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FEED-FORWARD: STRENGTHENING ASSESSMENT OF PRE-PRIMARY AND PRIMARY SCIENCE AND MATHEMATICS EDUCATION IN TANZANIA

Nipael Eliabu Mrutu¹, Esther Samwel Kibga²

Abstract

Classroom assessment is a critical part of teaching and learning and is a potentially useful tool for enhancing learning outcomes. It provides information on where learners are with their learning goals and what they need to do to improve their understanding and meet the intended learning outcomes. In response to the agent's need for proper interpretation of classroom assessment, researchers and policymakers have developed guidelines, principles, and models to help teachers understand and implement effective assessment conceptions. Despite these initiatives, research continues to show that teachers struggle to interpret assessment policies and implement practices aligned with contemporary formative assessment notions. This paper presents a narrative review of 52 pieces of literature related to pre-primary and primary science and mathematics education assessment between 2008 and 2023. To respond to the proposed research questions using Tanzania as a case study, and focusing on science and mathematics in pre-primary and primary education, we performed this narrative review of the literature on formative assessment and its potential to improve classroom teaching. Findings indicate that principles and models alone are insufficient to create the necessary changes in classroom assessment and thus call for the need for integrated and focused professional learning initiatives that enable teachers to collaboratively explore new assessment practices. Findings indicate further that such

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professional learning models require ongoing support by knowledgeable practitioners. In addition, effective support strategies require time and effort to develop learning cultures that recognize the value of assessment for learning and translate it into action.

Keywords

Early childhood, science and mathematics education, assessment for learning

INTRODUCTION

Public education increasingly resides within a cultural context of accountability. Given this context, researchers, policymakers, and practicing educators are searching for educational policies and practices that will enable science and mathematics teachers in pre-primary and primary schools to better support learners' learning and achievement. Over the past 20 years, new conceptions of formative assessment have emerged and developed that have been shown to have the potential to positively impact learners' educational outcomes (Andrade et al., 2021; Deneen et al., 2019; Greenfield, 2015; Tilya, 2013). As a result, teachers across international jurisdictions have been expected to revise their classroom assessment practices to better support their learners' learning (Birenbaum et al., 2015). This paper through a narrative review of literature related to pre-primary and primary science and mathematics highlights the role of formative assessment in improving teaching and learning.

REVIEW OF LITERATURE

Classroom assessment

Previously, teachers were largely concerned that assessment has to be an "objective" measure of achievement and should emulate standardized tests (DeLuca, Coombs, et al., 2019). At the same time, any formative assessment would be for the

primary benefit of the teacher, to monitor learner learning and modify subsequent instruction (Fukuda et al., 2022). Such assessments were considered useful for teaching but not a valuable learning resource (Brown, 2019). Besides, researchers have put the thrust assessment for learning into the spotlight, creating renewed attention to the purposes and educational values of assessment. Heitink et al. (2016) review of research on assessment for learning has been extensively cited and has had a profound impact on how the educational community views assessment as a supportive process for teaching and learning. Additionally, scholars acknowledge the power of formative assessment to raise learner achievement (Black & Wiliam, 2009). According to them, the studies included in their review were diverse in context and methodology, formative assessment interventions generally had effect sizes in the range of 0.4 to 0.7. Other authors such as Kingston and colleagues argued that the actual impact was likely much less (Kingston & Nash, 2011). After the renewed focus initiated in the 1990s, the learning benefits of formative assessment became a topic of interest. Such assessments designed to maximize learning must happen during the instruction, not just at endpoints, and should essentially focus on learning processes i.e., what strategies are used to facilitate children's learning and not just outcomes (DeLuca et al., 2012).

Learners must also be an active part of both the learning and assessment process. The introduction of the phrase "Assessment for Learning" helped to highlight this critical shift to the purposes and processes of effective, ongoing classroom assessment. Furthermore, it is noted from the literature that effective classroom assessment is a progressive inquiry, reflection, and a process of interpretation of learners' attitudes, understandings, and literate abilities (Andrade et al., 2021). In other words, classroom teachers must focus on 'how' learners are learning and not just 'what' learners are learning. As a concept, "assessment for learning", identifies

‘why’ we are assessing a learner’s learning and what is being assessed (DeLuca et al., 2012).

Key assessment factors

Education is a complex, context-dependent endeavor, and so effective means of assessing vary depending upon the age of the learners, the subject area, the resources available, and a host of other factors. Klinger et al. (2016) highlight three aspects that reflect critical components of effective Assessment for Learning, learner voice and choice, assessing higher-order thinking, and feedback.

Learner voice and choice

“Learners should be meaningfully engaged in the assessment process and use of the assessment evidence to enhance their learning” (Klinger et al., 2016, p. 11). There are many ways to involve learners in classroom assessment, but perhaps the simplest example is working with learners to ensure they understand the purpose of the assessment, and the evaluation criteria to be used (Heitink et al., 2016; Ragupathi & Lee, 2020). There is also evidence that involving learners in their assessment improves their motivation to learn (Yan et al., 2021). This is predicted by the self-determination theory, which posits a strong positive relationship between self-determination and intrinsic motivation (Van den Broeck et al., 2016). Saracho (2023) argued that giving learners some autonomy in how they are assessed improves learner-teacher relationships and creates an atmosphere of trust in the classroom.

