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Exploring Assessment Techniques that Integrate Soft Skills in Teaching Mathematics in Secondary Schools in Zambia

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Abstract. This study investigated the assessment techniques mathematics teachers use that integrate soft skills in secondary schools in Mazabuka District in Zambia. A total of 91 teachers, who were purposively selected, took part in the study, of which 81 completed a questionnaire and four observers evaluated 124 video-recorded lessons which were taken of 31 teachers. A sequential multi-phase design was used to collect data. The data were analyzed using frequencies, means, standard deviations and chi-square statistics. The findings revealed that the assessment techniques mathematics teachers used did not assess soft skills. In addition, mathematics teachers' gender was not found to have influenced teachers' choice of assessment techniques in the teaching and learning process but the type of schools where teachers were teaching, though the effect size was weaker. The consequence of this may be that secondary school leavers may not be good communicators, innovators, creators and critical thinkers. Therefore, it is recommended that mathematics teachers be upskilled on how to assess soft skills in the teaching and learning of Mathematics if the integration of soft skills is to be realized as espoused in the Zambia Education Curriculum Framework of 2013.

Keywords: assessment techniques; soft skills; integration; mathematics; mixed methods

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1. Introduction

1.1 Background to the Problem

Assessment is an essential part of the teaching and learning process. Through assessment evidence of an individual, student's learning progress is collected, interpreted and later judgments are made about the students' accomplishments following some set standards (Guevara-Bazán et al., 2020). Guevara-Bazán et al. (2020); the Ministry of Education [MINEDUC] and Rwanda Education Board [REB] (2015b) also concurred that the purpose of assessment is for monitoring students' progress, providing feedback on students' performance, guidance on future progressions, promotion, selection and certification. The Curriculum Development Centre [CDC] (2013e) and Tejeda and Gallardo (2017) stated that assessment must match the aims of the curriculum so that it supports teaching and learning. When this is achieved, teachers focus consistently on the intended learning outcomes, as opposed to teaching to test.

Assessing knowledge, skills, values and attitudes, in totality, are foundational to having students that will be equipped with relevant competences. However, the various forms of assessment used in mathematics education are reported to have failed to provide an insight into what students understand, know and can achieve (Gallego & Dandis, 2014). This is probably due to technological advancements that have increased the need for students to develop soft skills, such as problem-solving, critical thinking, collaboration, communication, and the ability to analyze and present data orally and in a written format (Dochy, 2001; Gallardo, 2020; Schwab, 2017; Putra et al., 2020). This has brought about thinking of how to assess these skills, as they are not normally captured in the standardized tests commonly administered to measure students' performance. Thus, mathematics teachers are required to use assessment techniques, such as rubrics, portfolios, concept maps, self-assessments, and group assessments, to determine what students know and where they are in the learning process (Rebecca, 1998; Birgin, 2011).

Lesson observation in mathematics education research has become important partly because the researcher has an opportunity to get the actual teacher and student interactions which impact student learning significantly as opposed to what teachers claim to do in class (Bostic et al., 2021; National Council of Teachers of Mathematics [NCTM], 2014). Bostic et al. (2021) reviewed 114 peer-reviewed articles that involved classroom observations between 2000 and 2015 using the cross-comparative method of research. The authors concluded that to understand classroom interaction in Mathematics, researchers require methods like observation that would capture classroom events.

Furthermore, assessment practices are key in the integration of soft skills that contributes to the individual students' achievements in all aspects of life. The Zambia Education Curriculum Framework (ZECF) of 2013 provides for the development of six soft skills of problem-solving or critical thinking, cooperation, communication, entrepreneurship, creativity and innovations, and self-management (CDC, 2013e). Thus, this study examined mathematics teachers' assessment approaches to establish the extent to which they assessed soft skills in Mathematics in secondary schools in Mazabuka district in Zambia.

