

Transforming Biology Assessment through Written Feedback in Tanzania Secondary Education: Insights from Action Research

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ABSTRACT

This study examined the impact of written feedback in Biology assessment in secondary schools, focusing on both student and teacher perspectives. Using action research with 80 students and their teacher, the study spans four months across three reflective cycles. Central findings reveal that descriptive, non-evaluative feedback empowers students. Feedback clarifies misunderstandings, offers specific improvement guidance, and makes "next steps" manageable. Further, descriptive feedback exposes students to broader problem-solving strategies. The study also shows that written feedback transcends mere evaluation. It becomes a reflective dialogue, with students actively using feedback to improve, and teachers acting as facilitators, guiding students towards better learning outcomes. Consequently, assessment shifts from simply judging to a transformative partnership. Both students and teachers contribute actively, aligning assessment with the ultimate goal of enhanced learning.

Keywords: Action research, assessment, reflection, written feedback

INTRODUCTION

Assessment is the cornerstone of education, shaping student learning experiences and providing vital feedback for both students and teachers. Within the context of education, assessment for learning (AfL) stands out as a powerful tool for empowering students, not only in gauging their progress but also in fostering independent learning and goal achievement. Today, various researchers are emphasizing the role of feedback between teachers and students, and such has gained significant traction in Tanzania's educational landscape (Al-Bashir, Kabir & Rahman, 2016 and, Tanzania Institute of Education, 2013). However, effective implementation of AfL principles continue to be challenging, particularly in the realm of written descriptive feedback, which has the potential to transform learning in secondary education.

Written descriptive feedback plays a crucial role in AfL, acting as a bridge between a student's current understanding and learning objectives. Beyond mere assessment, it informs students about their strengths, areas for improvement, and strategies for growth (Brookhart, 2017). Compared to fleeting oral feedback, written feedback offers several advantages. It serves as a tangible record, allowing students to revisit and self-reflect, and can be tailored to individual needs, providing detailed and personalized guidance. Notably, effective feedback can trigger "double-loop learning," prompting students to move beyond surface-level errors and critically examine their learning strategies and assumptions (Carless, 2019). Despite the recognition of AfL's potential and the compelling benefits of written descriptive feedback, a significant research gap exists in understanding its specific impact and effective implementation within the context of Biology teaching for secondary education in Tanzania. While studies have acknowledged the importance of AfL and descriptive feedback in general, there is a scarcity of research specifically explore their influence and practical application in Biology

classrooms in Tanzania. The problem is also seen in Contextual factors, whereby the unique challenges facing education in Tanzania, such as large class sizes, limited resources, and a culture of high-stakes testing, require tailored investigations into how AfL and descriptive feedback can be adapted and optimized in this context. Within the realm of Teacher training, equipping Biology teachers with the competencies and strategies to effectively provide written descriptive feedback remains a crucial but underexplored area.

Such a research gap translates into a possibility that several secondary school Biology students may not have access to the transformative potential of AfL and meaningful feedback, hindering their learning outcomes, critical thinking skills, and scientific inquiry development. Therefore, this study aimed at addressing the following research question: How can written descriptive feedback be effectively implemented in secondary school Biology classrooms in Tanzania to enhance student learning outcomes? By addressing this question, this study may contribute valuable insights to fill the current research gap and inform practical strategies for enhancing the learning and teaching of Biology in Tanzania; Equipping Biology teachers with the skills and knowledge to provide effective written descriptive feedback developing context-specific AfL approaches for Tanzanian secondary schools.

Literature Review

Assessment for learning (AfL) stands as a cornerstone of transformative education, promoting student empowerment and deep understanding through a continuous cycle of assessment, feedback, and adjustment (Black, & Wiliam, 1998). Feedback, the heart of AfL, acts as a bridge between student performance and learning goals, offering insights into strengths, weaknesses, and pathways for improvement (Sadler, 1989). Numerous studies reinforce the critical link between effective feedback and enhanced learning outcomes,

highlighting its influence on student motivation, self-regulation, and metacognitive skills (Hattie, & Timperley, 2007; Wiliam, 2011). Guiding the implementation of AfL, several principles inform the design and delivery of impactful feedback. Notably, Black and Wiliam, (1998) propose five key principles: focusing on what students can do next, providing specific and actionable guidance, aligning feedback with learning goals, facilitating student self-assessment, and offering feedback in a timely and regular manner. These principles emphasize the transformative potential of feedback, moving beyond mere assessment to empower students to actively participate in their learning journey.