A further benefit of providing learners with choices is that learners need to self-assess and be metacognitive in making those choices (Andrade, 2019). Lu and Law (2012) consider the advancement of these metacognitive skills as the key objective of assessment for learning. With increased self-

assessment and metacognitive skills, learners are better able to take control of their learning and become independent learners. Yan et al. (2021) argued that self-assessment by learners is an essential aspect of learning and it should not be taken just as an interesting option or luxury. This is because ultimately, most of the learning is done by the learners (Andrade et al., 2021). Unless the learner understands the gap between his/her achievement and the expected level of achievement, there can be no improvement. Self-assessment strategies can be formal and complex (e.g., self-assessment using rubrics; learner-led conferences) or informal and relatively quick (e.g., exit tickets, thumbs-up-thumbs-down).

When the goal of assessment is to enhance learners' learning, it puts the learner at the center of the assessment process (Andrade et al., 2021). Thus, in an assessment for the learning environment, it naturally follows that learners should have both voice and choice in their assessments. This is not to say that learners are the sole determinants of their assessments, only that their voice is considered.

Assessing higher order thinking

Recent studies on assessment in education have discovered that over 80% of all teacher test questions are directed at the surface level, recall types of knowledge (DeLuca et al., 2012; Nishizuka, 2022) even though teachers claimed to value higher-order thinking skills (Arumugam et al., 2018; Schulz & FitzPatrick, 2016). Subsequently, Andrade et al. (2021) wrote that the majority of teachers' questions aimed at surface and recall of knowledge levels. Since then, despite many advances in knowledge about assessment and education, it appears little has changed (Schulz & FitzPatrick, 2016). There are several reasons for this; recall items are easy to create, easy to craft into a multiple-choice format, and easy to score reliably and quickly. Nevertheless, an over-reliance on these types of

lower-level assessment items likely negatively impacts learner learning, and limits opportunities to engage in critical, complex, and challenging higher-order thinking tasks.

According to Wisniewski et al. (2020), learners engaged in higher-order thinking tasks demonstrated a substantive improvement in the enjoyment of and positive disposition towards school. Eka-Putra and Iswantir (2021) conducted a meta-analysis of the impact of school-based interventions intended to improve learners' higher-order thinking skills with problem-based learning. The results were dramatic whereas the interventions raised learners' cognitive and curricular achievement outcomes with a substantial average effect size. In addition, greater gains were found in learners' attitudes. Besides, given the known associations between positive attitudes toward school, motivation, and academic achievement (Timms et al., 2016), it is reasonable that at least part of the rationale for assessing higher-order thinking skills is an increased level of interest and engagement in the part of the learners.

A further benefit of assessing higher-order thinking is the impact on teaching practice (Schulz & FitzPatrick, 2016). Consider the following example in one classroom. The learners are required to graph the equations $3y + 4 = 7x - 2$ and calculate the correct y -value for any given x -value. In a second classroom, the teacher asks learners to use climate data from the last 100 years to predict the average temperature of the earth in the year 2100 if the current warming trend continues. Next, the learners are asked to give a range of possible temperatures based upon different potential events such as massive volcanic eruptions, increasing population, increasing development, and technological advancement. A question such as this demands a very different approach to teaching, one in which teaching algorithms to solve linear equations is necessary, but not sufficient for learners to complete the task. This task requires learners to develop

research skills, examine underlying assumptions, recognize linearity in real data sets, and communicate an argument using a combination of mathematics and text. The problem itself is inherently more interesting than a plain equation, and the process of arriving at an answer exposes learners to the complex world of actual data, forcing them to synthesize different areas of knowledge.

Creating assessment tasks that ask learners to move beyond factual recall and use higher-order thinking skills can be difficult, and time-consuming. Further, these assessments are often more difficult to score. Yet, the positive impact these types of assessments have on learners' learning, engagement, and teachers' practice fully justify their use in classroom assessment. Lastly, the importance of assessing higher-order thinking does not diminish the importance of learners knowing (and teachers assessing) fundamental knowledge.

Theories and models supporting assessment in pre- and primary Science and Mathematics education

A broad range of literature on theories and models supporting assessment in pre- and primary science and mathematics was reviewed. These theoretical perspectives are summarized in Table 1, and they include the Montessori educational model, Waldorf Education model, Reggio Emilia educational model, Maturation theory, Constructivist theory, and Behaviorist theory. The three models, Montessori's, Waldorf's, and Reggio Emilia's educational models, focus assessment in pre-primary to be based on individual pupils and not a collective entity (Mooney, 2013; Saracho, 2023). In addition, assessment in pre-primary is emphasized not to be paper-based but based on the physical and mental development of a pupil through plays and the use of varieties of learning materials (Aljabreen, 2020). Besides, Maturation, Constructivist, and Behaviorist theories suggest that assess-

ment should focus on pupils' maturity, physical, literacy, and language development through reinforcement and motivation (Fani & Ghaemi, 2011; Mooney, 2013; Saracho, 2023).

Feedback

Feedback is information provided to a learner's performance or knowledge to confirm, overwrite, tune, add to, or restructure information in memory (Van den Broeck et al., 2016). In simpler language, feedback is information that learners can use to help them improve. Hattie and Timperley (2007) reviewed 12 different meta-analyses of feedback and its impact on learner learning and found a mean effect size of 0.79. This is double the mean effect size that Harrison (2013) found for educational interventions in general. Wisniewski et al. (2020) in their meta-analysis found an average effect size of 0.61 which clearly shows how quality of formative feedback for learning. Timely, specific, and appropriate feedback may be the single most important thing teachers can do to improve learners' learning. In an assessment for the learning environment, the assessment tasks are the data collection tools, and teachers knowing what feedback will be effective for enhancing learner learning is the desired outcome of those tools. Given the importance of feedback to support and impact learners' learning, it is critical to understand the characteristics of effective feedback.

