Transforming Formative Assessment in a Construction Roadworks Short Learning Programme: A Reflective Case Study

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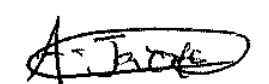
UNIVERSITY OF THE FREE STATE  
October 2023

Declaration

I, Asavela Jack declare that the treatise entitled **Transforming Formative Assessment in a Construction Roadworks Short Learning Programme: A Reflective Case Study**, submitted for the qualification of PGDip in Higher Education (HE) at the University of the Free State is my own independent work.

All the references that I have used have been indicated and acknowledged by means of complete references.

A Turnitin Report on the work produced is included in Annexure B

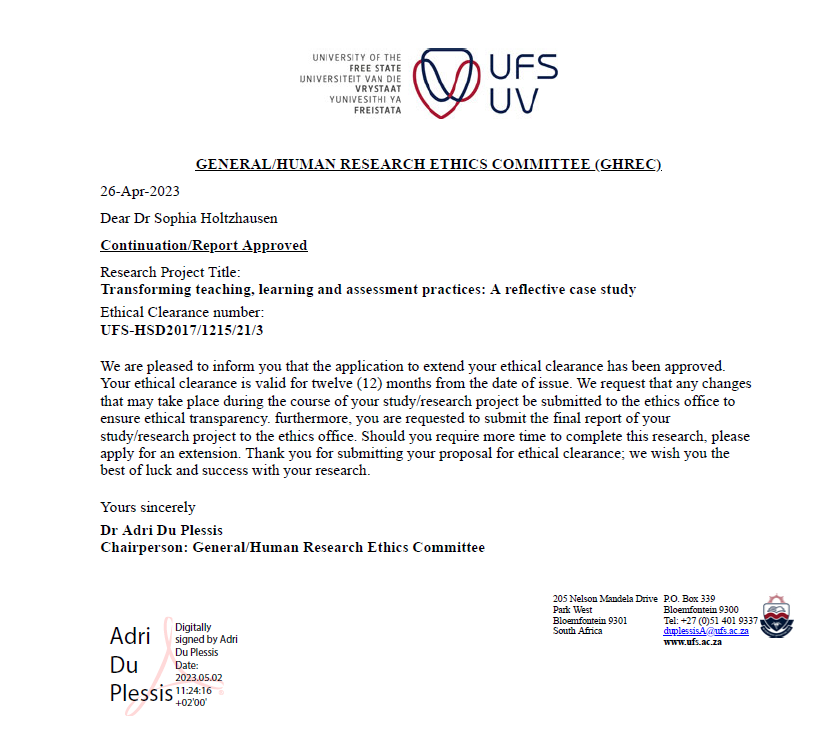


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Ethics Statement



Abstract

The link between assessment difficulty, Bloom's Taxonomy, and SAQA formative assessment criteria has been a significantly under-researched issue in South Africa. 15 formative evaluations from the Construction Roadworks SLP were used in this study. The attempt is to determine the degree of alignment between Bloom's taxonomy and SAQA level formative tests.

There is a discrepancy between the cognitive levels emphasized in the SAQA level descriptors and the cognitive levels emphasized in the formative assessments for construction roadworks. When comparing SAQA level descriptors with Blooms taxonomy, it is clear that cognitive level " Apply" dominates other cognitive levels. However, cognitive level "understand" predominates when compared to Bloom's taxonomy and formative assessments for construction roadworks SLP.

In a nutshell, there is no formal national policy guiding higher education institutions (HEIs) on how to apply Bloom's taxonomy or any other taxonomy to assess students at the appropriate National Qualifications Framework (NQF) level. As a result, our findings imply that a national assessment policy framework is required to guide HEIs on how to assess undergraduate students at different cognitive levels as mandated by the NQF. Also, alignment between SAQA and Bloom's Taxonomy, together with effective examiner training, can lead to more accurate and valid assessments that meet South African educational and regulatory criteria.

**Keywords**

Construction roadworks SLP; Blooms taxonomy; Formative assessments; SAQA;

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List of Acronyms

1. SLP- Short Learning Programme
2. SAQA- South African Qualification Authority
3. HE- Higher Education
4. HEI- Higher Education Institutions
5. NQF- National Qualification Framework

## Introduction

The practice of assessments in education has evolved and adapted alongside instructional pedagogies over time (Jayne, 2015). Since assessments are made to monitor student learning and give feedback on how well education is working, there is a connection between assessments and instructional approaches. Education exams in the past frequently emphasised rote memorization and material recall. However, as instructional pedagogies shifted towards more student-centered and active learning approaches, assessments also underwent significant changes. Examining higher-order thinking capabilities, problem-solving aptitudes, critical thinking, and creativity took precedence over merely testing information memory.

In higher education (HE), assessments serve a variety of functions. It promotes student learning, ensures that students are ready to satisfy the program's learning objectives (Irons & Brown, 2022). However, assessments are intricate, multifaceted, and heavily impacted by the environment in which they occur (Sambell et al., 2013). Formative assessment, commonly referred to as assessment for learning, is a generally accepted strategy for raising academic standards. The relationship between assessment practises and learning in higher education is significantly influenced by formative assessment. Numerous studies have shown its positive impact on student learning and achievement (Frunza, 2013).

Among the key benefits of formative assessment is its role as a facilitator of learning. By collecting data on students' progress and understanding, teachers can recognize areas of strong point and fault, tailor their instruction to meet individual needs, and provide targeted feedback to guide students' learning. This process allows teachers to make timely adjustments to their instructional tactics and provide additional support or challenges as necessary.

Formative assessment is not a new concept; in fact, it was initially described as "the continuous improvement of the curriculum" by Michael Scriven in 1967. Harold Bloom tied this to assessments provided in the classroom in 1969. The concept of formative evaluation, as mentioned by Bloom and Scriven, encompasses different perspectives regarding its usage and purpose in the educational context.

According to Bloom, formative evaluation refers to brief tests or assessments employed by educators and pupils as tools to aid the education process. These valuations are designed to afford ongoing feedback on students' improvement and understanding, enabling teachers to make informed instructional decisions and adjustments. By separating formative evaluation from the grading process, Bloom suggests that it can be more effectively utilized to enhance teaching and learning rather than solely focusing on assigning grades (Bloom, 1969). In this context, formative evaluation serves as a tool for teachers and students to recognize areas of strong point and fault, guide instruction, and provide feedback that promotes learning.

Scriven expanded the concept of formative evaluation to encompass program evaluation. In this broader sense, formative evaluation refers to the assessment of an educational program's effectiveness, implementation, and improvement (Scriven, 1967). Scriven's perspective suggests that formative evaluation can be used to guide program development and refine instructional strategies based on the feedback and data collected throughout the evaluation process.

It's vital to note that both Bloom and Scriven's interpretations of formative evaluation are valid within their respective contexts. Bloom focuses on the evaluation of individual students within the learning process, while Scriven broadens the scope to include the evaluation of educational programs. The study referenced, conducted by Meirav in 2013, explores these different perspectives and distinctions in the usage of formative evaluation. The research may highlight the benefits of separating formative evaluation from grading and emphasize its role as a instrument for improving teaching and education. Additionally, it might discuss Scriven's perspective on formative evaluation as applied to program evaluation and its impact on educational practices.

Overall, the concept of formative evaluation encompasses various approaches, including its usage as a tool for student assessment and feedback, as well to evaluate and improve educational programs. The specific context and purpose of formative evaluation may vary depending on the perspective adopted by researchers, educators, or practitioners in the field of education.

Rawlusyk (2018), claim that rather than emphasizing the promotion of learning itself, the prevalent rhetoric around assessment in higher education concentrates on "measuring" learning. Formative assessment is how, practically, we switch the emphasis from teaching to learning. This change is not always simple to implement since there are several things that might prevent formative practices from happening (Irons & Brown, 2022). According to the theory of assessment, an effective assessment technique may influence learning in addition to serving as a tool to signify accomplishment or results attained. In fact, formative learning and teaching exchanges exist between instructors and students in higher education (as well as between students) (Irons & Brown, 2022). According to certain study, formative evaluation has a favorable effect on students' learning results (Weurlandera et. al., 2011).

When it comes to teaching construction engineering, it is crucial for facilitators to employ appropriate assessment methodologies that align with their own and their students' responsibilities. To achieve this, facilitators need to consider the context in which construction engineering activities and assessments are presented, aiming to mirror real-world workplace experiences for students.

## Background

As a facilitator, I support the learner-centered approach, which is a teaching strategy that is being promoted in education more and more. This method's advantage is that it promotes several different sorts of approaches relatively than just one, altering the role of teachers from information benefactors to facilitators of pupil learning (Darsih, 2018). Teachers tell less this way, and students learn more as a result. In the learner-centered tactic, the part of the educator or lecturer is to strategy the course so that it fosters an environment for optimal learning, to serve as an example of acceptable student behavior, to inspire scholars to learnfrom each other, and to give additional feedback through the course. As a result, learning environments that are prepared and tailored for different learning styles have a direct impact on the learners' success and skills. However, it is first required to identify the learners' learning styles in order to build and prepare a space that is appropriate for their preferred learning style (Burak et al., 2021).