Within the AfL framework, written descriptive feedback emerges as a particularly potent tool for supporting student learning (Brookhart, 2017). Compared to fleeting oral feedback, written comments offer tangible permanence, allowing students to revisit, reflect, and internalize insights at their own pace (Carless,2019). More importantly, effective written feedback, characterized by its specificity, detail, and focus on improvement strategies, has been shown to foster deeper understanding and knowledge retention (Wiggins and McTighe, 2011). Studies by Andrade and Crandall, (2009) and Kluger and Dunning, (2000) further demonstrate how descriptive feedback promotes self-efficacy and metacognitive awareness, encouraging students to become active participants in their learning process. The significance of written descriptive feedback is accentuated in the context of secondary Biology education in Tanzania. As King'aru, (2014) highlights, the dominance of traditional knowledge- centered teaching often neglects the crucial role of practical activities and meaningful feedback. This gap is further widened by challenges faced by Biology teachers, including large class sizes, limited assessment literacy, and a culture of standardized testing (Mpapalika & Vhurumuku, 2013; Sanga, 2017). Consequently, many teachers resort to generic,

evaluative feedback, missing the opportunity to capitalize on the transformative potential of AfL and double-loop learning (Carless, 2019). Equipping Biology teachers with the skills and knowledge to provide effective written descriptive feedback becomes crucial to address these challenges and catalyze transformational learning in Tanzanian classrooms. By incorporating robust AfL practices, emphasizing detailed and personalized feedback, and fostering student self-assessment skills, educators can bridge the gap between intention and understanding in Biology education. This shift, informed by principles of AfL and supported by targeted teacher training initiatives, holds the potential to empower students, enhance learning outcomes, and cultivate a generation of critical thinkers and problem-solvers, capable of applying their knowledge and skills to navigate the complexities of scientific inquiry. Therefore, there is little double loop learning because of the teacher's poor assessment practices. Change to students learning Outcomes in Biology can be improved if both teachers and students are transformed, engaging in effective written descriptive feedback.

Methodology

This study embraced a constructivist philosophical approach, aligning itself with qualitative research methodologies and adopting an action research design. The choice of action research was influenced by the intention to equip teachers with the essential skills needed to provide written feedback employing double-loop learning techniques, thereby enhancing students' learning experiences. Qualitative data served as the primary focus of this study. Moreover, the researchers considered self-reflection to critically assess their own beliefs, biases, and teaching methods and analysis. Thus, the researchers analyzed their reflections as well as reflections shared by participants to identify patterns, trends, challenges, and successes. The research unfolded over 16 weeks,

comprising 80 intensive hours of study. Within this timeframe, a structured intervention plan was implemented, which included the following:

1. Reconnaissance – to identify current assessment strategies of teachers;
2. Training of teachers – to introduce them to written descriptive feedback;
3. Evaluation – to assess whether written descriptive feedback improved student learning for the Biology subject.

The data collection process took place between July and October, 2020. This research design paved way for a comprehensive exploration of the impact of written feedback rooted in double-loop learning, providing valuable insights into the transformative potential of this pedagogical approach. The review of the documents such as examination scripts, students' focus group discussion and entry interview for Biology teacher were done during reconnaissance stage, July, 2020 to assess the current assessment practices and after intervention stage during evaluation: exit interview, focus group discussion, and document review were conducted to observe the change after intervention.

Study Site

The study's geographical scope encompassed Nyamagana Municipality in Mwanza City, Tanzania. The study was carried out at Jitegemee Secondary School in Nyamagana District. The school is a co-secondary school comprising both ordinary and advanced levels, with a population of 1700 students, and 72 teachers. The school has 8 Biology teachers, 6 of them teaching ordinary level and 2 teaching advanced level. This school is well equipped with science and computer laboratories. The rationale for selecting the school was that, it is very resourceful with experienced teachers as well as a large number of students so the researcher was able to get enough representatives. The Form Three class had a total of 300 students who were allocated to three

streams (A, B, and C). Moreover, the qualitative data collected in each stage of an action research were thematically analyzed.

Findings

Overall results of this intervention study have shown that written descriptive feedback helps both teachers and learners to self-regulate their learning by reflecting on each stage of learning. The results are presented in three steps of action research: reconnaissance, intervention, and evaluation.

