

Students' Perceptions on Assessment for Learning in Science: How Can Students' Self-directed Learning Be Encouraged?

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Abstract- Assessment for learning remains under-utilized in the science classrooms as greater emphasis is placed on assessment of learning. The aim of this paper was to find out how students perceived assessment for learning and how self-regulation in the learning of science could be enhanced. This study also included focus groups with 50 students aged between 12 years and 15 years from the three middle schools. Results showed that assessment for learning positively impacts on students' motivation, engagement, self-efficacy, autonomy, promotes cooperation with peers while making assessment interesting and stress free. Most students also reported that formative assessment provided them with platforms for self-assessment and self-feedback as they compare their work against set standards and criteria for success. Students highlighted the importance of recognition for their effort from their peers and teachers and felt comfortable working on their own when teachers had provided adequate criteria for success. Students further stressed that lack of adequate feedback and encouragement from teachers is demotivating.

Indexed Terms- Self-regulated learning, Assessment of Learning, Assessment for Learning, Self-efficacy, Motivation, Testing.

I. INTRODUCTION

This study sought to explore the way students perceived formative assessment as well as how their perception could be used to encourage self-regulated learning. Assessment is formative when the evidence is used as an on-going process within the classroom to adapt the teaching to meet student needs as well as providing feedback to the students (Black and Wiliam, 1998). According to Heritage, Kim, and Vendlinski (2007), formative assessment is a systematic process to continuously gather evidence about learning. The

data are used to identify a student's current level of learning and adapt lessons to help the student reach the desired learning goal. In formative assessment, students become active participants with their instructors, sharing learning goals and understanding how their learning is progressing, what steps they need to take and how to take them. Assessment can reinforce the efficacy of teaching and learning. It also encourages the understanding of teaching as a formative process that evolves over time with feedback and input from students. This creates good classroom rapport (PISA,2012).

Garcia Laborda et al., (2015) argued that assessment is a systematic process which takes place throughout the entire teaching/learning act. The process was designed to judge and make decisions about students' performance and improvement regarding one or multiple skills. Torres (2019) pointed out that while assessment tools and methods have been evolving over time, their effects have rarely changed in the students' minds as they keep feeling threatened by the risk of failing their courses, especially on the summative stage. While formative assessment and summative assessment should complement each other, teachers and students are under a lot of pressure to show progress in the later (Stull, 2013). Some educationists have indicated that the time has come when formative assessment, occurring within the learning process, needs greater prominence to ensure that learners and teaching professionals focus more on the needs of learners than on the needs of politicians (Black and Wiliam 1998; Layng, Strikeleather, and Twyman 2004). Learning should focus on knowledge building instead of regurgitating what has already been established. Our schools should generate new ideas, but we are spending time encouraging students to reconstruct what has already been established (Stull, 2013).

It should be noted that assessment is not testing but testing is just one of the components of assessment. Testing is an event that comes in during the process of assessment, yet many students view assessment in the same way they view testing (Saddler, 1989). The process of assessment includes all the steps of teaching, observing, testing, judging, making decisions, feedback and re-teaching while focusing on students' areas of need and cementing areas of strength (Torres, 2019).

According to Saddler (1989) the intention of formative assessment is to generate feedback on performance and to accelerate learning, as learners begin to take charge of their learning. This research intended to discuss the extent to which assessment for learning or formative assessment reinforces self-regulated learning among students. The study also intended to explore how assessment for learning can improve self-efficacy, motivation, and autonomy in students in the learning of science. Nicol and Macfarlane-Dick (2006) pointed out that assessment for learning and feedback generated by teachers, peers and self are inherent in learner self-regulation. They went on to argue that formative assessment ensures that students are always actively involved in their learning and are therefore drivers of their own academic destiny, vision, and achievement. This study therefore explored how formative assessment assists in ensuring that there is indeed active student involvement in the science classroom and science laboratory. Pintrich and Zusho (2002) suggested that the construct of self-regulation refers to the degree to which students can regulate some phenomena of their thinking, behavior, and motivation during learning. Nicol and Macfarlane (2006) also pointed out that formative assessment can be useful in creating a sense of interest-based learning among students as the student has in mind some goals to be achieved and works towards achieving the set goals. The authors suggested that students generate internal feedback as they actively interpret feedback from teachers and from other students in relation to their internal goals.