Construction engineering courses should attempt to deliver students with authentic education experiences that reflect the challenges and expectations they will encounter in the workplace. This includes designing assessments that simulate real-world scenarios, tasks, and problem-solving situations commonly encountered in construction engineering practice (Marcus et al, 2004).

Practical skills assessment: Construction engineering is a hands-on field that requires practical skills and application of theoretical knowledge. Professors should incorporate assessments that evaluate students' ability to apply concepts, perform technical tasks, and demonstrate competency in essential construction engineering skills (Slaÿana, 2016). This could involve practical exercises, lab work, design projects, or case studies that emulate real-world construction projects.

Construction projects often involve multidisciplinary teams, emphasizing the importance of effective collaboration and communication skills. Assessments should include opportunities for students to work in teams, showcasing their ability to collaborate, coordinate tasks, and contribute to group projects (Diane, 2011). Peer evaluations and group assessments can be valuable tools to assess teamwork skills.

Construction engineering professionals encounter complex problems that require analytical thinking, problem-solving abilities, and critical decision-making skills. Assessments should focus on evaluating students' capacity to analyze and solve construction-related problems, make informed judgments, and propose innovative solutions. (Pham et al, 2019) This can be achieved through assignments, case studies, simulations, or project-based assessments.

By adopting appropriate assessment methodologies that mirror the workplace context, professors in construction engineering education can enhance students' learning experiences and better prepare them for future careers. These assessments should evaluate practical skills, teamwork, problem-solving abilities, and critical thinking, while also providing opportunities for continuous feedback and self-reflection.

Traditional assessment systems often prioritize the measurement of rote memorization and recall of facts, typically through multiple-choice tests (Biggs, 2003). These tests are useful for measuring specific elements of learning, but they might not accurately reflect a student's capacity for complex reasoning and problem-solving. According to Thomas and Thorne (2009), higher order thinking skills (HOTS) are cognitive processes that go beyond the basic memory or reproduction of information. These skills involve the application, analysis, evaluation, and creation of knowledge. While all students have the capacity to think, it is essential to afford them with the essential provision, instruction, and encouragement to develop and enhance their higher order thinking abilities.

Higher order thinking skills, such as critical thinking, analysis, synthesis, and evaluation, are better assessed through performance-based assessments that need students to apply their knowledge in real-world settings (Oser & Biedermann, 2020). These assessments can include tasks like research projects, case studies, essays, presentations, simulations, or hands-on experiments.

As societies and industries evolve, graduates are expected to possess not only a solid foundation of knowledge and skills acquired through education but also the capacity to apply that knowledge in innovative and adaptable ways. The rapid pace of technological advancements, globalization, and the complexity of modern challenges require individuals to think critically, analyze situations, and derive up with creative and effective resolutions (Pellegrino & Hilton, 2012). The traditional approach of relying solely on memorized information and following established procedures may not be sufficient to address the diverse and dynamic problems graduates will encounter.

The impact of the built environment skills shortages in South Africa is recognized as a significant institutional challenge. The demand for construction management professionals and skilled workers in the built environment has increased substantially, leading to a shortage of qualified individuals in both the private and public sectors (Pathegama, 2017). Since more preparation and experience are demanded of graduates, educators must modify their methods of instruction and evaluation.

For students to apply the module outcomes through assessment they need to first understand the learning outcomes through activities and teaching practices. It is essential for pupils to have a clear understanding of the intentional education outcomes and engage in relevant activities and teaching practices before they can successfully apply their knowledge and abilities in assessments. The goal is to enhance the alignment between learning outcomes, teaching methods, and assessments, ultimately promoting a more comprehensive and effective learning experience for students in the field of construction roadworks.

Constructive alignment (CA) is grounded on the principle that Teaching and Learning Activities (TLA) and Assessment Tasks (AT) should align with the identified Intended Learning Outcomes (ILO) (Maffei, 2022). This alignment ensures that the learning activities and assessments are directly connected to the desired outcomes, promoting a coherent and purposeful learning experience for students.

One key aspect of achieving alignment is the use of action verbs. The exact acts or behaviours that students should be able to exhibit to show that they have mastered the desired learning outcomes are described by action verbs (Stanny & Claudia, 2016). These verbs are often associated with Bloom's Taxonomy and the different levels of cognitive processes.Top of Form

## Problem statement

Higher Education (HE) assessment system continues to be dominated by summative exams and written assignments. The majority institutional schooling, education, and assessment methods urge for growing diversity in assessment techniques (Medland, 2016). There has been an increase in formative assessment systems over the past 10 to 15 years, however there are many various types and forms, and they do not necessarily agree on the set of behaviors required to fulfill formative aims (Wylie & Lyon, 2012). Recognition of the potential function of formative assessment in education has grown recently (Scully, 2017) due to its capacity to inform instructors of the successes and areas for improvement in learning, including evaluations of student growth (Eka & Wayan, 2018).

The two main evaluation methods utilised in schools are formative and summative, and both are crucial to our educational system. There is a need to see a change in favor of further developing efficient formative assessment techniques in the teaching space (Jayne, 2015). Tasks for formative assessment must be prepared methodically to ensure that the learning promoted feeds forward to pertinent tasks and difficulties (Irons & Brown, 2022). A good strategy to influence student learning is to alter the evaluation process.

We frequently think that kids who perform poorly on tests don't grasp the material, but they may actually be having trouble with certain cognitive abilities or the format of the questions. Teachers are forced to gauge their students' aptitude. To do this accurately, a taxonomy of stages of intellectual behaviour crucial to learning is required. Bloom's Taxonomy gave us a way to measure our thinking. According to Mohamed & Lebar (2017), the concept of thinking skills is the act of using the intellect to make judgements and resolve issues. In terms of the capacity to think conceptually, Bloom's taxonomy has traditionally served as a guide (Eka & Wayan, 2018).

When assessments focus on application and comprehension instead of just basic information (recalling facts), students will learn more profoundly. Assessments that just access fundamental knowledge (recalling facts) will only support moderate growth (Weurlandera et. al., 2012). Assessing pupils' high order thinking abilities helps improve their cognitive abilities (Barak & Dori, 2009). Pupils with higher order thinking skills (HOTS) are more likely to excel in the classroom than those with lower order thinking skills (LOTS) (Eka & Wayan, 2018). As a result, assessment that is also HOTS-focused must be used to access student engagement in HOTS-based learning and high-level thinking. To put it another way, instruction that aims to support and stimulate students' HOTS should be followed by an evaluation that can access HOT. As a result, formative evaluation will serve as a "compass" to direct pupils toward improved learning and academic success (Hwang & Chang, 2011)

## Research questions

This research will be steered by the following central research question:

(1) What is the distribution of formative assessment question levels within bloom’s taxonomy, per unit, for the Construction Roadworks short learning programme (SLP)?

(2) How does this question level (Bloom’s taxonomy) distribution compare to those reflected in the SAQA level 3 outcomes?

(3) How should formative assessments for this module be changed in the future to better align with the SAQA framework regarding the required cognitive level targets?

## Aim of the study

The purpose of this study is to find out the extent to which Construction Roadworks SLP formative assessments assesses students’ thinking skills/ cognitive level by using Blooms taxonomy against the SAQA exit level outcomes with the intent to enhance formative assessments for Construction Roadworks.

This will be achieved with the following objectives:

(1) Determine the formative assessment question levels within bloom’s taxonomy, per unit, for the Construction Roadworks short learning programme?

(2) Evaluate question level (Bloom’s taxonomy) distribution in comparison with SAQA level 3 outcomes.

(3) Provide guidance on how formative assessments for this module be changed in the future to better align with the SAQA framework regarding the required cognitive level targets

# Review of the literature

## Introduction

This chapter focuses on the literature surrounding the primary ideas derived from the study's objectives. The study's goal is to determine how much the formative assessments used in the Construction Roadworks Short Learning Programme (Skills Development Programme) evaluate students' thinking abilities at various cognitive levels and how this relates to the SAQA requirements for this programme. In order to analyse the assessments in respect to the exit level outcomes set by the South African Qualifications Authority (SAQA), this research will employ Bloom's taxonomy as a framework. The sections that follow provide a thorough examination of formative assessment, Blooms taxonomy, SAQA exit level outcomes, and the Short Learning Programme (SLP) for Construction Roadworks.