Reconnaissance

The study findings revealed the use of standardized assessment practices in Biology teaching, and the impact of feedback on students learning. Standardized assessments were found to be a predominant method used by teachers to evaluate students' knowledge and skills and therefore feedback involved just ticks and crosses and finally a grade. These assessments were characterized by teacher-focused assessment, rigid scoring systems, and limited feedback giving direction on how to improve learning. The focus was primarily on testing memorization and recalling rather than encouraging critical thinking or problem-solving skills, all of which served to demotivate students' learning.

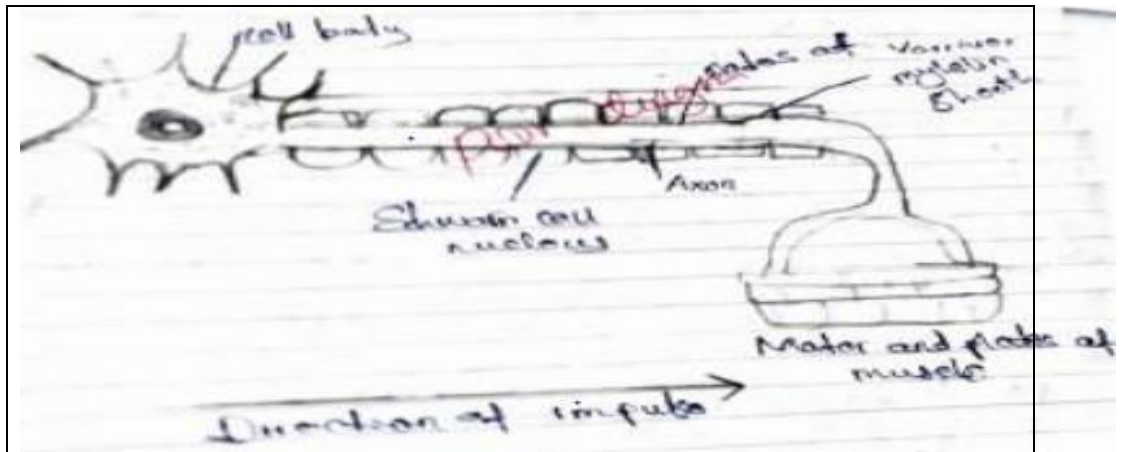


Figure 1: Sample of Written Feedback Provided by a Teacher before Intervention

Figure 1 shows that, the teacher gave negative written feedback to a student who sat for the Biology terminal examination. The feedback simply tells the student that the drawing is poor, without indicating how to improve and what is missing. The feedback is rather on the drawing skills and not on a Biology concept. This finding corroborates with findings of other assessment research that suggest that such practices adversely impact students' motivation and confidence (Johnson, Smith, and Miller, 2020). Furthermore, the findings align with previous studies (Smith, 2019) that underscore the prevalence of standardized assessments emphasizing error identification. Literature indicates that a narrow focus on errors diminishes students' intrinsic motivation, hindering their engagement with the learning process (Brown & Jones, 2018). The research highlighted the demotivating impact of these assessment practices on students. The constant emphasis on errors and a lack of positive reinforcement led to reduced self-confidence and enthusiasm for learning. Students felt discouraged and disengaged, as their efforts were met with a focus on what they got wrong rather than celebrating their achievements. The

findings of this study during students' focus group discussion echoed that:

Teachers give us ticks and crosses, and if someone gets low marks, we end up being punished. This makes most of us not attend some classes...it is embarrassing. Instead of being instructed on what to do we are punished! It is not fair! (Student 5, 2020. Focus Group Discussion).

The demotivating impact of error-focused assessments on students resonates with previous research (Garcia & Martinez, 2017). As evidenced by participant quotations, students expressed feelings of discouragement, leading to disengagement and a fragmented learning experience. This resonates with the literature on the importance of positive reinforcement and constructive feedback for cohesive learning environments (Johnson & Smith, 2016). In our investigation, it became evident that teachers predominantly relied on a single-loop assessment feedback strategy, which significantly hindered the provision of effective written feedback and obstructed students' learning processes. Single-loop assessment, characterized by conventional feedback methods aimed at immediate problem-solving without fostering a comprehensive understanding of the learning process, was pervasive in teachers' instructional approaches (Carless, 2019). This method limited feedback to mere marks or grades, neglecting the provision of explanations or avenues for students to grasp the reasoning behind the grading system or enhancing their performance. The use of single-loop feedback was substantiated during an interview with a Biology teacher, quoted that:

I often give feedback by writing comments on student's script during marking like see me, excellent, poor. Also, I always punish the students who scores low grades (Collaborative teacher, interview, July, 19, 2020).