It is known that simple praise "Good job!" or criticism "I am disappointed in you!" is not effective. This type of feedback is not specific to the task or the performance and contains so little task information that Van den Broeck et al. (2016) categorized these comments as "contingencies" and not feedback.

To be effective, feedback must contain information about the task, the performance, and how to improve. The simplest form of feedback is to describe a response to a task as correct

or incorrect. This provides a quick confirmation of a learner's developing understanding or skill level if correct but does not give any indication as to what may have led to an incorrect response or how to subsequently get to a correct response. For some learners, this may be enough, especially if the learner has made an error due to carelessness, instead of a lack of knowledge. Yet, for the majority of learners learning new concepts or skills, such feedback is insufficient. Hattie and colleague frame effective feedback in terms of three learner questions that are supported by the feedback: "Where am I going?", "How am I going?", and "Where to next?" (Hattie & Timperley, 2007, p. 89).

Effective feedback requires that teachers understand both the subject and the learner (Wisniewski et al., 2020). The decision as to the type, quantity, and detail of the feedback to be given requires a teacher to not only know the learners well enough to determine which types of errors they make, but also know the concept so that feedback can address specific errors and how to correct them. For example, feedback related to the task is effective when learners have misinterpreted the task (Hattie & Timperley, 2007). To properly understand when to give this type of feedback requires teachers to correctly identify that poor performance or product was the result of task misinterpretation and not the result of a lack of knowledge or skills.

Task-based feedback can be very useful for helping learners improve on a specific task; however, such feedback may not be helpful beyond each specific task. What is more helpful for general learner learning is feedback on the process (Hattie & Timperley, 2007). In particular, it appears that giving feedback on the process leads to learners adopting a deep approach to their learning (Lu & Law, 2012). If process feedback (or any feedback) is to be effective, it must be received, decoded, and incorporated by the learners (Timms et al., 2016). This implies that learners must be immersed in a positive, trusting

relationship with their teacher, that feedback must be expressed in learner-friendly language, and that learners are allowed to incorporate the feedback and demonstrate the new product to the teacher.

Wisniewski et al. (2020) highlighted that feedback given to pupils should be clear, have a logical connection, meaningful, purposeful, and well-matched with learners' prior knowledge. It also needs to trigger the active processing of information by the learners, have low task complexity as well, and relate to specific and clear goals. This is a long list of demands, and effective feedback requires practice, commitment, and competence (Timms et al., 2016). Ultimately, teachers need to understand that in an assessment of the learning environment, feedback is the primary tool that enables learner improvement and learning (DeLuca et al., 2012). The assessment task itself will reveal each learner's strengths and weaknesses, but it is specific, timely, and appropriate feedback that allows the learners to address their weaknesses and move to higher levels of knowledge and ability.

The three examples above represent three key aspects of classroom assessment that have been shown to effectively support learners' learning in a variety of educational contexts. Certainly, other strategies have been identified. Notably, the sharing and co-development of learning expectations, the effective use of teacher- and learner-led questions, and the co-development and use of success criteria and rubrics (Ragupathi & Lee, 2020; Schulz & FitzPatrick, 2016). These strategies commonly coexist with the three described more fully above. The co-development of expectation and success criteria requires learner choice and voice. Effective questions encourage higher-order thinking. Rubrics allow teachers to quickly provide descriptive and focused feedback, and they allow learners to self-assess their work using the descriptors within the (Nishizuka, 2022).

METHODOLOGY

This research study was entirely done as a narrative literature review. The information related to pre-primary and primary science and mathematics education assessment was gathered and summarized from related journal articles, books, and official written documents not more than 15 years old. In addition, the information obtained from the gathered literature aimed to get a general overview of the proposed topic and identified challenges encountered by the educators on assessment from literature. A computer-assisted literature search was done using various search engines using keywords such as: “classroom assessment”, “assessment in pre-primary education”, “assessment in primary education”, “assessment in pre- and primary science education”, “assessment of higher order thinking” and “feedback”. This review of literature highly focused on the seminal literature that contributes significant knowledge in the highlighted areas without considering the context as the literature published in the reviewer’s geographical area was found to be minimal.

Moreover, the criteria for inclusion included: the publications in well-reputed journals between 2008 and 2023 published in the English language related to the fields of pre- and primary as well as science and mathematics education assessment. Additionally, authentic assessment and feedback-related documents published in the Tanzanian context were included. Based on the highlighted criteria of inclusion, 52 pieces of literature including published journal articles, books, theses, dissertations, and government official documents such as education policies and frameworks were reviewed. Besides, the publications and other related documents that could not be obtained as full text or in their full scope were excluded from this review.

This research review was guided by the following research questions:

1. How can teachers be supported in developing effective classroom assessment strategies to facilitate learning?
2. How is pre- and primary science and mathematics education assessment done in the Tanzanian context?
3. What are the challenges affecting the assessment landscape in Tanzania?