## Formative Assessment

### What is formative assessment?

Formative assessment is a procedure that happens in the classroom and involves gathering proof of learning to comprehend current learning progress and make necessary changes to teaching or learning, according to a commonly accepted definition (Wylie & Lyon, 2012 P1). Understanding learning progress and making necessary adjustments to teaching or learning is important, as it reflects the idea that formative assessment is not just a one-time event, but rather an ongoing process that occurs throughout the learning experience (OECD, 2008). Additionally, helping students understand their level of learning and the standards and objectives they are working towards is essential for promoting student engagement and motivation, as well as for guiding their ongoing learning efforts (Sherry, 2011).

### What’s the value and purpose of formative assessment?

In terms of what it aims to accomplish, formative assessment differs from summative evaluation. According to Brookhart (2013), formative assessment is focused on shaping learning and improving teaching by providing students with frequent and constructive feedback that helps students to recognize areas for development and adjust their learning accordingly. The goal is to support ongoing learning and improvement throughout the learning process.

By informing and adjusting the pace of instruction in accordance with the data amassed during the assessment process, formative assessment enhances teaching and learning (Meirav, 2013). In order to improve learning and formative evaluation, feedback is consequently crucial (Hattie, 2012). Creating methods to evaluate students' knowledge, abilities, and competences has become crucial to institutional success in higher education institutions all over the world. The government of South Africa has advised higher education institutions to use a number of effective strategies to increase students' knowledge and abilities (Du Plessis et al., 2022).

### Effective ways of implementing formative assessment

According to Wiliam and Thompson's 2007 research, formative assessment can be thought of as containing five essential procedures. As a means of conducting productive class discussions and other learning tasks that elicit evidence of student knowledge, one of the ways includes the use of classroom questioning (Cusi et al, 2017). In addition, group work, peer evaluation, self-evaluation, and the use of formative assessment tools like checklists or rubrics are possible. According to Paul Black and Dylan Wiliam (2009), the secret to implementing effective formative assessment is to employ a variety of strategies and approaches that enable the gathering of detailed and insightful evidence of student understanding and that foster continuous learning and improvement for all students.

### Teacher assessment

Effective assessment practices by teachers are critical in improving student learning. It is important for teachers to have clear aims for their instruction and to design learning activities that support those aims. Assessment can then be used to gather evidence of student understanding and progress towards those aims, and to adjust instruction as needed to support ongoing learning and improvement (Paul Black & Dylan William, 2009).Overall, effective assessment practices require a collaborative approach between teachers and students, with a focus on using assessment as a tool for supporting ongoing education and improvement.

### Student Involvement

Since both the learner and the teacher are accountable for the learning process, it is each party's responsibility to take all reasonable steps to lessen the effects of the failings of the other. According to Hidi and Harackiewicz (2000), empowering students to take ownership of their education is a potent educational strategy that fosters metacognition, motivation, curiosity, attribution, and self-evaluations. Activities such as peer and self-assessment can be utilised to encourage students to use one another as educational resources and to take ownership of their own learning.

As they encourage students to reflect on their own work and the work of others and to offer helpful criticism, self- and peer-assessment are good techniques for developing these abilities (Hidi and Harackiewicz 2000). Students can actively participate in their own learning and gain a greater grasp of the learning objectives and achievement criteria through self- and peer-assessment.

## Blooms Taxonomy

### Background

According to Lord and Baviskar (2007), the Bloom's taxonomy is a hierarchical classification system for cognitive abilities and educational goals. It was created in the 1950s, soon after World War II, by a team of educators under the direction of Benjamin Bloom. Bloom's Taxonomy is one of the most widely used and frequently quoted references in education, despite receiving little attention when it was initially published and having been translated into 22 languages (Forehand, 2005). The most recent revision of the taxonomy, which was released in 2001, has undergone a few revisions but is still in widespread use today (Anderson et al., 2001). Figure 1 below depicts Bloom's taxonomy in its updated form.

Figure 1 Revised version of Blooms taxonomy (2001)

The primary motivation behind the development of Bloom's taxonomy was to provide a systematic approach to educational objectives and assessment (Forehand, 2010). Benjamin Bloom and his colleagues recognized the need for a clear and organized way to define and measure learning outcomes across different subject areas and grade levels. Their taxonomy intended to categorise various levels of cognitive abilities, from lower-order to higher-order abilities.

After World War II, education became increasingly important, and its significance for both social and economic advancement was acknowledged (Johan & Edward, 2018). The importance of information and abilities in the growth of science and technology was brought home by the conflict. The need for a workforce with education and the ability to handle the complex difficulties of the modern world increased as civilizations industrialised (Klein, 2013). As governments and educational institutions increased their investments in education, formal schooling systems grew in size and standardised approaches to curriculum and assessment became necessary.

In this context, Bloom's taxonomy provided a valuable tool for educators and curriculum developers (Sobral, 2021). Blooms taxonomy offered a way to articulate clear learning objectives and design instructional activities that targeted specific cognitive skills. The taxonomy also informed the development of assessment methods that could measure the extent to which students had achieved these objectives.

While Bloom's taxonomy reflects the increasing importance of education in industrialized societies, it is more directly associated with the need for a systematic approach to curriculum design and assessment (Thompson et al, 2008). Its influence extends beyond formal education and has been widely adopted in various fields, including training, professional development, and instructional design, as a framework for organizing and evaluating learning outcomes.

Students indeed need higher-order thinking skills (HOTS) to effectively navigate and adjust to a changing environment. In today's rapidly evolving world, simply acquiring and memorizing information is no longer adequate. Students must develop critical intellectual, problem-solving, analysis, synthesis, and evaluation skills to make sense of complex situations, apply knowledge in novel ways, and innovate (Hadzhikoleva, Hadzhikolev, & Kasakliev, 2019).

Explicitly evaluating questions is an important aspect of assessing whether students are developing higher-order thinking skills (David, 2002). When teachers pose questions, they can structure them in a way that requires students to analyze information, think critically, and synthesize ideas. These types of questions typically go beyond simple recall or factual knowledge and prompt students to apply their understanding, evaluate evidence, and generate creative solutions.

Explicitly evaluating questions also helps teachers provide constructive feedback to students, identify areas where further development is needed, and guide instructional decisions (Shepard et al, 2018). It enables educators to assess the effectiveness of their teaching methods in promoting higher-order thinking and adjust their strategies accordingly.

### Cognitive levels

In fact, Bloom's taxonomy's classification of query cognitive levels serves as a foundation for assessing if the right levels are being covered in educational contexts. According to Gulistan et al. (2018), Bloom's taxonomy is divided into six hierarchical categories, from lower-order thinking skills to higher-order thinking skills. Knowledge, comprehension, application, analysis, synthesis, and evaluation are all included at these levels. Higher-order thinking skills are at the top of Bloom's taxonomy's hierarchy of cognitive abilities, while lower-order thinking skills are at the bottom.

***Higher-Order Thinking Skills***

As this level entails integrating components or concepts to produce something new, synthesis is recognised as HOTS (David, 2002). It entails having the capacity to develop theories, design fixes, or produce creative works. Making judgements, assessments, or conclusions based on criteria and data constitutes evaluation as one of the HOTS. With analysis, it is necessary to dissect intricate thoughts or concepts into more manageable components in order to discover patterns and linkages (Hadzhikoleva, Hadzhikolev, & Kasakliev, 2019). It entails finding patterns, drawing conclusions, and organising data. Last but not least, application entails employing newly acquired information and concepts to resolve issues or apply them in novel circumstances. It necessitates the capacity to apply knowledge or ideas in practical or real-world settings.

**Lower-Order Thinking Skills**

Comprehension involves understanding and interpreting information. It includes the ability to summarize, explain, or paraphrase ideas. WhileKnowledge represents the lowest level of cognitive skill in Bloom's taxonomy. It involves recalling or remembering factual information, concepts, or terms (David, 2002).

### Value of Bloom’s taxonomy in formative assessment

By analyzing assessment data using Blooms taxonomy, teachers can identify gaps in understanding, misconceptions, or areas of student difficulty (Tanujaya & Mumu, 2020). This information informs instructional planning, allowing teachers to address students' specific needs and modify teaching strategies to enhance learning outcomes. Bloom's taxonomy offers a systematic and comprehensive framework for designing and implementing formative assessments. It promotes clear learning objectives, appropriate assessment tasks, meaningful feedback, higher-order thinking, informed instructional decisions, and tracking of student progress (Sobral, 2021). By leveraging Bloom's taxonomy, formative assessment studies can be more effective in supporting student learning and promoting educational outcomes.

Bloom's taxonomy helps instructors establish a balanced approach to inquiry and assessment by classifying questions according to different cognitive levels (Hasan, 2016). It encourages instructors to create questions that call for higher-order thinking abilities including application, analysis, synthesis, and evaluation in addition to simple memory and comprehension. Teachers can examine if different cognitive levels are being addressed in their teaching materials, tests, and class discussions by using Bloom's taxonomy (Kahveci, 2010). It enables them to determine whether teachers are pushing pupils to think critically, solve issues, critically analyse data, and evaluate evidence.

