

DeLuca, C., Chapman-Chin, A. E., LaPointe-McEwan, D., & Klinger, D. A. (2018). Student perspectives on assessment for learning. *The Curriculum Journal*, *29*(1), 77-94.

Figa, J. G., Tarekegne, W. M., & Kebede, M. A. (2020). The practice of formative assessment in Ethiopian secondary school curriculum implementation: The case of West Arsi Zone Secondary Schools. *Educational Assessment*, *25*(4), 276-287.

Furtak, E. M., Kiemer, K., Circi, R. K., Swanson, R., de Leo´n, V., Morrison, D., & Heredia, S. C. (2016). Teachers' formative assessment abilities and their relationship to student learning: Findings from a four-year intervention study. Instructional Science, 44, 267–291.

Harris, S. E. (2016). *Teachers' understanding and use of formative assessments in the elementary mathematics classroom*. Harvard University.

Heritage, M. (2007). Formative assessment: What do teachers need to know and do? *Phi Delta Kappan*, 89(2), 140-145

Heritage, M. (2010). *Formative assessment: Making it happen in the classroom*. Thousand Oaks, CA: Corwin Press.

Hill, P. (2013). Asia-Pacific secondary education system review series no. 1: Examination systems. *Thailand: UNESCO*, 1-42.

Johnson, C. C., Sondergeld, T. A., & Walton, J. B. (2019). A study of the implementation of formative assessment in three large urban districts. *American Educational Research Journal*, *56*(6), 2408-2438.

Kingston, N., & Nash, B. (2011). Formative assessment: A meta-analysis and a call for research. Educational Measurement: Issues and Practice, 30(4), 28–37.

Mahdavi, M. (2014). An overview: Metacognition in education. *International Journal of Multidisciplinary and current research*, *2*(6), 529-535.

Marope, P. T. M., Wells, P. J., & Hazelkorn, E. (Eds.). (2013). *Rankings and accountability in higher education: Uses and misuses*. Unesco.

McMillan, J. H., Venable, J. C., & Varier, D. (2013). Studies of the effect of formative assessment on student achievement: So much more is needed. *Practical Assessment, Research, and Evaluation*, 18(1), 2.

Moss, C. M., & Brookhart, S. M. (2019). Advancing formative assessment in every classroom: A guide for instructional leaders. ASCD.

Musa, M. A., & Islam, M. R. (2020). The problems that teachers face in applying formative assessment in the classroom. *International Journal of Scientific and Technology Research*, *9*(1), 2466-2468.

Mwebeza, M. (2010). *Continuous assessment and students' performance in "A" level secondary school in Masaka district*. Journal of Education and Practice,4, 13.

National Education Commission (2009). New proposals for a general educational policy in Sri Lanka. Context, issues and suggestions. Colombo, Sri Lanka.

National Institute of Education, (2015), *An Investigation In to The Nature Of The School Based Assessment Programme Implemented In G.C.E. (O/L) Classes,* National Institute of Education, Sri Lanka.

Organization for Economic Co-operation and Development (OECD) (2005). *Formative Assessment: Improving learning in secondary classrooms*. Policy Brief, Paris: OECD.

Ozan, C., & Kıncal, R. Y. (2018). The effects of formative assessment on academic achievement, attitudes toward the lesson, and self-regulation skills. Educational Sciences: Theory & Practice, 18, 85–118.

Sedere, M. U., Kularatne, W. G., Junaid, M. N. & Illeperuma, P. N. (2009) "Report of the Committee of Experts for Reviewing the Duties of the Department of Examinations of Sri Lanka and to Make Recommendations for Improvement of Its Quality" Appointed by the Cabinet of Ministers, Government of Sri Lanka

Scott, G. E. (2018). *A quantitative study of the implementation of formative assessment strategies in the classroom* (Doctoral dissertation, Ashland University).

Swaffield, S. (2011) Getting to the heart of authentic Assessment for Learning, Assessment in Education. Principles, Policy & Practice,18, 433–449.

Thusarika, W. D, & Nawastheen, F. M. (2019). School based assessment practices: how students and teachers perceived. *South Eastern* University International Arts Research Symposium.*2019.*

Vygotsky, L. S. (1978). *Mind and society: The development of higher psychological processes*. Harvard University Press.

Wafubwa, R. N., & Ochieng, P. O. (2021). Students' perception of teacher's use of formative assessment strategies in mathematics classrooms. Elementary Education Online/ilkoegretim Online, 20(2), 123-132.

Wiliam, D. (2011). *Embedded formative assessment*. Solution tree press.

Wylie, E. C., & Lyon, C. J. (2016). The fidelity of formative assessment implementation: Issues of breadth and quality. Assessment in Education: Principles, Policy & Practice, 22(1), 140-160.