RESULTS

The Tanzanian context: An overview

Assessments in Tanzanian primary schools have been developed in the context of the 1995 Education and Training Policy (ETP), Teacher Education colleges, and primary school education curricula. The 1995 ETP emphasized the need to strengthen teachers' assessment and evaluation skills. The 1995 Tanzanian ETP among other things highlighted the significance of quality education, through curriculum review, improved teacher management, and appropriate assessment strategies (URT, 1995). The ETP also provided six aims and objectives for teacher education and training in Tanzania, one of them being to impart skills and techniques of research and the second one being assessment and evaluation in education (URT, 1995).

ETP highlighted the need to introduce courses in assessment and evaluation suggesting that before this policy, evaluation and assessments courses were largely lacking at both primary and secondary school teachers training colleges. The ETP was an indicator of the government's positive commitment to training teachers who are competent in using various assessment and evaluation skills to enhance learners' learning. The 1995 ETP policy statement led to the introduction of topics and courses in measurement and evaluation in the 1996 syllabuses for diplomas in education. The syllabuses were: (1) Teaching and curriculum and (2) Education research

evaluation and measurement (MoEVT, 2015). The topic in question had three instructional objectives as follows: the trainee should be able to (1) describe methods of administering classroom tests and examinations, (2) explain the merits of each method, and (3) describe methods of preventing cheating in classroom tests and examinations.

Assessment in the 1996 syllabuses for diploma in education focused on administering tests and examinations and assigning grades. The way assessment was conceived was not broad enough to allow teacher trainers to acquire the skills and competencies of using assessment as part and parcel of classroom teaching and learning. The topics largely focused on training teachers to use tests and examinations as the only assessment strategies in school. Mid-annual and annual examinations, standard four mock and national examinations, standard seven mock examinations, and standard seven national examinations are the main summative assessments in primary schools in Tanzania. The 1996 syllabuses seem to confirm the findings of Tilya's work that for most stakeholders' assessment simply means giving learners tests and assigning them grades (Tilya, 2013).

Assessment in pre-primary and primary science and mathematics education

The 1995 Education and Training Policy (ETP) stipulated the need to provide opportunities for children to acquire basic literacy and numeracy skills before they joined primary schools. The 1995 ETP emphasized the provision of 2 years of pre-primary education highlighting the objectives of this level of education including the provision of opportunities to enable young learners to acquire and develop communication, numerical, and manipulative skills (URT, 1995, 2014). However, it wasn't till the 2014 education policy that it became mandatory for each primary school to have a pre-primary class

and a teacher, early childhood education was thus formalized. Despite these educational milestones, the learning outcomes were still unsatisfactory.

To improve learning outcomes in Tanzanian primary schools and ensure that the government is making positive progress toward achieving the vision of 2025, the government launched the Big Results Now (BRN) in 2013. Within the education sector, BRN focused on improving the quality of education and the transformation of the Tanzanian education system. This led to the development of a new curriculum in 2016 focusing on competencies rather than content. On top of that, focusing on the competencies acquired rather than the content learned as depicted in the new curriculum in line with reviewed theories and models propositions.

From 2013 Primary school pre-service teacher training in Tanzania was managed and coordinated by the National Council for Technical Education (NACTE). Hence, all certificates and diploma teacher colleges were under NACTE, which was responsible for three key functions; namely, regulatory, quality assurance, and advisory functions. Regarding primary school teacher training, the qualification offered was a diploma in either early childhood education or primary education. The duration for teacher training was two to three years for Form Six and Form Four graduates respectively. The curriculum indicated that the candidate should take 26 modules, one of them being a module for measurement and evaluation. The number of credits in the pre-service teacher training modules ranged from 3 to 20 (five modules had 3-5 credits, eight had 6-8, six 9-12, and seven 13-20 credits. A module in assessment and evaluation was been assigned nine credits (MoEVT, 2015). The curriculum further demanded that, in the assessment and evaluation module, learners should attend six hours per week. Out of these, four hours were allocated to classroom teaching, one hour to independent studies, and the remaining hour to practical work (Ndalichako, 2013).

The 2016 curriculum stipulated that teaching and learning in grades one and two should focus on the 3Rs (reading, writing, and arithmetic). This curriculum also identified assessment as an integral part of teaching and learning. The 3Rs were to be taught by a qualified teacher who is capable of assessing, evaluating, and using results to enhance pupils' learning. This is as proposed by Vygotsky, Piaget, and Bruner in the Constructivist theory that assessment should focus on pupils' development due to the knowledge acquired through the experience of the interpretation of the outside environment (Fani & Ghaemi, 2011; Saracho, 2023). Furthermore, the curriculum emphasizes the essential role of assessment in informing pupils regarding their performance and assisting them to plan learning objectives to enhance their learning (MoEVT, 2015). This curriculum highlighted two major types of assessment i.e., pre-testing and formative evaluation. The former requires that pupils be assessed before they join standard one to determine their ability and understand the kind of support they will need. Assessment in this curriculum was integrated into teaching and learning. Following the 2016 curriculum was the development of a teachers' guide for teaching arithmetic, reading, and writing. Teachers' guide for these three subjects highlights the importance of assessment and evaluation of pupils' progress in teaching and learning (TIE, 2015).

The major assessment strategies noted in the guide were questions and answers, classroom exercises (oral and written), teachers listening to pupil's pronunciations, and teacher observation whereby teachers were required to observe pupils performing arithmetic activities and reading and writing activities (TIE, 2015). The assessment through listening and observation complies with Montessori's, Waldorf's, and Reggio Emilia's educational model's postulates (Aljabreen, 2020). At this juncture, it is worth noting that, teachers' competency in literacy assessment strategies is largely deter-

mined by the quality and quantity of the assessment training they received in teacher-training colleges.