## SAQA

### What is SAQA and what is its purpose?

It is essential that educational goals are clearly in line with regional, state, and national standards. According to Du Preez and Fossey (2012), the National Qualifications Framework in South Africa offers level descriptors for the incorporation of generic graduate traits at various educational levels in curricula. This framework's goal is to guarantee consistency in learning attainment when awards of qualifications are made (SAQA 2012, 3). The alignment of educational objectives with standards in South Africa is driven by the pressure from companies and the government to produce graduates who are employable and have the necessary skills for the workforce (Griesel & Parker. 2009). This alignment ensures that educational programs are relevant, prepares students for the next stage of their education or careers, and provides a framework for evaluating the effectiveness of educational programs (Manatos, 2016).

### Level descriptors

The South African Qualifications Authority (SAQA) released level descriptors for the South African National Qualifications Framework (NQF) in 2012 (SAQA 2012, 1). To ensure consistency across learning in the assignment of qualifications to specific levels and to benchmark international comparability of qualifications, the South African Qualifications Authority (SAQA) has provided level descriptors for Levels One through Ten of the National Qualifications Framework (NQF) (SAQA 2010).

In each module's or unit's learning goals as well as for the entire learning programme, there are statements of what is expected of the student at the conclusion of their learning experience, or what SAQA refers to as learning achievements. Universities may clearly express expectations to students and make it easier for these talents to be assessed and recognised by introducing generic graduate qualities in learning programmes and openly integrating them with level descriptors (BitzerI & Withering, 2020).

## Construction Roadworks

### What is it?

Those who operate in or intend to work in a construction setting on a site and who want acknowledgment for crucial skills in roadworks construction operations may pursue this qualification. It is a level 3 NQF subfield of civil engineering construction, according to Janse (2005). The holders of this qualification ought to be capable of performing the main duties necessary for safe and effective work in the road construction industry. In order for a wide range of people to pursue and benefit from a qualification, it must be flexible and accessible (Training force, 2021).

### Outcomes

People who earn the National Certificate (NC) Construction Roadworks credential must understand and be able to communicate (verbally, in writing, and by signs) in a road construction context (Training force, 2021); To do calculations and plan operations using mathematics in the context of building roads; Conduct general construction tasks (using and maintaining small equipment) and roadwork tasks (according to the unit standard chosen); Additionally, carry out additional roadwork construction tasks (South African Qualifications Authority, 2012).

### Value of various levels of Bloom’s level within construction roadworks

The applicants must be able to communicate on a building site using a range of means, including writing, after finishing the programme (Training force, 2021). Since construction work is by its very nature practical, the practical application of knowledge and ability within the sector, and particularly in roadworks, comprises a significant component of the programme results. Educational institutions must prioritise and incorporate 21st-century abilities into their instructional practises in order to meet the needs of the global economy (OECD, 2018). This involves encouraging pupils to develop their critical thinking, problem-solving, communication, teamwork, creativity, and innovation skills. The relationship between content, pedagogy, and knowledge must be understood by educators in order to effectively include these skills (Koehler et al, 2014).

## SHORT LEARNING PROGRAMMES

### **What is it?**

Short Learning Programmes (SLPs) are introductory, practical, non-degree programmes created to develop knowledge and abilities in a particular subject area quickly and effectively. They are intended to update or expand students' knowledge and skills in a particular area by addressing key fundamental principles. The SLPs employ a "just enough" learning technique, which means they are designed to meet the specific educational demands of a prospective student or a specific employment necessity (UNISA, 2023). SLPs can cover a wide range of subjects, from business management to computer programming, and can last anywhere from a few days to several months. People have the chance to swiftly pick up knowledge and skills that are applicable to their present or future careers through these programmes.

### Accreditation & purpose

The training provider will comply with the necessary standards and criteria for the delivery and assessment of the qualification provided they are accredited with the applicable Education and Training Quality Assurance body (ETQA). To make sure the provider is meeting the certification standards and requirements for quality assurance, the ETQA is in charge of monitoring and assessing the provider's performance (Zondo, 2021). To guarantee that learners are evaluated on their knowledge, abilities, and competences in a consistent and objective manner, the assessment process must be fair, valid, reliable, and practical (Burns & Grove, 2001). In order to make sure that students are competent and have the abilities they need to do their jobs safely and successfully, assessment quality is crucial.

## CONCLUSION

Formative assessment is widely argued as an integral part of the teaching and learning process. It provides valuable insights into students' learning progress, guides instructional decisions, promotes student self-assessment and reflection, and enhances student engagement and motivation. Feedback is a key element of formative assessment, and its implementation is essential for enhancing learning outcomes. Formative assessment encompasses various strategies, including classroom questioning, group work, peer assessment, self-assessment, and the use of formative assessment tools. Effective assessment practices require clear instructional aims, alignment with learning activities, and ongoing monitoring of student progress. Activating students as owners of their own learning is a valuable approach that promotes metacognition, motivation, and self-assessment.

Bloom's taxonomy provides a valuable tool for designing instruction and assessing students' progress towards higher-order thinking skills. A criticism of the literature revealed that by incorporating questions and assessments targeting different levels of cognitive skills, educators can assess students' understanding, application, analysis, synthesis, and evaluation abilities. Incorporation of level descriptors and the inclusion of generic graduate traits in learning programs contribute to clarity, coherence, and consistency in education.

Construction roadworks SLP is designed to align with the requirements of the NQF .The National Certificate Construction Roadworks program emphasizes the importance of communication skills, mathematical abilities, practical application of knowledge, and the integration of 21st-century skills within the construction industry, specifically in roadworks. By focusing on these aspects, the program prepares individuals for the demands of the construction sector and aligns with the evolving needs of the global economy. This Short Learning Programme (SLPs) is designed to provide rapid and effective learning experiences in specific subject areas. There is accreditation involved which provides assurance to learners and employers that the program meets recognized standards and that the learning outcomes are aligned with industry requirements. The following section describes the methodology employed in this study.

# Research Methodology

## Introduction

This chapter proceeds in eight sections/sub-chapters. Following the introduction, section two lays out the quantitative research design which outlines the nature of the study whether it’s textual or numerical. Section three proceed to case study type used for this study. While section four detailed the sampling method used. Section five outlines the data collection strategy used. Following after is section six which clarifies the data analysis method used. Section seven entails trustworthiness and credibility which seek to ink the research study's findings with reality in order to demonstrate the truth. The last section details ethical considerations applied to this study.

This research was directed by the following central research question:

(1) What is the distribution of formative assessment question levels within bloom’s taxonomy, per unit, for the Construction Roadworks short learning programme (SLP)?

(2) How does this question level (Bloom’s taxonomy) distribution compare to those reflected in the SAQA level 3 outcomes?

(3) How should formative assessments for this module be changed in the future to better align with the SAQA framework regarding the required cognitive level targets?

This study used a quantitative research design underpinned by Bloom's Taxonomy framework. The reason for using a quantitative research design was because it was considered that the best way to answer the research questions was to present the extent to which the Construction Roadworks SLP’s formative assessments assesses the cognitive level of students’ thinking using frequencies and percentages, and to compare these to the SAQA exit level outcomes for this qualification. Data were collected from formative assessments from units of the Construction Roadworks SLP (NQF level 3). The reason for this was to find out the alignment of the cognitive levels targeted by the Construction Roadworks SLP formative assessments with the SAQA framework with an intent to suggest ways to enhance the design of the Construction Roadworks SLP formative assessments.

Utilising descriptive statistics, data were examined. The statistical characterization, agglomeration, and presentation of the relevant constructs or relationships between these components are referred to as descriptive analysis. Simple descriptions about the sample and the observations are provided by descriptive statistics. These summaries may be quantitative, such as summary statistics, or visual, such as easily comprehensible graphs that offer information on the development of knowledge regarding the suitability of formative assessments for Construction Roadworks SLP.

## Quantitative research

This study employed quantitative data due to its emphasis on utilization and analysis of numerical data using specific statistical techniques to answer questions like how much, what, how many, and how. Quantitative study also describes the methods of explaining an issue or phenomenon through gathering data in numerical form. Quantitative research designs are either experimental or non-experimental and seek to obtain accurate and reliable measurements [Rahman, 2017]. Quantitative assessment data came from formative assessments of the construction roadworks SLP through categorizing questions marks according to marks allocated per cognitive level as informed by Blooms taxonomy. The data to answer objective two of the study was obtained through matching the Construction Roadworks SLP level descriptors against Blooms taxonomy hierarchy of cognitive levels. Quantitative data was used to highlight the frequencies and percentage distributions of question within each unit evaluated.

This method was chosen because, as a result of formative assessment marks being assigned based on Blooms taxonomy cognitive levels, the phenomenon being studied is very numerical (Keith, 2014).Therefore, using this method was pertinent because it led to a full and in-depth understanding of the Construction Roadworks SLP formative assessment's adherence to Bloom's taxonomy and SAQA level outcomes. Furthermore, because this was the document review (Formative assessments), the knowledge generated/constructed will be of great assistance to programme designers to improve the Construction Roadworks SLP programme.