Consequently, this approach severely curtailed students' capacity to comprehend feedback, hampered their engagement, and ultimately restricted their learning opportunities. This observation underscores the urgent need for a shift towards more comprehensive feedback strategies to enhance the quality of education and foster a deeper understanding among students. In summary, the findings underscore the need for a paradigm shift in assessment practices. Teachers of Biology must embrace assessment practices that celebrate successes, identify areas for improvement, and actively involve students in their learning journey. Incorporating student feedback mechanisms (Harrison & Thomas, 2018) and promoting a growth mindset (Dweck, 2016) can contribute to a more cohesive and empowering educational atmosphere. The current focus on standardized assessments, error identification, and teacher-centric evaluation approaches do not only demotivate students, but also hinder their potential for future learning. Addressing these issues is imperative for creating an educational environment that nurtures a positive learning experience, encourages student engagement, and facilitates continuous improvement.

Intervention Phase: Empowering Teachers through Written Descriptive Feedback

Intervention

During the intervention phase, teachers underwent comprehensive training on Assessment for Learning strategies and the art of crafting effective written descriptive feedback (Wiggins & McTighe, 2017). Subsequently, a scaffolding phase was initiated, whereby teachers collaboratively planned assessment tasks with the researcher. This planning phase integrated thoughtful considerations for feedback mechanisms, ensuring alignment with learning objectives and individual student needs. The collaboration fostered a sense of shared responsibility for student learning outcomes, emphasizing the

partnership between teachers and researchers (Hattie & Timperley, 2007).

Shifting Roles: from Evaluators to Mentors

A notable finding was the transformative shift in teachers' roles. Through intervention, teachers were transitioned from mere evaluators to mentors, guiding students through personalized feedback. This shift echoed the principles of formative assessment, emphasizing the importance of feedback as a tool for learning rather than a mere judgment of performance (Black & Wiliam, 1998).

This is evident from a teacher's testimony during an interview that

You have opened my eyes ...although I have been teaching for 17 years in secondary schools, I have never thought about this type of feedback if it could be effective as I have experienced in this study. It made me reflect on my teaching practices and decide what to improve, it is like a mirror image! Also, my students were confidently able to give and receive written feedback even physically challenged students (with hearing impairment) were able to receive and give feedback which earlier was not possible. My teaching has changed completely. I feel like I am lucky to be a part of this study" (Collaborative teacher, interview, September 25,2020).

Student-Centered Learning and Reflective Planning

As teachers embraced written descriptive feedback, the classroom dynamic evolved towards a more student-centered approach. Lesson planning began to include reflective considerations on assessment tasks, aiming not just at testing knowledge but at fostering deep understanding (Carles, 2019). This shift indicated a profound pedagogical change, focusing on meaningful student engagement and understanding.

Engaging in Double-Loop Learning Through Written Descriptive Feedback

A significant finding of the intervention phase was the evident engagement of teachers in double-loop learning through the implementation of written descriptive feedback. Traditionally, assessments focused on identifying errors and providing corrective measures without delving into the underlying thought processes. However, the intervention encouraged teachers to adopt a reflective approach, where they did not only identify mistakes, but also probed the fundamental assumptions and strategies leading to those errors. Through written descriptive feedback, teachers engaged in a deeper level of reflection. They examined not only what went wrong but also why it went wrong, encouraging them to question their instructional methods and the effectiveness of their assessments (Argyris & Schön, 1996). This reflective process fostered a continuous cycle of improvement, enabling teachers to refine their teaching techniques and assessment strategies iteratively. This finding highlights the transformative potential of written descriptive feedback as a tool for promoting double-loop learning among educators. By encouraging teachers to critically reflect on their teaching practices and adapt their approaches based on student responses, the intervention facilitated a profound shift in pedagogical paradigms, emphasizing the importance of ongoing, reflective improvement for both teachers and students.

Increased Student Engagement, Agency, and Learning

Crucially, the impact of this intervention was profound on students. Their engagement increased significantly, reflecting a new found agency in their learning journeys. With personalized feedback guiding them, students became active participants in their education, leading to substantial improvements in their learning outcomes and overall academic performance (Brookhart, 2017). The findings from this intervention phase underscore the transformative power of written

descriptive feedback in reshaping the educational landscape. By empowering teachers with the tools and knowledge to provide meaningful feedback, a shift occurred not only in classroom dynamics but also in student engagement and learning outcomes. These results substantiate a growing body of research emphasizing the crucial role of formative assessment and target feedback in enhancing students learning experiences.