Pre-service teacher training is an avenue for the provision of fundamental knowledge, skills, and competencies in assessment, measurement, and evaluation (DeLuca, Chapman-Chin, et al., 2019). This argument speaks to Tanzanian objectives of pre-service teacher education, as stated by the Tanzania Institute for Education. More specifically, one of the objectives of the primary education teacher certificate course is to allow teachers to construct tests and examinations associated with the primary education curriculum which accommodates the three domains of knowledge (3Rs) (TIE, 2009).

Challenges affecting the assessment landscape

Factors that affect the carrying out of effective assessment strategies include inadequate support provided to teachers by quality assurance officers and school management, teachers' workload, and teachers' commitment to evaluating learners' work (MoEVT, 2013; Ndalichako, 2013). In addition, teachers' workload affects the frequency of assessment and the extent to which teachers provide immediate feedback. Heavy workload contributed to teachers' tendency to rely on tests and annual or end-term examinations as the major ways of assessing learners learning. However, the paper-based assessment may limit teachers on the collective understanding of their class assessment instead of the individual pupil. Therefore, this kind of assessment is contrary to the reviewed models' and theories' highlights on the individual pupil's development through learning and assessment.

The school management was vested with the responsibility of supporting teachers to effectively conduct assessments. This is arguably one of the key responsibilities of head teachers in Tanzanian schools. It has been clearly stated that head tea-

chers were in charge of setting mechanisms for internal evaluation and assessment particularly, by creating school rules and regulations about internal examinations. The aim was to provide resources and supervise preparation for both internal and external examinations (MoEVT, 2013). However, in practice, the lack of resources in schools affected the amount of support provided by the head teachers.

It has been revealed that assignments, quizzes, and tests in schools are not administered regularly as required due to a lack of teachers' commitment to evaluating learners and poor supervision by school heads. Furthermore, it has been noted that learners are given low-quality tests and examinations, which in most cases result in low-order thinking on the side of the learners. This was mainly due to inadequate skills among teachers on how best to set and moderate test and examination questions and low supervision coupled with a lack of mentorship by the head of the school (MoEVT, 2013).

Ineffective teacher training is yet another challenge in the assessment landscape in Tanzania. Teachers who teach early literacy and numeracy are expected to be assessment literate and competent in the use of various assessment strategies as a means to support learners' learning and inform their instruction and pedagogy (DeLuca & Hughes, 2014). However, teachers' competency in literacy assessment strategies is largely determined by the quality and quantity of the assessment training they received while attending teacher-training college. Unfortunately, the literature suggests that teachers are not provided with adequate, contextual relevant assessment training to allow them to adequately handle the assessment activities in the classroom (Klinger et al., 2012).

Limitations and future directions

The quality of research on assessment in science and mathematics of Tanzanian pre-primary and primary education

will be highest if the following limitations are addressed or the respective studies address them in the extant research work: (1) Still there is no correlation between the curriculum implemented in teachers' colleges which is still content-based and that implemented in pre-primary and primary schools which competence-based. The difference between the two curricula can bring discrepancies in the outcome of the assessment; (2) Effective assessment should not only be done to monitor the progress of the teaching and learning process rather should be an integral part of the teaching and learning process; (3) Assessment should be prepared by a reflective process to both teachers and pupils on the teaching and learning process to go beyond informing their performance; (4) Based on the fact that learners plan learning objectives to inform their learning, therefore, the assumption that assessment is always done in the service and regulation of the teachers' goals (Andrade et al., 2021) should be reinterpreted. This is because learners do not always grow as it is envisioned by their teachers.

On the aspect of feedback, a related limitation to be addressed in future research can be, (5) it is vital for feedback to take into account the learners' group and individual learning goals on top of all other aspects of feedback like assessment literacy, self-appraisal, engagement and motivation as well as goal setting and self-regulation (Wisniewski et al., 2020). It is important to understand how feedback relates to learners' individual and group goals to determine whether learning has occurred or not (Andrade et al., 2021). Thus, the quality and characteristics of feedback as the aspect of assessment should also be given the needed attention.

DISCUSSIONS

As noted from literature at the onset of this review, classroom assessment especially in science and mathematics at

the pre-primary and primary levels of education should benefit both teachers and pupils at the same time. It is in this view, therefore, that classroom assessment is sought to be highly considered as a supportive agent of teaching and learning (Andrade & Brookhart, 2020; Deneen et al., 2019). Besides, teacher preparation programs should endeavor to prepare pre-primary and primary teachers; who can incorporate moral and ethical assessment and evaluation trends in the learning process which supports pupils' intellectual development as proposed by constructivists (Saracho, 2023). In addition, the rules and principles of assessment and evaluation that support pupils' creativity are paramount to make the teaching and learning process go hand in hand with today's world of transformations and changes (Al-Mogbel, 2014). Assessment for learning is being considered to involve the practices and approaches that allow teachers to gather evidence about learners' understanding to inform future learning (DeLuca et al., 2012). It is thought out further as a process that involves ongoing initiatives geared towards recognizing and responding to the learners' learning needs for effective learning outcomes (Dann, 2014; Lam, 2016). In light of this view as literature has indicated, assessment for learning involves engaging pupils in their learning by providing rich feedback, using effective questioning, and engaging them in peer and self-assessment (Ghahari & Sedaghat, 2018; Lu & Law, 2012).