Formative assessment and feedback are inherent in learner self-regulation since students are assumed to occupy a central and active role in their learning processes (Nicol and Macfarlane, 2006). Clark (2012) argued that formative assessment provides a good

platform for effective feedback for students. The author pointed out that effective feedback forms the core of formative assessment, and this encourages learners to articulate their tacit knowledge. Voogt and Kasurien (2005) emphasized the importance of tacit knowledge, "Formative assessment may consist of hard data, but more often and more importantly of 'tacit knowledge', i.e., knowledge that both the teacher and student obtain through discussion, reflection and experience" (p. 154). Clark (2012) further suggested that in the formative classroom, tacit knowledge is made explicit and accessible to the learning community through active participation and mutual discourse. It therefore shows that the use of formative assessment in the classroom encourages active student participation and interaction with all members of the learning community. This was also supported by Zimmerman (2002) who also revealed that formative assessment encourages self-regulated learning as individuals are meta-cognitively, motivationally, and behaviorally active participants in their own learning process. Assessment for learning creates a symbiotic classroom ecosystem which is mutual for all members of the classroom ecosystem (Stull, 2013). Bandura (1997) was of the opinion that assessment for learning or formative assessment creates a conducive environment for the learner to explore and expand on what would have been introduced in the classroom. Learners become more independent and more likely to be innovative and creative. Fox and Riconscente (2008) pointed out that the significance of others in the development of self-regulation is explicit in the seminal work of both Piaget and Vygotsky. Formative assessment, therefore, ensures that the learning process does not occur in a vacuum.

Nicol and Macfarlane (2006) noted that studies by scholars in the USA have proved that learners who are more self-regulated are more effective learners, who are more persistent, resourceful, confident, and higher achievers. Feedback from those who are part of the learning environment provides for the opportunity for self-regulated learning as students take time to self-review (Zimmerman and Schunk, 2001).

As Stiggins (2002) pointed out that summative assessment and assessment for learning are both important. The main variation is between assessment to determine the status or level of learning and

assessment to encourage deeper learning experiences. Assessment of learning provides a summative component of evidence of achievement for public reporting while assessment for learning assist the student to learn more from an educational process hence providing the formative component of evidence of learning progress. Nicol and Macfarlane (2006) noted that formative assessment provides the student with a platform for self-assessment and peer assessment in a way that is more effective than teacher assessment which is more prevalent in summative assessment. They went on to state that formative assessment increases dialogue through feedback and this ensures that students can engage their teachers in discussions about feedback. This stimulates response and continuing dialogue and as the student discusses with the teacher, resulting in greater understanding of the learnt concepts, (Freeman and Lewis, 1998).

It was noted during this study that students have less stress and are more prepared to learn and engage when teachers use assessment for learning than they would when they are assessed using assessment of learning.

Research question

1. What are students' experiences and perceptions of the way formative assessment is used in the science classroom?
2. How can assessment for learning be used to encourage students' self-regulation in Middle School science?

Research Methods

Focus groups were used because they allow for piggybacking as discussions facilitate building concepts from peers. This study used Focus groups as they also allow for a more relaxed and non-formal discussion platform. Focus groups are ideal for exploring ideas and perceptions that are developed, cultivated, and sustained within communities. The use of Focus groups was done to triangulate data for comparative purposes with data from observations, questionnaires and interviews. A sample of 50 students was used for the Focus group. Since these were minors whose ages ranged from 12 to 15 years, ethical approval was granted from the schools.

The limitations to this study included the challenges that were presented by the Covid19 pandemic as there

was a limit to group gatherings. The modified school programs during the study period also limited the number of times that the researcher would have met with the Focus groups.

Focus groups were also chosen due to their effectiveness under quarantine and restricted gathering periods since only a limited number of students could sit in the same place with adequate social distancing.

Data analysis

This study used thematic analysis as the analytic approach, allowing for a diverse and detailed interpretation of the data (Braun and Clarke, 2006). Individual student responses were allocated numbers from 1 to 50 ensuring that students anonymity remained at the centre of the study.

Findings

Focus groups with students revealed the following themes from the different types of summative assessments they were exposed to by their teachers:

- Games are fun, motivating and helpful for students.
- Short quizzes encourage students to focus on their work.
- Simulation models are helpful for students.
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- Discussions help students express themselves and improve their understanding.
- Presentations offer students opportunities to present in front of others and encourage peer learning.
- Projects are a powerful tool for learning.
- Debates are helpful for students.
- Station-based learning provides more room for student interactions.
- Role-plays create a conducive environment for formative assessment.
- Lesson starters are important in motivating students.
- Sitting arrangement in the science classroom is important.
- Sharing learning objectives and success criteria is valued.
- Linking prior knowledge with learning objectives is important for students.
- Individual feedback is valued by students.