## Case Study

Utilising quantitative data, a case study is used. One of the earliest research methods to be applied in the area of quantitative methodology was case studies (Baxter & Jack, 2008). To name just a few of the fundamental sciences, they now make up a sizable amount of the research provided in books and articles on psychology, history, education, and medicine (Biba, 2013). A case study is a suitable strategy, according to Creswell (2012), when the researcher has clearly definable examples with boundaries and wants to offer a thorough comprehension of the cases or a comparison of numerous cases.

A case study aims to thoroughly investigate a bounded system (Creswell and Plano, 2010). In this research, the formative assessments utilised to evaluate the Construction Roadworks SLP pupils are referred to as a system. The term "bounded" refers to the fact that the research was carried out inside the confines of a certain module, project, or site, in this case Construction Roadworks SLP.

An instrumental case study was selected as the research method for this study. An instrumental case study refers to a case that is bound by time and place and that seeks to naturalistically make generalizations. By focusing on an instrumental case study, a detailed qualitative data through documentation analysis method was gathered. An instrumental case study design is particularly useful when researchers seek to explore issues in depth and challenge established viewpoints or theories (Stake, 2005). Instrument case study allows researchers to thoroughly investigate the complexities and nuances of a specific case, leading to a richer understanding of the subject matter (Kathryn & Kim, 2009). Because the goal of this study was to determine the efficacy of assessments, alignment with Bloom's taxonomy, SAQA, and prospective changes, the instrumental case study approach was chosen.

## Sampling

According to Sanjoy (2018), pp. 1–8, sampling is the definition of choosing a small sample of cases for a population study. Purposive sampling of the documentary sources utilised to gather data was part of the study design. In a category of non-probability sampling methods known as "purposive sampling," units are chosen because they meet the criteria for inclusion in the sample (Kassiani, 2022). Purposive sampling is used because it better matches the sample to the goals and objectives of the research, enhancing the study's rigour and the reliability of the data and findings. The major objective of sampling is to limit the amount of repetitious data in a study and use that percentage of data as support for the current hypothesis while being careful not to falsify research results.

The data collected consisted of 15 formative assessments of the Construction Roadworks SLP from each unit standard. A unit standard is a detailed document that specifies the expected knowledge, skills, and competencies for a particular task or job role (Leonie, 2023). It sets the criteria for successful performance and provides a framework for assessment and training. There are three types of unit standards which includes core, fundamentals and electives. The goal of selecting these 15 formative assessments from the Construction Roadworks SLP, comprising 5 core, 5 fundamentals, and 5 electives, was to create a sample that accurately denotes the entire population of assessments within the course. The assessments selection criteria was driven by purposive sampling, which in this study, assessment with clear and easy questions was used. By including assessments from different categories, such as core, fundamentals, and electives, the intention was to capture a representative sample of the formative assessments within the Construction Roadworks SLP.

Part of the formative assessments (exercises) used include cores, fundamentals and electives. Candidates must earn forty credits in communication—twenty in their home tongue at the level of the qualification and twenty in English at level one—in order to demonstrate their ability to communicate in a variety of ways on a building site, including writing. The remaining credits have been given to the practical application of knowledge and skill within the construction business, notably in roadworks, due to the practical character of construction work; these assessments are referred to as fundamentals. Finally, candidates can choose (Electives) any 35 credits from the list of elective unit standards to reach the required 155 credits for the Construction Roadworks SLP qualification (Stanny & Claudia, 2016).

Five assessments were used under each which made a total of fifteen assessments used as discussed above (Sampling). Table 1 below outline the formative assessment documentations used.

Table 1 indicating formative assessments selected to achieve the aim of this study

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NO** |  | **UNIT STANDARD** | **ID** | **UNIT STANDARD TITLE** |
| 1 |  | Core | 9966 | Establish and prepare a work area |
| 2 |  | Core | 120496 | Provide risk-based primary emergency care/first aid in the workplace |
| 3 |  | Core | 9986 | Apply quality principles on a construction site |
| 4 |  | Core | 14580 | Read and interpret construction drawings and specifications |
| 5 |  | Core | 110095 | Interpret the composition, construction sequence and processes of the construction industry |
| 6 |  | Fundamental | 7456 | Use mathematics to investigate and monitor the financial aspects of personal, business and national issues |
| 7 |  | Fundamental | 9012 | Investigate life and work related problems using data and probabilities |
| 8 |  | Fundamental | 9013 | Describe, apply, analyse and calculate shape and motion in 2-and 3-dimensional space in different contexts |
| 9 |  | Fundamental | 119465 | Write/present/sign text for a range of communicative contexts |
| 10 |  | Fundamental | 119457 | Interpret and use information from text |
| 11 |  | Electives | 9357 | Develop and use keyboard skills to enter text |
| 12 |  | Electives | 114218 | Demonstrate an understanding and implement environmental initiatives on a construction project |
| 13 |  | Electives | 117902 | Use generic functions in a graphical user interface (GUI)-environment |
| 14 |  | Electives | 12910 | Erect fencing |
| 15 |  | Electives | 13958 | Maintain and repair bituminous road surfaces |

## Data collection strategy

Utilising documentary analysis, the research goal was accomplished. Documentary analysis is a process that involves finding, confirming, and taking into account records that are relevant to the object under investigation (Selma at all, 2018).Information was gathered from formative tests created for students enrolled in the Construction Roadworks SLP over the previous academic year. Each activity (formative assessment) item was evaluated in relation to the revised Bloom's Taxonomy's cognitive tiers.

A table for data collection was prepared to capture the marks allocation per cognitive level as indicated in table 2 below. Blooms taxonomy action verbs used in the questions in the formative assessment were used to place each question within Blooms taxonomy. The marks per cognitive levels were totaled and recorded in the data collection sheet.

Table 2 Showing data collected to answer objective one of the study.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **MARKS ALLOCATED PER COGNITIVE** | | | | | | |
| **LOW-ORDER THINKING SKILLS** | | **MEDIUM-ORDER THINKING SKILLS** | | **HIGH-ORDER THINKING SKILLS** | | |
| **UNIT** | **Ʃ MARKS** | **REMEMBER** | **UNDERSTAND** | **APPLY** | **ANALYSE** | | **EVALUATE** | **CREATE** |
| 120496 | 79 | 48 | 31 | 5 | 0 | | 0 | 0 |
| 9966 | 50 | 30 | 15 | 5 | 0 | | 0 | 0 |
| 9986  CORE | 151 | 13 | 93 | 45 | 0 | | 0 | 0 |
| 14580 | 104 | 69 | 35 | 0 | 0 | | 0 | 0 |
| 110095 | 73 | 20 | 47 | 0 | 6 | | 0 | 0 |
| 7456 | 70 | 5 | 20 | 45 | 0 | | 0 | 0 |
| 9012 | 99 | 37 | 62 | 0 | 0 | | 0 | 0 |
| 9013  FUNDAMENTAL | 35 | 3 | 17 | 15 | 0 | | 0 | 0 |
| 119457 | 50 | 0 | 30 | 0 | 0 | | 20 | 0 |
| 119465 | 30 | 10 | 15 | 0 | 5 | | 0 | 0 |
| 9357 | 55 | 10 | 0 | 45 | 0 | | 0 | 0 |
| 12910 | 139 | 50 | 63 | 20 | 0 | | 0 | 0 |
| 13958 | 85 | 30 | 55 | 0 | 0 | | 0 | 0 |
| 114218 | 56 | 0 | 56 | 0 | 0 | | 0 | 0 |
| 117902 | 87 | 19 | 68 | 0 | 0 | | 0 | 0 |

ELECTIVES

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **TOTAL** | **1162** | **344** | **607** | **180** | **11** | **20** | **0** |

The second objective of this study which pursued to evaluate question level (Bloom’s taxonomy) distribution of the construction roadworks SLP in comparison with SAQA level 3 outcomes, SAQA Level Descriptors for the South African National Qualifications Framework document was used. Table 3 below indicate the SAQA NQF level 3 level descriptors used with cognitive level targeted in Bloom’s Taxonomy. This data was used to determine the alignment of SAQA level descriptors against Bloom’s taxonomy.

The cognitive level targeted in Bloom’s Taxonomy for each SAQA NQF level 3 level descriptors was assigned through the analysis of key phrases within the level descriptor. For instance, if the level description states that the learner must be able to demonstrate the capacity to utilise one's knowledge to choose acceptable methods to solve problems within predetermined constraints, it follows that a learner may be capable of using knowledge to address issues. In that situation, "Apply" would be the cognitive level aim.