Scholars have highlighted numerous reforms that have taken place in the assessment landscape in the world at large and Tanzania in particular. However, despite these reforms, challenges persist in Tanzania regarding how to assess teaching and learning in a meaningful way. For instance, the involvement of proper reinforcements and motivations as an important aspect of assessment and evaluation suggested by behaviorist theory still needs to be reinterpreted (Mooney, 2013). This is because the contingencies that are given as feedback do not enable the learners' development of high-

order thinking and achievement of their stated learning goals (Hattie & Timperley, 2007; Ragupathi & Lee, 2020). Besides, pre-service and in-service training seem to offer the avenue for preparing teachers who are assessment, measurement, and evaluation literate (Tilya, 2013). Yet, for effective assessment strategies to be manifested in our education system, there seems to be a need for conscious investment not only in monetary terms but also in time and political will.

Literature has indicated further that; the impartation of assessment strategies such as sharing success criteria with learners (Brown, 2019) and giving informative feedback helps a learner attain the intended learning outcome (Black & Wiliam, 2009; Cheah & Li, 2020). Moreover, this is in line with Gan et al. (2019) who contended that sharing success criteria and developing good assessment task that calls for higher-order thinking, calls for not only training but also supportive supervision from assessment experts. Similarly, the use of instructional rounds seems to be one of the effective strategies for supporting teachers to attain effective assessment strategies which will in turn support teaching and learning (Deneen et al., 2019). In the Tanzanian context, instructional rounds could be adopted and used during in-service training. For instance, quality assurance officers as they visit schools to offer supportive supervision may use instructional rounds and thus support teachers to become more effective in instruction, assessment, and feedback given.

CONCLUSIONS

In the Tanzania context, we argue that effective assessment strategies are those that can help a teacher to effectively assess large classrooms. For instance, strategies such as peer assessment and self-assessment should be encouraged in schools, especially in large classrooms. Nonetheless, for such strategies to be effective teachers must share success criteria and learning

expectations with learners regardless of their age. It is argued further that assessment strategies need to be context-specific and strictly consider both the individual learner and group learning goals. Without disputing the importance of policies and even the significance of summative assessments in shaping teaching and learning, we also argue that assessment strategies and initiatives that take place daily in classrooms should be accorded the attention they require. In due respect, effective assessment strategies help to mold independent and responsible learners; thus, effective assessment strategies are crucial in each educational level, from pre-primary where the foundation for future learning is built.

REFERENCES

- Aljabreen, H. (2020). Montessori, Waldorf, and Reggio Emilia: A comparative analysis of alternative models of early childhood education. *International Journal of Early Childhood*. 52(3), 337–353. <https://doi.org/10.1007/s13158-020-00277-1>
- Al-Mogbel, A. N. (2014). A proposal for the development of pre-primary education in Saudi Arabia based on the experiences of Malaysia and South Korea. *Creative Education*. 5(24), 2071–2089. <https://doi.org/10.4236/ce.2014.524231>
- Andrade, H. L. (2019). A critical review of research on student self-assessment. *Frontiers in Education*. 4, 87. <https://doi.org/10.3389/feduc.2019.00087>
- Andrade, H. L., & Brookhart, S. M. (2020). Classroom assessment as the co-regulation of learning. *Assessment in Education: Principles, Policy & Practice*. 27(4), 350–372. <https://doi.org/10.1080/0969594X.2019.1571992>
- Andrade, H. L., Brookhart, S. M., & Yu, E. C. (2021). Classroom assessment as co-regulated learning: A systematic review. *Frontiers in Education*. 6, 751168. <https://doi.org/10.3389/feduc.2021.751168>
- Arumugam, L. M. P., Kaur, C. S. S., Safinas Raja Harun, R. N., & Masa Singh, T. S. (2018). The implementation of higher order thinking

- skills for teaching and learning. *The Journal of Social Sciences Research*, 5, 668–675. <https://doi.org/10.32861/jssr.spi5.668.675>
- Attfield, K. (2022). The young child’s journey of ‘the will’: A synthesis of child-centered and inclusive principles in international Waldorf early childhood education. *Journal of Early Childhood Research*. 20(2), 159–171. <https://doi.org/10.1177/1476718X211051184>
- Birenbaum, M., DeLuca, C., Earl, L., Heritage, M., Klenowski, V., Looney, A., Smith, K., Timperley, H., Volante, L., & Wyatt-Smith, C. (2015). International trends in the implementation of assessment for learning: Implications for policy and practice. *Policy Futures in Education*. 13(1), 117–140. <https://doi.org/10.1177/1478210314566733>
- Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*. 21(1), 5–31. <https://doi.org/10.1007/s11092-008-9068-5>
- Brown, G. T. L. (2019). Is assessment for learning really assessment? *Frontiers in Education*. 4, 64. <https://doi.org/10.3389/feduc.2019.00064>
- Chadwell, M. R., Roberts, A. M., & Daro, A. M. (2020). Ready to teach all children? Unpacking early childhood educators’ feelings of preparedness for working with children with disabilities. *Early Education and Development*. 31(1), 100–112. <https://doi.org/10.1080/10409289.2019.1621584>
- Cheah, S., & Li, S. (2020). The effect of structured feedback on performance: The role of attitude and perceived usefulness. *Sustainability*. 12(5), 2101. <https://doi.org/10.3390/su12052101>
- Dann, R. (2014). Assessment as learning: Blurring the boundaries of assessment and learning for theory, policy and practice. *Assessment in Education: Principles, Policy & Practice*. 21(2), 149–166. <https://doi.org/10.1080/0969594X.2014.898128>
- DeLuca, C., Chapman-Chin, A., & Klinger, D. A. (2019). Toward a teacher professional learning continuum in assessment for learning. *Educational Assessment*. 24(4), 267–285. <https://doi.org/10.1080/10627197.2019.1670056>
- DeLuca, C., Coombs, A., MacGregor, S., & Rasooli, A. (2019). Toward a differential and situated view of assessment literacy: Studying