- Individual feedback is valued by students.
- The use of success criteria encourages students to be innovative.
- Peer collaboration is valued.
- Success in individual work is effective.
- The use of 3D models promotes innovation.
- Students are sensitive to teachers' actions.
- Students are sensitive to grades.

Games are fun, motivating, and helpful for students.

Students reported that they enjoyed being assessed through games as it brought fun into their learning process. Students felt that when learning involves some play it becomes more appealing for them, and they would always look forward to it.

S37: Using games for assessment makes it fun to learn as games bring joy and relief from pressure.

S38: Playing games, a part of learning, has changed my whole perception about science, I now love what I learn as learning has become so fun.

S50: Some games require that I use critical thinking to continue to the next stage. Such games challenge me to think critically as failure to do so would mean that I remain at lower stages. I feel empowered when I have to search for certain concepts outside of the game and find them before I can resume my game.

Short quizzes encourage students to focus on their work.

The use of short quizzes by teachers to assess their students formatively was mentioned as another form of assessment that encouraged students to be more focused on their work. Students mentioned that short quizzes were less stressful and allowed them to focus more on their tasks.

S7: Short quizzes are easier to handle for me as the questions are unambiguous. Short quizzes require short answers which makes it easier for me to expand from my own answers.

S15: Short quizzes help me to be more focused and when I struggle to understand, some online short quizzes are structured differently but they convey the same concept which helps me to re-focus when I am lost.

Simulation models are helpful for students.

There was an overwhelming response from students about how they positively felt with regards to simulation models. Students mentioned that they were more engaged when they worked on simulation models.

S5: Simulation models helps me to understand abstract concepts as I can use the models to bring in some realism into my science.

S6: When I use simulation models everything becomes so easy to grasp, I even feel that whenever I use simulation models my understanding of the concepts becomes enriched and deeper.

Discussions help students express themselves and improve their understanding.

Students also mentioned that whenever they had class discussions with their teachers controlling and giving every student a chance to air their views, they were better able to comprehend and master the concepts. Students reported that it was even more to their advantage when their discussions were linked to the learning objectives and success criteria as some students would explain some concepts in ways, they would better understand than when their teachers explained.

Some students believed that when they had discussions they were encouraged as they would contribute to the discussions thereby improving their own understanding of the concepts.

Presentations offer students opportunities to present in front of others and encourage peer learning.

Getting people to stand in front of others is not always an easy thing to do. However, when students present their work to their peers, they are more relaxed and ready to showcase their findings. Presentation skills are necessary in life as they prepare learners to be articulate and confident before other people. Students mentioned that they are more comfortable with presentations of their findings from experiments and benefit from their peer presentations.

S17: It feels good too when presenting before the class, as we can show what we know and share our experiences with others. Presenting findings from experiments allows us to self-assess ourselves and get feedback from others.

Projects are a powerful tool for learning.

When assessment for learning is done using projects students are more engaged and there is greater self-regulation and autonomy. Students reported that working on projects allows them to work independently and with minimal teacher input. They also mentioned that when teachers provide rubrics it becomes more convenient for them to come up with original ideas for their projects.

S10: I can easily relate to projects than I would do from just reading, listening and from experiments. Projects enable me to have hands-on experience with my learning.

S12: The use of projects in my science has helped me to ask questions as to why certain things happen instead of focusing on what things are. I think projects are making me see things differently.

Debates are helpful for students.

Students expressed their opinions about how helpful debates were in comprehending and understanding concepts as well as how they could be able to look at a topic from more than one perspective.

Students demonstrated a lot of critical thinking from the way they would analyze data from their peers. Students' reactions to how they felt when debate was used as a way of assessment showed that they were able to be critical of scientific data.

S39: Listening to my peers, debate has always offered me an extra learning opportunity as some of the points they bring would be new to me. Debates have always challenged me to read widely, which has greatly helped me in the way I prepare myself for science.

S37: Hearing other people's views that are different from ours creates an environment that challenges us to do a lot of research on our part. It allows us to better understand the topic from different viewpoints.

S10: When we are assessed using debates it removes the spirit of selfishness and replaces it with cooperation. I like the fact that I collaborate with others to come up with points and responses to those on the other side.

Station-based learning provides more room for students' interaction.

Students reported that interaction among their classmates is greatly improved when they work in smaller stations. Most students stated that they are

offered more chances to contribute to their group tasks when they have smaller stations which are rotational.