Table 3: Level Descriptors for the South African National Qualifications Framework (SAQA, 2012)

|  |  |  |
| --- | --- | --- |
| SAQA NQF LEVEL 3 LEVEL DESCRIPTORS | | Cognitive level targeted in Bloom’s Taxonomy |
| A (F1) | Scope of knowledge, in respect of which a learner is able to demonstrate a basic understanding of the key concepts and knowledge of one or more fields or disciplines, in addition to the fundamental areas of study | Remember |
| B (F2) | Knowledge literacy, in respect of which a learner is able to demonstrate an understanding that knowledge in a field can only be applied if the knowledge, as well as its relationship to other relevant information in related fields, is understood | Understand |
| C (F3) | Method and procedure, in respect of which a learner is able to demonstrate operational literacy, the capacity to operate within clearly defined contexts, and the ability to work within a managed environment | Apply |
| D (F4) | Problem solving, in respect of which a learner is able to demonstrate the ability to use own knowledge to select appropriate procedures to solve problems within given parameters | Apply |
| E (F5) | Ethics and professional practice, in respect of which a learner is able to demonstrate the ability to comply with organisational ethics | Apply |
| F (F6) | Accessing, processing and managing information, in respect of which a learner is able to demonstrate the basic ability to summarise and interpret information relevant to the context from a range of sources, and the ability to take a position on available information, discuss the issues and reach a resolution | Evaluate |
| G (F7) | Producing and communicating information, in respect of which a learner is able to produce a coherent presentation and report, providing explanations for positions taken | Evaluate |
| H (F8) | Context and systems, in respect of which a learner is able to demonstrate an understanding of the organisation or operating environment as a system, and application of skills in measuring the environment using key instruments and equipment. | Apply |
| I (F9) | Management of learning, in respect of which a learner is able to demonstrate the ability to learn within a managed environment | Apply |
| J (F10) | Accountability, in respect of which a learner is able to demonstrate the capacity to actively contribute to team effectiveness | Create |

Each test question used was analyzed and converted according to the cognitive level of Bloom’s taxonomy. The verbs used in the formative assessments questions was used to locate the question within Blooms taxonomy framework. The reason for that was to gauge cognitive levels addressed by these questions. Table 4 below provide cognitive levels based on Blooms taxonomy and their associated cognitive process, operational verbs and criteria which used when collecting the data.

Table 4: Cognitive Levels from Bloom's Taxonomy

|  |  |  |  |
| --- | --- | --- | --- |
| **Cognitive Level** | **Cognitive process** | **Operational Verbs** | **Category** |
| Remembering (C1) | Recognising, recalling | remembering, listing, repeating, imitating, knowing, mentioning, identifying | LOTS |
| Understandin g (C2) | interpreting, exemplifying, classifying, summarising, inferring, comparing, explaining | explaining, clarifying, accepting, reporting, describing, distinguishing, repeating |
| Applying (C3) | Executing, implementing | using, demonstrating, illustrating, operating, clarifying, checking, using |
| Analysing (C4) | differentiating, organising, attributing | comparing, checking, critiquing, assessing, analysing categorising, differentiating | HOTS |
| Evaluating (C5) | checking, critiquing | evaluating, assessing, refuting, deciding, concluding, supporting, checking |
| Creating (C6) | creating, planning, producing | constructing, designing, creating, developing, writing, arranging, formulating |

Construction Roadworks SLP is a SAQA level 3 programme. SAQA level 3 outcomes was used as part of analysis to evaluate the alignment of SAQA level descriptors against the Blooms taxonomy question levels discovered. Each SAQA level descriptor was placed within Blooms taxonomy hierarchy with an intention measure the mostly addressed cognitive level based on the programmed design.

## Data analysis

The descriptive methodology informed the quantitative analysis. These quantitative methods were chosen because they can gather in-depth knowledge about the subject that qualitative methods are unable to. Data from the Construction Roadworks SLP formative assessments were analysed using a descriptive approach. In order to meet the study's first goal, the obtained data was assessed using the revised Bloom's cognitive level (David, 2002). Frequencies and percentages were used to display the data that was gathered. The distributions of question level within each unit were assessed in order to calculate percentages. A comparison of frequencies and percentages acquired from both objective one and two was done in order to respond to the third research question, which was about adjusting the formative assessment in the future to better correspond with the SAQA framework regarding the requisite cognitive level targets.

## Trustworthiness and credibility

Concepts like credibility and trustworthiness are employed to rate the calibre of research. They show the accuracy of a procedure, methodology, or test. Credibility is about the accuracy of a measure, while trustworthiness is about the consistency of a measure (Collins, 2020, p. 3). The reliability of a measure is defined as its regularity. In order to strengthen the validity and reliability of this study, a review of the literature on formative assessments, Bloom's taxonomy, Construction Roadworks SLP levels, and SAQA levels was conducted.

As the researcher I used my professional judgment and expertise to make informed decisions regarding the allocation of marks to specific cognitive levels. But a certain level of subjectivity is often unavoidable, especially in complex assessments. As the measure to enhance objectivity and consistency to increase the validity of the study, a collaborative analysis with colleague was done to ensure impartiality, fairness, and consistency in the grading process. This approach helps mitigate the potential for individual biases and subjectivity in interpreting and analyzing the students' work.

A second analysis was done by a colleague to improve reliability and validity of the study. From the 15 formative assessments used, three was done by the colleague for improving the validity & reliability of the study. From the three, one came from core, the other from fundamentals and the last one from electives. All three unit standard was done by a colleague. Figure 1 below displays the percentage of marks allotted for each cognitive level in the construction roadworks SLP. It's important to acknowledge the challenges and limitations associated with the use of Bloom's Taxonomy in assessments. Bloom's Taxonomy provides a framework for categorizing cognitive levels, but its application can indeed be context-dependent, and interpretation may vary among evaluators. The variation in interpretations among evaluators "evaluate" and "understand," (See figure 1) is not uncommon when using a framework like Bloom's Taxonomy. This variability can be due to differences in perspective, experience, and the specific context of the assessment.

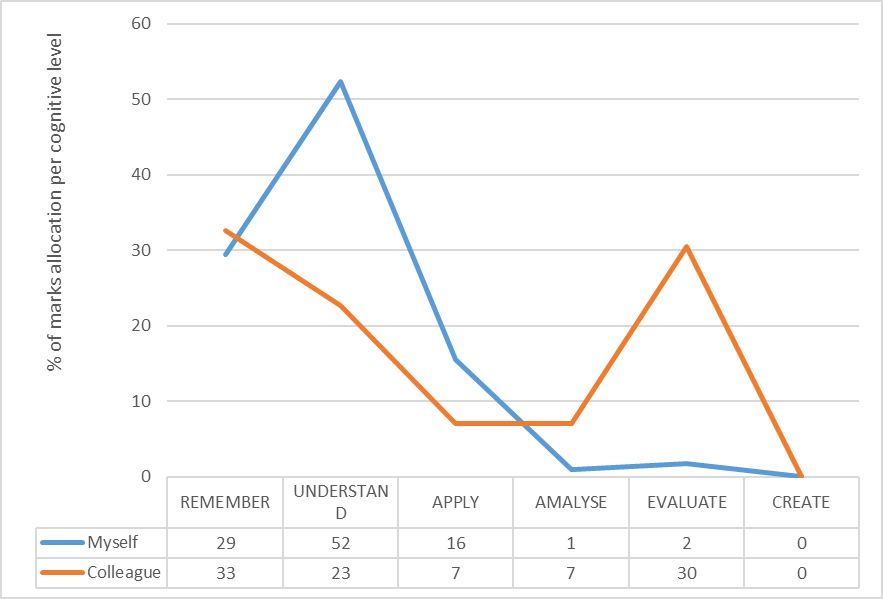


Figure 1 percentage of marks allocated per cognitive level from construction roadworks SLP formative assessments

It is evident that none of the questions/marks were allocated to “create” as both interpretations shows zero percent mark allocation. Apart from the disagreements, what seem to be the common ground from the above (figure 1), is that more questions covers LOTS compared to HOTS. This calls for examiners to enhance the questioning technique to cover more HOTS questions.

Recognizing that different evaluators may arrive at different conclusions is important for maintaining the integrity of the assessment process. To improve reliability, it's crucial to provide clear and consistent guidance to assessors and to implement calibration processes because no assessment framework is perfect, and they all have limitations. Nevertheless, Bloom's Taxonomy is widely used because it provides a structured approach to assessing cognitive skills, but it's essential to be aware of its constraints and the need for thoughtful adaptation. As long as these limitations are acknowledged and well-documented, the framework can still be a useful tool for guiding assessments and evaluating learning outcomes in construction roadworks or other contexts.

## Ethical considerations

Ethical clearance was obtained from GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC) UFS for the research title “Transforming teaching, learning and assessment practices’’. The ethical clearance number is UFS-HSD2017/1215/21/3 and was only for the duration of twelve months. Ethical considerations was taken into account by not mentioning the institution's name and the examiners' names in the data. This helps maintain confidentiality and privacy for the individuals and organizations involved in the assessments.