Evaluation Phase

Deepening Engagement and Enhancing Learning Outcomes

The evaluation phase of the intervention revealed positive transformations in the teaching and learning process. Teachers continued to engage in double-loop learning through the systematic application of written descriptive feedback, consistently probing the underlying assumptions and methodologies that influenced student performance (Argyris & Schön, 1996). This ongoing reflective practice does not only deepen educators' engagement with their teaching strategies but also had a direct impact on the learning outcomes of their students. The iterative feedback loops (The cyclical process of assessment, feedback, and adjustment, where each step informs the next, leading to continuous improvement.) created a dynamic classroom environment where both teachers and students actively participated in continuous improvement efforts.

Deepening the Learning of Biology

The evaluation phase revealed a profound impact of written descriptive feedback on the learning of Biology, taking on board both theoretical and practical sessions. In theoretical classes, personalized feedback enabled students to grasp complex biological concepts with clarity and precision. Through detailed explanations tailored to individual misunderstandings, students gained a deeper understanding of theoretical principles, fostering a robust foundation in Biology (Sadler, 2005). Moreover, in practical sessions, written feedback provided

students with explicit guidance on experimental techniques, data analysis, and scientific reasoning. This targeted feedback not only corrected errors but also elucidated the underlying scientific principles, enabling students to refine their practical skills and develop a nuanced understanding of experimental methodologies (Quigley, Marshall & Deaton, 2018). Consequently, written descriptive feedback emerged as a vital tool in bridging the gap between theory and practice, facilitating a holistic and comprehensive learning experience in the field of Biology.

Cultivating Student Agency and Self-Regulation

A notable outcome of the evaluation phase was the cultivation of student agency and self-regulation. Through personalized written feedback, students were empowered to take ownership of their learning journey (Nicol & Macfarlane-Dick, 2006). Encouraged by the detailed guidance provided by teachers, students became proactive in identifying their strengths and areas for improvement. This newfound agency did not only enhance their motivation but it also nurtured essential skills for lifelong learning, aligning with the broader goals of education (Zimmerman, 2002). The impact of written descriptive feedback extended to the realm of learning Biology, empowering students to take ownership of their academic progress. In theoretical classes, the detailed feedback encouraged students to delve deeper into specific topics, conduct independent research, and explore biological phenomena beyond the classroom curriculum (Nicol & Macfarlane-Dick, 2006). In practical sessions, feedback on laboratory experiments motivated students to refine their methodologies, designed their investigations, and critically analyzed experimental outcomes. This heightened sense of agency nurtured self-regulation, inspiring students to actively seek knowledge, engaged in scientific inquiry, and cultivated a genuine passion for Biology (Zimmerman, 2002). Through this process, written descriptive feedback played a pivotal role in shaping

Biology learners into self-directed, inquisitive individuals, fostered a lifelong love for the subject.

Fostering Collaborative Learning Environments

The impact of written descriptive feedback transcended individual student-teacher interactions and permeated the broader classroom environment. Collaborative learning became a cornerstone of the educational experience, as students actively engaged in peer discussions, leveraging feedback to enhance their understanding (Hattie & Timperley, 2007). The feedback-rich atmosphere fostered a sense of camaraderie and collective responsibility for academic growth, creating a vibrant, intellectually stimulating learning community. Moreover, written descriptive feedback facilitated collaborative learning environments in Biology classes. In theoretical sessions, students engaged in peer discussions, using feedback as a catalyst for intellectual discourse and collaborative problem-solving (Hattie & Timperley, 2007).

In practical sessions, feedback not only improved individual performance but also encouraged students to collaborate on experiments, share insights, and collectively analyze data. This collaborative atmosphere not only enhanced the depth of learning but also cultivated essential teamwork and communication skills vital for future scientific endeavors (Quigley, Marshall, & Deaton, 2018). Thus, written descriptive feedback emerged as a cornerstone in fostering a Biology classroom characterized by shared knowledge, mutual respect, and collaborative learning experiences. In summary, the evaluation phase reaffirmed the enduring impact of written descriptive feedback on the teaching and learning process. By fostering double-loop learning, empowering student agency, nurturing collaborative environments, and strengthening teacher-student relationships, written descriptive feedback emerged as a

transformative pedagogical tool, shaping a positive and enriching educational landscape.