Yan, Z., Li, Z., Panadero, E., Yang, M., Yang, L., & Lao, H. (2021). A systematic review on factors influencing teachers' intentions and implementations regarding formative assessment. *Assessment in Education: Principles, Policy & Practice*, *28*(3), 228-260.

Annexures

Table A1: Frequency of Formative Assessment practices implemented by science teachers

Formative Assessment Practices	Extent of implementation										Total		Skewness
	Always		Very often		Sometimes		Rarely		Never				
	N	%	N	%	N	%	N	%	N	%	N	%	
1.1	414	57.5	194	26.9	85	11.8	21	2.9	6	0.8	720	100	-1.385
1.2	456	63.3	173	24.0	79	11.0	11	1.5	1	0.1	720	100	-1.370
1.3	195	27.1	221	30.7	186	25.8	99	13.8	19	2.6	720	100	-.404
1.4	258	35.8	260	36.1	152	21.1	42	5.8	8	1.1	720	100	-.715
1.5	273	37.9	225	31.3	157	21.8	58	8.1	7	1.0	720	100	-.653
1.6	155	21.5	171	23.8	209	29.0	165	22.9	20	2.8	720	100	-.023
1.7	409	56.8	190	26.4	76	10.6	37	5.1	8	1.1	720	100	-1.399
1.8	387	53.8	172	23.9	108	15.0	44	6.1	9	1.3	720	100	-1.144
1.9	334	46.4	233	32.4	96	13.3	46	6.4	11	15	720	100	-1.111
1.10	436	60.6	170	23.6	91	12.6	19	2.6	4	0.6	720	100	-1.371
1.11	364	50.6	213	29.6	105	14.6	33	4.6	5	0.7	720	100	-1.087
1.12	205	28.5	195	27.1	178	24.7	110	15.3	32	4.4	720	100	-.405

Table A2: Mean (M), Standard Deviation (SD), and one-way ANOVA test results of formative assessment practices according to the grade

Formative Assessment Practices		Mean	SD	F value	P value
1.1	Grade 8	4.43	.81	2.62	.11
	Grade 10	4.32	.92		
1.2	Grade 8	4.53	.75	2.15	.14
	Grade 10	4.45	.77		
1.3	Grade 8	3.76	1.12	6.36	.01
	Grade 10	3.56	1.06		
1.4	Grade 8	4.01	.99	.06	.82
	Grade 10	3.99	.91		
1.5	Grade 8	4.14	.99	19.92	.00
	Grade 10	3.81	.98		
1.6	Grade 8	3.58	1.11	22.49	.00
	Grade 10	3.19	1.13		
1.7	Grade 8	4.43	.86	8.07	.01
	Grade 10	4.23	.99		
1.8	Grade 8	4.24	.98	.11	.74
	Grade 10	4.22	.99		
1.9	Grade 8	4.25	.92	6.87	.01
	Grade 10	4.06	1.03		
1.10	Grade 8	4.51	.79	10.09	.00
	Grade 10	4.31	.89		
1.11	Grade 8	4.27	.94	.59	.44
	Grade 10	4.22	.89		
1.12	Grade 8	3.61	1.24	.04	.85
	Grade 10	3.59	1.12		

Table A3: Mean (M), Standard Deviation (SD), and one-way ANOVA test results of formative assessment practices according to the school type

Formative Assessment Practices		Mean	SD	F value	P value
1.1	1AB	4.33	.89	3.69	.03
	1 C	4.34	.86		
	Type 2	4.56	.75		
1.2	1AB	4.42	.82	4.61	.01
	1 C	4.50	.71		
	Type 2	4.66	.62		
1.3	1AB	3.55	1.12	3.84	.02
	1 C	3.80	1.05		
	Type 2	3.73	1.09		
1.4	1AB	3.92	.97	3.09	.04
	1 C	4.07	.93		
	Type 2	4.12	.93		
1.5	1AB	3.84	1.05	6.74	.00
	1 C	4.12	.92		
	Type 2	4.10	.97		
1.6	1AB	3.24	1.17	6.21	.00
	1 C	3.53	1.09		
	Type 2	3.55	1.09		
1.7	1AB	4.20	1.01	7.76	.00
	1 C	4.46	.85		
	Type 2	4.49	.77		
1.8	1AB	4.13	1.11	3.77	.02
	1 C	4.32	.84		
	Type 2	4.35	.84		
1.9	1AB	4.05	1.04	5.29	.01
	1 C	4.24	.93		
	Type 2	4.35	.87		
1.10	1AB	4.26	.94	13.13	.00
	1 C	4.57	.70		
	Type 2	4.59	.71		
1.11	1AB	4.12	.98	8.07	.00
	1 C	4.34	.86		
	Type 2	4.46	.76		
1.12	1AB	3.41	1.21	12.08	.00
	1 C	3.71	1.17		
	Type 2	3.97	.96		