Working with interpretations of documentations or text also involves at least one ethical concern: the problem of bias or subjectivity, which impacts how the researcher perceives and interprets the results. Bias is unethical because it might make the results of the research findings, including the reliability and validity of any conclusions drawn, difficult to see. When conducted this research, especially it is a qualitative study, it was crucial to be aware of my subjective position as a researcher and its potential impact on the interpretative process. Being mindful of my own biases, preconceptions, and personal experiences helped me avoid inadvertently skewing the results or drawing conclusions that are influenced by my own beliefs. The aim was to enhance the quality and validity of my interpretations and ensure that my findings are more robust and reliable.

# Data presentation

## Introduction

The data that were compiled for this investigation are presented in this chapter. 15 Construction projects SLP formative tests, SAQA level descriptor papers, and Bloom's taxonomy cognitive level framework were utilised in a quantitative, descriptive review approach to gather data. The collected data was analyzed and interpreted in a descriptive form presenting it in a clear and insightful manner to address the research questions and test the hypotheses. Creating visual representations of the data using appropriate graphs, charts, histograms, or plots. Visualization helps in better understanding patterns, trends, and relationships within the data (Islam & Jin, 2019)

## Formative Assessment Question Levels Within Bloom

Based on the first objective of this study, document investigation data was gathered in the form of percentage distributions using the marks allocation per unit standard formative assessment as indicated in table 5 below.The marks per cognitive levels were totaled and recorded in the data collection sheet.

Table 5 the distribution of formative assessment question levels within bloom’s taxonomy, per unit, for the Construction Roadworks short learning programme (SLP).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | LOTS |  |  | HOTS |  |  |  |
|  | UNIT | Ʃ MARKS | REMEMBER | UNDERSTAND | APPLY | AMALYSE | EVALUATE | CREATE |  |
| 1 | 120496 | 79 | 44 | 30 | 5 | 0 | 0 | 0 |  |
| 2 | 9966 | 50 | 30 | 15 | 5 | 0 | 0 | 0 |  |
| 3 | 9986 | 151 | 13 | 93 | 45 | 0 | 0 | 0 |  |
| 4 | 14580 | 104 | 69 | 35 | 0 | 0 | 0 | 0 | Core |
| 5 | 110095 | 73 | 20 | 47 | 0 | 6 | 0 | 0 | 457 |
| 6 | 7456 | 70 | 5 | 20 | 45 | 0 | 0 | 0 |  |
| 7 | 9012 | 99 | 37 | 62 | 0 | 0 | 0 | 0 |  |
| 8 | 9013 | 35 | 3 | 17 | 15 | 0 | 0 | 0 |  |
| 9 | 119457 | 50 | 0 | 30 | 0 | 0 | 20 | 0 | Fundamental |
| 10 | 119465 | 30 | 10 | 15 | 0 | 5 | 0 | 0 | 284 |
| 11 | 9357 | 55 | 10 | 0 | 45 | 0 | 0 | 0 |  |
| 12 | 12910 | 133 | 50 | 63 | 20 | 0 | 0 | 0 |  |
| 13 | 13958 | 85 | 30 | 55 | 0 | 0 | 0 | 0 |  |
| 14 | 114218 | 56 | 0 | 56 | 0 | 0 | 0 | 0 | Electives |
| 15 | 117902 | 87 | 19 | 68 | 0 | 0 | 0 | 0 | 416 |
|  |  |  |  |  |  |  |  |  |  |
|  | TOTAL | 1157 | 340 | 606 | 180 | 11 | 20 | 0 |  |

Regarding the number of formative assessments (sample) used, 15 formative assessments were used. These formative assessments were divided into three categories (5 per category) namely, Core, Fundamental and Electives. As shown in table 5 above, this revealed that the majority of the marks were allocated to questions testing the understanding of the students. Figure 2 provides the classification of marks allocated per assessment in terms of the cognitive level they achieve.

Figure 2 Marks allocated per formative assessment per cognitive level

The questions are analysed one by one according to the level they speak to in terms of Blooms taxonomy using the blooms verbs. The results showed that of the six categories of Blooms taxonomy cognitive levels, “*understanding* (52%)’’ is leading in terms of the mark allocation, followed by “remember (41.6%). “Apply” is the third highest with 18.4%. It is evident that none of the questions/marks were allocated to “create” and few marks were given to question covering “analyse and “evaluate”, more questions addressed LOTS compared to HOTS.

## Cognitive level within Construction Roadworks SLP

Figure 3 Graphical representation of percentage marks allocated per cognitive level

Table 6 Summary of marks distribution per cognitive level

|  |  |
| --- | --- |
| COGNITIVE LEVELS | MARKS |
| REMEMBER | 340 | LOTS |
| UNDERSTAND | 606 |
| APPLY | 180 |
| ANALYSE | 11 | HOTS |
| EVALUATE | 20 |
| CREATE | 0 |

In educational or research contexts, assessing or allocating marks to cognitive levels often involves some degree of subjectivity and interpretation on the part of the researcher or assessor. This process is commonly known as "marking" or "grading," and it entails evaluating a student's performance based on predetermined criteria or standards which in this study it was Blooms taxonomy action verbs (See Appendix A)

When assessing cognitive levels, researchers typically refer to Bloom's Taxonomy, a widely used framework that categorizes cognitive skills into various levels, such as remembering, understanding, applying, analyzing, evaluating, and creating (University of Western Cape, 2019). Each level represents a different degree of complexity in cognitive processing. However, applying these levels to marks allocation per cognitive level per formative assessment can involve subjective judgment and interpretation by the assessor.

## Roadworks construction SAQA level descriptors matched to Bloom's taxonomy

To achieve the second objective of the study, Table 7 below presents the distribution of SAQA level 2 outcomes against Blooms taxonomy cognitive levels. It is evident that cognitive level “Apply” dominates other cognitive levels as the nature of the course is practical in nature that confirms that Construction roadworks SLP requires students to apply knowledge and mind towards solving the construction problems (Training force, 2021). SAQA level descriptor F1-F3 seems not to require higher order thinking skills. NQF level three indicators do require students to create new information within a familiar context.

Table 7 question level (Bloom’s taxonomy) distribution compare to those reflected in the SAQA level 3 outcomes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SAQA OUTCOMES/LEVEL DESCRIPTORS | REMEMBER | UNDERSTAND | APPLY | ANALYSE | EVALUATE | CREATE |
| F1- Language usage | x |  |  |  |  |  |
| F2-Information presentation |  | x |  |  |  |  |
| F3-Proper communication |  | x |  |  |  |  |
| C1-Establish health & safety |  |  | x |  |  |  |
| C2-Prepare a work area |  |  | x |  |  |  |
| C3-Maintain records |  |  | x |  |  |  |
| E1-Set out control points |  |  |  |  |  | x |
| E2-Organise and control of compaction |  |  |  | x |  |  |
| E3-Setting out |  |  |  |  | x |  |
| E4-Install road stud |  |  |  |  |  | x |
|  |  |  |  |  |  |  |
| SUM | 1 | 2 | 3 | 1 | 1 | 2 |

Considering Figure 4 below who portrays NQF level 3 descriptors in comparison with Blooms taxonomy. It is evident that there is a roughly even balance of all the Blooms taxonomy cognitive level across the SAQA level 3 descriptors. This means that construction roadworks SLP is designed to enhance students’ knowledge to be able to address all levels of Bloom’s taxonomy. Aligning a construction roadworks Student Learning Programme (SLP) with a balanced distribution of Bloom's Taxonomy cognitive levels across the South African Qualifications Authority (SAQA) Level 3 descriptors is an effective approach to enrich students' knowledge and capabilities.

Figure SAQA level descriptors for construction roadworks SLP (NQF LEVEL 3) against Blooms taxonomy

By intentionally incorporating learning activities and assessments that cover all levels of Bloom's Taxonomy into the construction roadworks SLP, students can develop a well-rounded understanding and competence in construction roadworks (Kembo, 2020). This approach prepares them to function effectively at various cognitive levels as outlined by the SAQA Level 3 descriptors, ultimately enhancing their capabilities in the field of construction roadworks.

# Findings and Discussion

## Introduction

Documentary analysis is a valuable research method and data collection technique that can significantly contribute to consolidating Construction Roadworks as a technical profession by providing empirical evidence and valuable insights. Documentary analysis contributes to the consolidation of Construction Roadworks as a technical profession by leveraging existing empirical evidence and knowledge from a wide range of documents (Benjamin & Joshua, 2020). `

The results of this study may lead to improved graduate student knowledge of the benefits of critical and analytical thinking as well as the promotion of a more structured norm for creating formative tests that are in line with the appropriate NQF cognitive level. For the Construction Roadworks short learning programme, the primary goal of this study was to identify the formative assessment question levels within Bloom's taxonomy, per unit. As it offers an organised and hierarchical method for planning, developing, and evaluating learning goals and objectives, Bloom's Taxonomy is a useful framework for educators (Jabbar & Omar, 2015). It provides a distinct sequence of cognitive abilities, starting with easier tasks like remembering and understanding and working up to more complex tasks like applying, analysing, evaluating, and producing.