- teachers' responses to classroom assessment scenarios. *Frontiers in Education*. 4, 94. <https://doi.org/10.3389/feduc.2019.00094>
- DeLuca, C., & Hughes, S. (2014). Assessment in early primary education: An empirical study of five school contexts. *Journal of Research in Childhood Education*. 28(4), 441–460. <https://doi.org/10.1080/02568543.2014.944722>
- DeLuca, C., Luu, K., Sun, Y., & Klinger, D. A. (2012). Assessment for learning in the classroom: Barriers to implementation and possibilities for teacher professional learning. *Assessment Matters*. 4, 5–29. <https://doi.org/10.18296/am.0104>
- Deneen, C. C., Fulmer, G. W., Brown, G. T. L., Tan, K., Leong, W. S., & Tay, H. Y. (2019). Value, practice and proficiency: Teachers' complex relationship with assessment for learning. *Teaching and Teacher Education*. 80, 39–47. <https://doi.org/10.1016/j.tate.2018.12.022>
- Dodd-Nufrio, A. T. (2011). Reggio Emilia, Maria Montessori, and John Dewey: Dispelling teachers' misconceptions and understanding theoretical foundations. *Early Childhood Education Journal*. 39(4), 235–237. <https://doi.org/10.1007/s10643-011-0451-3>
- Eka Putra, R. & Iswantir (2021). The analysis of implementation of Higher Order Thinking Skills (HOTS) with Problem Based Learning (PBL). *Journal of Physics: Conference Series*. 1779(1), 012037. <https://doi.org/10.1088/1742-6596/1779/1/012037>
- Fani, T., & Ghaemi, F. (2011). Implications of Vygotsky's zone of proximal development (ZPD) in teacher education: ZPTD and self-scaffolding. *Procedia-Social and Behavioral Sciences*. 29, 1549–1554.
- Fukuda, S. T., Lander, B. W., & Pope, C. J. (2022). Formative assessment for learning how to learn: Exploring university student learning experiences. *RELC Journal*. 53(1), 118–133. <https://doi.org/10.1177/0033688220925927>
- Gan, Z., He, J., & Liu, F. (2019). Understanding classroom assessment practices and learning motivation in secondary EFL students. *The Journal of AsiaTEFL*. 16(3), 783–800. <https://doi.org/10.18823/asiatefl.2019.16.3.2.783>
- Ghahari, S., & Sedaghat, M. (2018). Optimal feedback structure and interactional pattern in formative peer practices: Students'

- beliefs. *System*. 74, 9–20.
<https://doi.org/10.1016/j.system.2018.02.003>
- Greenfield, D. B. (2015). Assessment in early childhood science education. In K. Cabe Trundle & M. Saçkes (Eds.), *Research in early childhood science education* (pp. 353–380).
https://doi.org/10.1007/978-94-017-9505-0_16
- Harrison, C. (2013). Collaborative action research as a tool for generating formative feedback on teachers' classroom assessment practice: The KREST project. *Teachers and Teaching*. 19(2), 202–213. <https://doi.org/10.1080/13540602.2013.741839>
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*. 77(1), 81–112.
<https://doi.org/10.3102/003465430298487>
- Heitink, M. C., Van der Kleij, F. M., Veldkamp, B. P., Schildkamp, K., & Kippers, W. B. (2016). A systematic review of prerequisites for implementing assessment for learning in classroom practice. *Educational Research Review*. 17, 50–62.
<https://doi.org/10.1016/j.edurev.2015.12.002>
- Klinger, D., DeLuca, C., & Chapman, A. (2016). Implementing assessment for learning: A continuum for teacher professional learning. *Annual Conference of the American Educational Research Association*.
- Klinger, D., Volante, L., & DeLuca, C. (2012). Building teacher capacity within the evolving assessment culture in Canadian education. *Policy Futures in Education: Developing Sustainable Assessment Cultures in School Learning Organisations*. 10, 447–460.
- L Atli, S., Korkmaz, A. M., Tastepe, T., & Koksall Akyol, A. (2016). Views on Montessori approach by teachers serving at schools applying the Montessori approach. *Eurasian Journal of Educational Research*. 16(66), 1–30.
<https://doi.org/10.14689/ejer.2016.66.7>
- Lam, R. (2016). Assessment as learning: Examining a cycle of teaching, learning, and assessment of writing in the portfolio-based classroom. *Studies in Higher Education*. 41(11), 1900–1917.
<https://doi.org/10.1080/03075079.2014.999317>