S10: I can learn more from my peers when we work in smaller stations as we are not hurried. There is always enough time for everyone to contribute before we transition to the next station.

S14: I get more help from workstations than I would from bigger groups as the teacher allows us to transition from one station to another. Therefore, I have multiple support systems from my peers whenever I do not understand.

S27: I like stations especially when I remain in a station where I become the team expert after having gained extra experience from other in-transit station members.

Role-plays create a conducive environment for formative assessment.

Another way that students reported as having been helpful to them was when they were assessed using role-play. Just like debates, students reported that role-plays gave them the chance to put themselves into other people's shoes to be able to solve scientific challenges.

S1: When my teacher uses role-play to assess us, it provides me with the means to think quickly just from observing and listening to my peers' line of thought.

S18: Roles plays always gives me the opportunity to see things from someone else's point of view and this has helped me better understand and appreciate the value of diversity.

S50: Role-plays for me are an extension of debate and they energize me as I can act in different roles to solve scientific problems.

Lesson starters are important in motivating students.

Most students were engaged in the introductory phases of the lessons with most teachers linking their lesson objectives and success criteria to their previous lessons. In all cases students were able to explain how to complete their daily tasks using the Success criteria. While most of the times teachers were initiating discussions through questions and lesson starters, in a few instances students would initiate discussions based on previous lessons and prior knowledge. In one of the lessons students introduced the lesson from the topic and generated lesson questions for each other while the teacher was facilitating the discussions. Data

from the students showed that they enjoyed lessons that were started in unique ways by their teachers.

S37: I like it when my teacher starts the lesson with fun or something interesting, this allows me to refocus on what I would have learnt from other classes and be ready for science.

S5: I value lesson starters because they are always simple to understand and no one fails them, they make our lessons more interesting.

S34: When I am disinterested and disengaged on that day, lesson starters have a way of turning me on and I suddenly want to know what comes thereafter. Lesson starters have thus been helpful for me as I become engaged and forget about anything that would have been bothering me.

Sitting arrangement in the science classroom is important.

The physical configuration of a classroom is more than an organizational or stylistic choice by the instructor. In-person classroom seating arrangements affect student learning, motivation, participation, and teacher-student and student-student relationships (Fernandes, et al., 2011). In the virtual classroom space, such as real-time platforms like Zoom, instructional choices to employ engagement strategies and provide opportunities for feedback also have a positive impact on student learning outcomes (Francescucci and Rohani, 2019). Another concept that came up from the focus group was that students were sensitive to their sitting arrangements in the classroom. Students reported that there were some sections of the classroom that they would avoid if they needed to focus more on their progress. Some students were, however, more likely to sit in seating positions and their teachers were more likely to ask them to move, especially where there were high chances of peer distractions.

Sharing learning objectives and success criteria is valued by students.

Data from the focus group showed that students felt involved from the onset of the lesson through the sharing of learning objectives and the criteria for success. Students felt that it was important for them when their teachers explained to them what and how they were going to learn for the day.

S13: I feel empowered and involved when start our lessons by going through the topic, the 'I can' or

learning objectives and the success criteria before the we start the lesson.

S11: When I work with learning objectives and success criteria it is easy for me to reflect on every step, I make in the learning process and identify where things are off track and be able to adjust my trajectory thus enabling me to be more confident in my science.

Linking prior knowledge with learning objectives is important for students.

Every student wants to be successful, and their learning becomes more engaging when teachers link some learning objectives to things that students know already. Prior experience can be a platform from which new concepts may be developed. Many students in the focus groups revealed that they find the lessons making more meaning if they can connect with some of the objectives to things that they may have experienced or those that they have some prior knowledge of.

S5: When I learn something that is related to what I already know it becomes easier for me to link up the different pieces like a jig-saw puzzle to come up with the final product. Learning becomes more interesting when I can build from what I already know.

S7: I always build on what I already know when new concepts are introduced, and this makes it easy for me to connect different aspects of the topic and be able to understand things that will be new.

Individual feedback is valued by students.

Data showed that students valued feedback from both their teachers and their peers. Students reported that there is always a lot to learn and to take away from feedback. Students showed that they were responsive to feedback. Besides attaching value to feedback from the learning community it was also evident that students were very sensitive to feedback.

S7: When my teacher gives me feedback and links the feedback to the success criteria and learning objectives it helps me to know where I should put extra effort and where I would be doing well.

S8: I am sensitive to feedback provided by my teacher. I always make sure I follow up on my teacher's feedback before I proceed with my work.

Students enjoy working autonomously.