## Exploring the Distribution of Formative Assessment Question Levels Within Bloom

The distribution of formative assessment question levels within bloom’s taxonomy, per unit, for the Construction Roadworks short learning programme (SLP) reveals/identifies “understand” as the leading cognitive level based on the distribution of formative assessment questions within Bloom's taxonomy for the Construction Roadworks SLP. Most of the formative assessments questions designed by the examiner seeks to address “understand” cognitive level according to the outcomes of the research findings. Out of 1157 total marks from all the 15 selected formative assessments, 606 (52.4%) marks were allocated to questions addressing "understand". Assessments designed to match the "understand" level includes verbs like explain, summarise, paraphrase, describe, illustrate, classify, etc (University of the Western Cape. 2019). The second highest following understanding is the "remember" with 340 (29.4%) marks. Remember cognitive level includes verbs like arrange, define, describe, identify, name, state, etc. From this it can be concluded that lower order thinking skills are targeted to a greater degree than higher order thinking skills. However, this is not consistent with the SAQA framework for this programme, which requires roughly equal representation of each of the levels of Bloom’s taxonomy.

## Alignment of SAQA with Blooms taxonomy for construction roadworks SLP

All approved higher education institutions of learning are required to offer degree programmes in accordance with the NQF, according to the South African Qualifications Authority (SAQA 2012). Particularly in the context of a skills development module at NQF level 3, compliance with the National Qualifications Framework (NQF) is essential to guarantee that assessment criteria correspond with the relevant NQF level. All accredited higher education institutions in South Africa must ensure that their degree programs align with the NQF, including appropriate assessment standards that nurture high-level cognitive skills. Assessments should be designed in a manner that integrates and develops high-level cognitive skills effectively. This integration is a requirement of the NQF and is fundamental to the education system. The study in question focuses on a skills development module, emphasizing the need to adhere to the appropriate NQF level, specifically NQF level 3.

Mawa, Haque, and Ali (2019) contend that while effective assessment of learning is strongly emphasised in higher education, the majority of academics lack the information and abilities necessary to understand what constitutes successful assessment practises in higher education or to put such knowledge into practise. Academics with limited or no assessment experience face challenges in both aligning their questions with the proper NQF level and professionally formulating them in appropriate cognitive level (Jabbar and Omar 2015). According to Tremblay, Lalancette, and Roseveare (2012), tests should include questions that span all cognitive levels to help enhance the students cognitive abilities as required. The results from this study also indicated that according to SAQA level descriptors for construction roadworks SLP, the design of formative assessments should span throughout all the levels of Blooms taxonomy.

# Conclusion and Recommendations

## Introduction

15 formative tests created for NQF level 3 construction roadworks SLP were examined in this study. The overall conclusions showed that these publications (formative assessments) differ greatly in terms of overall score and design. We can observe from our first two research questions that the majority of the questions in construction roadworks SLP formative assessments are at levels one and two. As a result, teachers evaluate students based on how well they recall and comprehend the material. None of the 15 evaluations utilised evaluates every component of Bloom's taxonomy.

## HOTS or LOTS?

Most formative assessment questions, as can be seen, are used to evaluate and align with Bloom's taxonomy levels one through three (Remember to Apply). Students must retain and comprehend the material in this situation. The focus of formative assessments, on the other hand, is on applying knowledge and, in a very small number of instances, on information analysis. The case study questions in the Construction Roadworks SLP are also intended to gauge students' ability to apply knowledge. The questions on a single piece of formative assessment material could range from a level one question to a level four question. This study demonstrated plainly that there is a lack of LOTS questions and there is a need to increase in HOTS questions to align SAQA and Blooms taxonomy.

## Non alignment of formative assessments with SAQA & Blooms taxonomy

In relation to our third research question, we see that the observed findings from objective one and two does not align. The question of alignment need to be addressed. Aligning assessments with educational frameworks, such as Bloom's Taxonomy, is a crucial aspect of ensuring the quality and effectiveness of assessments. In the context of South Africa, the South African Qualifications Authority (SAQA) plays a significant role in overseeing and regulating qualifications and assessments. Aligning SAQA's requirements and expectations with a framework like Bloom's Taxonomy is a valuable endeavor.

Researching students' comprehension of Bloom's taxonomy might also be beneficial in order to better understand their expectations and how well they correlate with the results. There doesn't appear to be a clear national policy that instructs higher education institutions (HEIs) on how to apply Bloom's or any other taxonomy to evaluate students at the proper NQF level. The researcher therefore strongly suggests that a national assessment policy framework be created to direct HEIs on how to evaluate undergraduate and postgraduate students at various cognitive levels as required by the NQF.

## Intervention strategies

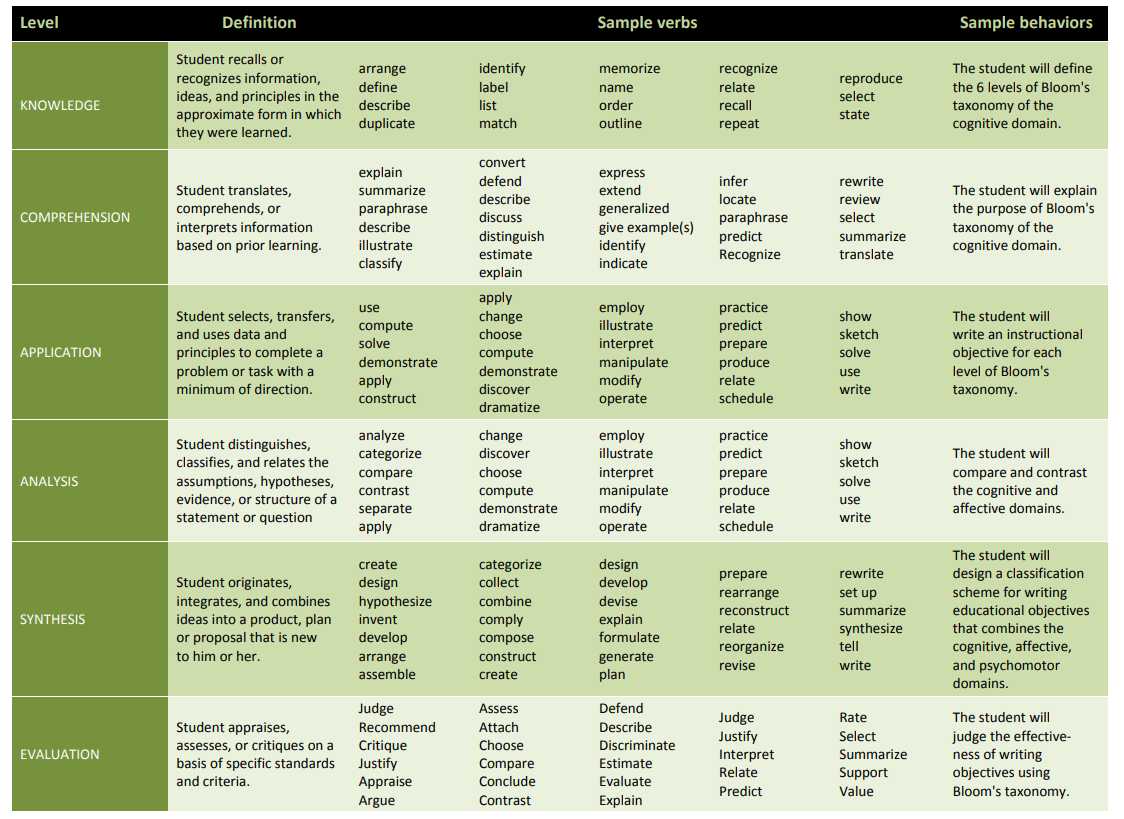
Providing training to examiners is a proactive step. Examiners should be familiar with both SAQA's requirements and the principles of Bloom's Taxonomy. Training can help examiners understand how to design and evaluate assessments that align with both the regulatory standards and the desired cognitive complexity. Assessments should be designed with a clear understanding of the learning outcomes and the cognitive skills expected. Exam questions, tasks, and rubrics should reflect the specific cognitive levels relevant to the qualifications and standards set by SAQA.

Alignment between SAQA and Bloom's Taxonomy, combined with effective training for examiners, can lead to more reliable and valid assessments that meet the educational and regulatory standards set by the South African authorities. It ultimately benefits learners, institutions, and the broader education and training system in South Africa.

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Annexure A.   
  
Blooms Taxonomy Action Verbs



Annexure B   
  
Turnitin Report