1.2 Research Questions

The following were the research questions that guided the study:

i. To what extent do the assessment techniques mathematics teachers use in secondary schools in Zambia assess soft skills?
ii. Is there any relationship between mathematics teachers' demographic factors and the assessment techniques they used in the teaching and learning of Mathematics?

2. Literature Review

2.1 Assessment of Soft Skills

The assessment of soft skills proves to be a challenge in the teaching and learning of mathematics. Similar sentiments are affirmed by Care et al. (2018), who stated that it was a challenge to measure most human social and non-cognitive capabilities directly and, hence, constructs such as critical thinking, problem-solving, communication and collaboration can be measured with tools designed to capture indicators of these skills. Since most of the soft skills are seen through behaviors, the challenge is to capture them accurately. Similarly, Mahasneh and Thabet (2015) also admitted that it was difficult to develop and measure soft skills, despite it proving increasingly valuable.

The challenges of assessing soft skills in schools are linked with determining the suitable methods for assessing them. It is therefore imperative to scrutinize the appropriate strategies for assessing soft skills (Durowoju & Onuka, 2014). It is argued that the use of rubrics can help in assessing soft skills. In support, Bargainnier (2003) reiterated that rubrics are tools, which teachers can use to come to similar conclusions about soft skills. Further, the author contended that rubrics provide clear descriptions of the work associated with each component, at varying levels of mastery, and it is an appropriate tool for measuring outcomes or competencies. Hence, teachers must go a step further to try and address the challenge by trying different methods of assessing soft skills during teaching and learning of Mathematics.

It is an indisputable fact that teaching Mathematics to students helps enhance knowledge, skills, and positive attitudes. It also helps them to connect what they learn to real-life situations. Furthermore, it enables students to acquire the competences needed for improved living in society (Holmes & Hwang, 2016; Moser et al., 1948). It is evident that when teachers adopt appropriate assessment approaches, it may help in developing students' mathematical soft skills (Gallardo, 2020; Stewart et al., 2020). It is essential for teachers to know when, how and what to assess. Teachers should choose the assessment that helps to develop students' critical thinking and problem-solving.

Subsequently, soft skills are seen through behavior and they therefore require appropriate assessment tools to test them. Assessment in formal education systems is undertaken through written tests and this is too narrow in scope to evaluate soft skills. However, REB (2015) and Care et al. (2018) advocated that soft skills can be measured by assessing the stages students go through to find solutions to a given task, establishing the reasoning behind resolving a situation, and using evidence to determine the students' advancement towards fulfilling performance tasks. In addition, the CDC (2013d) highlighted that soft skills are difficult to measure, and thus require tools designed to capture indicators of these skills, such as projects, portfolios and performance assessments. Therefore, the quality assessment of any performance depends on the accurate and reliable measurement of key performance factors.

2.2 Approaches in Soft Skills Assessment

Assessment is an important tool which is used to determine how teaching and learning had taken place. In this respect, various researchers and institutions acknowledge that, besides standardized tests, other forms of assessments are used to gauge students' achievement, what they know or can do (CDC, 2013a; Hamilton et al., 2021; Mustofa et al., 2020). The 2013 revised curriculum framework in Zambia, other researchers and documents have also suggested performance tasks, rubrics, assignments, and standard-based projects as alternative assessment strategies among others (CDC, 2013d, 2013c, 2013b; Danielson & Marquez, 2016; Perlman, 2003). Thus, the following paragraphs, present some of the suggested assessment techniques, particularly those that can be used to assess soft skills in the teaching and learning of Mathematics.

2.2.1 Performance assessment tasks

Performance assessment is a compilation of performance tasks, which are structured in such a way that stimulus materials and a demand for action are presented to a student, who generates responses that can be rated for quality using explicit standards (Stecher, 2010; Tejeda & Gallardo, 2017). In other words, performance assessment means an assessment that involves an evaluation of students' writing, products, or conduct (Danielson & Marquez, 2016).