Discussion

Descriptive written feedback significantly enhanced both teachers' assessment practices and students' learning experiences. This improvement fostered a more collaborative learning environment, allowing teachers and students to engage more effectively through the use of scaffolding. This reflective process empowered educators and learners to adapt and employ diverse strategies, not only addressing learning challenges in Biology but also extending to other disciplines. This constructive feedback loop played a crucial role in refining instructional methods. These findings align with the outcomes of studies conducted by Carless, (2019), Tagg, (2007), and Rahman, Abdurrahman, Kadaryanto and Rusminto, (2015). According to these scholars, scaffolding emerges as a well-considered and efficient technique for enhancing teachers' knowledge. Its capacity to implement tasks at a higher level of competence facilitates a nuanced reflection on current practices, promoting improvement through meaningful dialogue between trainers and trainees.

The integration of scaffolding, as supported by these studies, has proven instrumental in elevating teaching practices and contributing to a more effective and dynamic educational experience. Moreover, the incorporation of double-loop feedback practices resulted in a heightened comprehension of subject content among teachers. The study's findings underscored that educators could adapt their instructional approaches through meaningful dialogues with students, aligning them with agreed-upon success criteria and learning objectives. This parallels the conclusions drawn by Duncan and Buskirk-Cohen, (2011), who observed that teachers refine their instructional methods, and students enhance their performance

through learner-centered assessment. This approach, characterized by increased dedication and creativity compared to traditional assessment strategies, empowers teachers to receive feedback from students that is reflective of standards and learning objectives, thereby enhancing the quality of classroom instructions. Double-loop feedback played a pivotal role in redirecting students' attention from merely covering the syllabus or focusing solely on passing exams to fostering a genuine commitment to learning. The evidence presented in this study demonstrated that students, upon receiving detailed written feedback from both teachers and peers, were able to articulate strategies for future improvement. These findings align with the research conducted by Amua-Sekyi, (2016), supporting the notion that teachers' assessment practices significantly impact students' cognitive processes and thinking skills.

Conclusion

In the reconnaissance phase, a deep understanding of existing assessment practices was gained. Traditional evaluation methods were identified, where teachers primarily utilized single-loop feedback, limiting learning opportunities for students. This phase highlighted the necessity for a pedagogical shift towards more constructive and engaging feedback methods. During the intervention phase, teachers underwent rigorous training in Assessment for Learning (AfL) and the art of crafting detailed written descriptive feedback. Guided by this newfound knowledge, teachers transitioned from evaluators to mentors. They engaged in double-loop learning, critically examining their teaching strategies and adapting them based on student responses. This phase emphasized collaboration, leading to a student-centered approach where feedback became a tool for empowering student agency and self-regulation. In the evaluation phase, the sustained impact of written descriptive feedback was evident. Teachers continued their reflective practices, enriching their teaching methods

and deepening student engagement. The feedback process was instrumental in bridging the gap between theoretical knowledge and practical skills in Biology education. Students became active participants, utilizing feedback to fuel independent research and collaborative problem-solving. The learning environment transformed into a collaborative space, fostering shared knowledge, and mutual respect, and enhancing overall learning outcomes. This study demonstrates that written descriptive feedback, when harnessed effectively, can revolutionize Biology education. It not only empowers teachers to refine their pedagogy but also nurtures students into self-directed, inquisitive learners. By encouraging collaboration, critical thinking, and a deeper understanding of Biology concepts, this approach paves the way for a new era in education where feedback becomes a catalyst for continuous improvement and meaningful learning experiences.

In a nutshell, during reconnaissance, the findings of this study revealed that teachers and students applied single loop assessment strategies, employed the same assessment strategies repeatedly as the results the students' learning kept on being below standards, the use of teacher-centered assessment practices, as well as poor questioning, and teachers' lack skills for providing written descriptive feedback, especially in crowded classrooms, this led to the unclosed feedback loop. However, during the intervention in all three circles, the results show that training a teacher through scaffolding, clinical supervision, reflection, and collaboration changed the teacher's perception and practices on the use of written descriptive feedback hence the paradigm shift from a single loop to double loop assessment practices and this was possible due to change by using learner-centered assessment strategies and ability to construct higher-order questions to elicit learners' critical thinking also the application of written feedback practices that necessitated double loop assessment hence closing the

feedback loop through timely, prompt, positively phrased effective written descriptive feedback. Similarly, during the evaluation, the results show that teachers and students were able to transfer knowledge to other disciplines. The collaborative teacher was also prepared to train other staff members at the institutional level on how to use written descriptive feedback that obeys double-loop assessment practices to improve learning Biology and other subjects (Hattie, & Timperley, 2007; Nicol & Macfarlane-Dick, 2006; Quigley et al., 2018; Zimmerman, 2002).

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