Most students reported that they enjoyed being independent when they research and prepare for their science lessons. Results from the focus group also showed that more students felt motivated when they

worked alone and received feedback from their teachers for their individual efforts. Students felt that they benefitted more from autonomous learning as they had more control over what they were doing, which made them feel that they were not passive recipients of knowledge but rather builders of their own knowledge.

S9: Working alone allows me to work at my own pace, I do not feel any pressure from others where I face difficulties, I have all the time to myself to find a solution.

The use of success criteria encourages students to be innovative.

Data from the focus groups showed that students valued success criteria that were used by their teachers to assist them in coming up with solutions to their challenges. Most students would go a step further and would in most cases come up with their own modified success criteria.

S27: Success criteria helps me to see how success looks like before I begin. Therefore, when armed with success criteria I can plan and set goals for myself. Success criteria helps me a lot in self-assessment and self-evaluation. I can use it to check on where I could have done wrong and where I may need to improve on.

S26: Success criteria helps me to monitor my progress and adjust when I find out that my results are not going according to the shared criteria.

Peer collaboration is valued.

Students reported that they valued the times that they collaborated with their peers to come up with solutions to given challenges. Most students mentioned that they tend to learn more from their peers as concepts are explained in a way they better understand. Students viewed collaboration as a necessary activity to prepare themselves for classwork and assessment as collaboration enhances the sharing of study ideas and research skills toward certain topics. Students mentioned that collaboration enhances cooperation and removes unnecessary competition. There was also some consensus among students that collaboration was useful in bringing in real life situations in the classroom thus making their lessons more reflective of how people live and work together for the common good.

Success in individual work is effective.

Students reported that they had a greater sense of achievement each time they were successful in the work that they worked on as individuals.

S3: I feel that I achieve more for myself when I am given the chance to complete certain tasks on my own, especially after we have debates or other class activities. Working on my own challenges me to be creative.

The use of 3D models in assessment promotes innovation.

When students' learning includes some hands-on experiences where they come up with working models greatly promotes innovation. Students reported that the use of 3D models for their assessments drew them closer to being the kind of scientists they aspire to become. However, a minority of the students reported that they felt that some students were advantaged over others as the distribution of resources and home support were not the same for all students.

S1: Working with models has made me not to be afraid when my teacher says there will be an upcoming assessment. I now believe I can do it.

Students are sensitive to teachers' actions.

While a lot of positive phenomena came out from most of the students, a few students felt that they were not getting the kind of attention that some of their peers were getting. Students believed they could perform better if they also had their teachers' attention.

S11: I feel that my teacher does not really give me feedback like she does with other students, it is like some students always get all the attention and adequate explanations on their work than I receive when I present my work. Maybe I am not the teacher's favorite student.

S8: I could do better in my science if my teacher was fair in his comments towards my work.

S46: If we are all given the same kind of responses maybe all of us would feel valued, appreciated and this would help us catch up with others.

S49: I do better in all my work when my teacher checks on my progress as I work, and I tend to benefit more from my teacher's comments especially when comments are positive or encouraging.

Students are sensitive to grades.

Many students indicated that they felt stressed when they are graded in their science work, and it affects the

way they relate to their peers and their teachers. Mental health issues and school violence were also mentioned as being driven by bullying that could be a result of profiling from grades attained in learning. It was evident that learners felt intimidated by grades that are associated with summative assessment and this had negative impacts on the way they felt about themselves.

S2: I feel isolated and profiled as a failure when I get lower grades than my peers and this is made worse when my friends pick on me due to low grades. At times when I get low scores, I isolate myself or find a secluded place to cry. The worst part of it is when my parents have higher expectations and I fail to live up to their expectations it makes me feel like the end of my life.

S6: Getting high scores usually earns me new friends but the moment I get low scores it would be like the whole world is coming down upon you, suddenly you find yourself without friends and with no one to talk to.

S11: Scores bring in unhealthy competition for us and you ask yourself why as we would expect to be working as a team with our peers. You can also see that teachers tend to associate and help those with higher scores than those with lower scores.

Conclusion

The way teachers assess their students has a bearing on how students perceive and at times perform in the assessments. Understanding how students feel about assessment and tailoring assessment in a way that encourages learners to be willing to learn through assessment will give every learner the confidence that they need during the assessment process. Educators should thrive to make their students believe that the best can only come from themselves and not from the teachers or their peers. Assessment for learning removes stress associated with assessment of learning and promotes student autonomy and motivation. A motivated student is more likely to excel than one who is unmotivated. Assessment for learning promotes innovation and high self-esteem among students.

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