- Lu, J., & Law, N. (2012). Online peer assessment: Effects of cognitive and affective feedback. *Instructional Science*. 40(2), 257–275. <https://doi.org/10.1007/s11251-011-9177-2>
- MoEVT. (2013). *School improvement toolkit practical guide for head teachers and heads of school*. MoEVT.
- MoEVT. (2015). *Curriculum for primary school standard one and two*. MOEVT, Dar es Salaam, Tanzania.
- Mooney, C. G. (2013). *Theories of childhood: An introduction to Dewey, Montessori, Erikson, Piaget, and Vygotsky* (2nd ed.). Redleaf Press.
- Moss, P. (2016). Loris Malaguzzi and the schools of Reggio Emilia: Provocation and hope for a renewed public education. *Improving Schools*. 19(2), 167–176. <https://doi.org/10.1177/1365480216651521>
- Ndalichako, J. (2013). *Examining classroom assessment practices of secondary school teachers in Tanzania*. http://www.iaea.info/documents/paper_226dc3fd1.pdf
- Nishizuka, K. (2022). From assessment for learning to assessment for expansion: Proposing a new paradigm of assessment as a sociocultural practice. *Journal of Teaching and Learning*. 16(3), 44–68. <https://doi.org/10.22329/jtl.v16i3.6976>
- Ragupathi, K., & Lee, A. (2020). Beyond fairness and consistency in grading: The role of rubrics in higher education. In C. S. Sanger & N. W. Gleason (Eds.). *Diversity and inclusion in global higher education* (pp. 73–95). https://doi.org/10.1007/978-981-15-1628-3_3
- Saracho, O. N. (2023). Theories of child development and their impact on early childhood education and care. *Early Childhood Education Journal*. 51(1), 15–30. <https://doi.org/10.1007/s10643-021-01271-5>
- Schulz, H., & FitzPatrick, B. (2016). Teachers' understandings of critical and higher order thinking and what this means for their teaching and assessments. *Alberta Journal of Educational Research*, 62(1), 61–86.
- TIE. (2009). *Curriculum for certificate in teacher education programmes in Tanzania*. MoeVT, Dar es salaam, Tanzania.

- TIE. (2015). *Teachers guide for teaching mathematics for standard one and two*, Dar es salaam Tanzania.
- Tilya, F. (2013). *Educational Assessment: Are we doing the right thing*. <http://www.tenmet.org/Droop/Docs/COP%202013/Tilya.pdf>
- Timms, M., DeVelle, S., & Lay, D. (2016). Towards a model of how learners process feedback: A deeper look at learning. *Australian Journal of Education*. 60(2), 128–145.
- URT, U. R. of T. (1995). *Education and training policy*. United Republic Publishing Press.
- URT, U. R. of T. (2014). *The united republic of Tanzania; ministry of education and culture: Education and training policy*.
- Van den Broeck, A., Ferris, D. L., Chang, C.-H., & Rosen, C. C. (2016). A review of self-determination theory's basic psychological needs at work. *Journal of Management*. 42(5), 1195–1229. <https://doi.org/10.1177/0149206316632058>
- Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: A meta-analysis of educational feedback research. *Frontiers in Psychology*. 10, 3087. <https://doi.org/10.3389/fpsyg.2019.03087>
- 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. <https://doi.org/10.1080/0969594X.2021.1884042>

APPENDICES

Table 1

Popular theories and models supporting assessment in pre- and primary science and mathematics education

Theory and Theorist	Literature	Philosophy	Application in assessment
Montessori educational model by Mara Montessori in 1907–1950s	Aljabreen, 2020; L. Atli et al., 2016	Pupils develop and adapt to the physical conditions of the environment and social requirements of their age group.	Assessment is based on non-traditional teacher presence where teachers listen to pupils' responses as they develop physical and mental skills in using learning materials
Waldorf Education model by Rudolf Steiner in 1861–1925	Aljabreen, 2020; Attfield, 2022; Chadwell et al., 2020	Pupils develop naturally if they have the opportunity to explore their environment (Head-Heart-Hands philosophy or thinking, willing, and feeling).	Assessment focus on individual pupils in a particular period then teachers meet to formulate a helping question for that particular pupil i.e., not paper-based but physically, orally and play-based.
Reggio Emilia educational model by Loris Malaguzzi in 1920–1994	Aljabreen, 2020; Dodd-Nufrio, 2011; Moss, 2016	Establishes a context through which the creativity and curiosity of the pupils are listened to and accepted i.e., creates a joyful and playful classroom atmosphere.	Assessment is based on non-traditional assessment whereas a teacher listens to learners' responses as they develop physical and mental skills in using learning materials
Maturation theory by G. Stanley Hall (1846–1924) and Arnold Lucius Gesell (1880–1961)	Fani & Ghaemi, 2011; Mooney, 2013; Saracho, 2023	Pupils' development is the unfolding of genetically determined traits i.e., Education should be channeled through pupil development, Readiness and appropriate practices	Assessment should focus on the enhancement of individual pupil's genetic maturity

Constructivist theory by Lev Semenovich Vygotsky (1896–1934), Jean Piaget (1896–1980) and Jerome Bruner (1915–2016)	Fani & Ghaemi, 2011; Mooney, 2013; Saracho, 2023	Pupils energetically construct their knowledge based on their experience. This knowledge facilitates their interpretation of their view of the outside world	The assessment focuses on Intellectual development, literacy and Language development
Behaviorist theory by Ivan Pavlov (1849–1936), Edward Lee Thorndike (1874–1949), John B. Watson (1878–1959) B. F. Skinner (1904–1990) and Sidney William Bijou (1908–2009)	Fani & Ghaemi, 2011; Mooney, 2013; Saracho, 2023	Learning involves a modification in behavior as a result of attaining reinforcement	Effective assessment should involve reinforcement and motivation