> *Precisely, performance assessment includes all assessments except for multiple-choice, matching, true/false testing, or problems with a single correct answer. Classroom-based performance assessment includes all such assessment that occurs in the classroom for formative or summative purposes and is evaluated by teachers as distinct from large-scale, state-wide testing programs (Danielson & Marquez, 2016, p. 1).*

Additionally, performance assessments provide an effective way to measure students' abilities, such as communication, collaboration, thinking critically and solving problems (Perlman, 2003). Assessment tasks, such as oral presentations, projects, open-ended Mathematics problems and those requiring a critical evaluation, are examples of performance tasks (Perlman, 2003).

Tejeda and Gallardo (2017) conducted a study in Mexico to establish students' perceptions of performance assessment tasks in helping students reach good levels of skills and abilities. Interviews were used to collect data using a mixed-methods design involving 20 students. The results were that performance assessment was an effective approach for understanding students' strengths and weaknesses in teaching and learning. Furthermore, the authors indicated that the performance assessment technique helps to link what a student learns in school to real-life situations.

2.2.2 Rubrics

Rubrics appeal to teachers and students for many reasons. A rubric is described as a "rule, guide, criterion, or description that is used to assess the progress of students in their academic subjects, as well as the grading system for assessing each criterion" (Cooper & Gargan, 2011, p. 54). Furthermore, several researchers have argued that a rubric is a powerful tool for teaching and assessment; improves students' performance; makes teachers' expectations clear; and guides students on how to meet what is expected of them (Gallardo, 2020; Goodrich, 1997; Stewart et al., 2020). Goodrich (1997) also argued that the use of rubrics permits teachers to accommodate classes that are heterogeneous and reduces the amount of time teachers would spend evaluating students' work. Thus, the quality of students' performance is marked by improvements and rubrics make it easier for teachers to share the students' evaluations with various stakeholders.

Rubrics can be used in different subjects, including Mathematics; what differentiates them is the purpose of the rubric the teacher wants to use. Guskey (1994) indicated that rubrics "are specific guidelines that can be used to describe students' work in reading, writing, mathematics, and other content areas" (p. 25). Using rubrics provides teachers with a good context to give feedback on a student's performance level and indicates the next course of action for improvement. Similarly, Ash and Levitt (2003) state that rubrics can be used to diagnose the students' learning levels in the classroom, which provides teachers an opportunity to clarify learning targets by giving appropriate feedback to the students.

Mustofa et al. (2020) reported that among the various assessment tools used to measure and assess soft skills is the rubric. Furthermore, rubrics have been found to improve instruction, increase student achievement, evaluate courses and to assess soft skills (Khuzzan & Mahdzir, 2020; Reddy & Andrade, 2010). In addition, when rubrics are used as part of a student-centered approach, they have the potential to help students understand the targets for their learning and the standards of quality for a particular assignment, as well as making dependable evaluations and judgments about their work that can inform revision and improvement (Reddy & Andrade, 2010).

2.2.3 Projects-based learning technique

Project-based learning is a process where students work collaboratively to find solutions to the problems around them (Holmes & Hwang, 2016). Problem-based learning is identified as promoting students' skills in problem-solving, decision making, and investigation (Thomas, 2000, p. 1). Project-based learning is grounded on the constructivist theory where students attain a deeper understanding while actively constructing their ideas, and engaging in real and meaningful problem-solving activities (Krajcik & Blumenfeld, 2006).

The NCTM (2000) and Remijan (2016) recommended mathematics teachers to provide classroom activities that are relevant, such as projects, which provide students with opportunities to engage in real-life problem solving and allow for many avenues to demonstrate what they have learned. The project-based learning technique assists students studying secondary Mathematics to be motivated to learn, and apply their content knowledge and skills, such as collaboration, problem-solving and critical thinking (Holmes & Hwang, 2016; Thomas, 2000). In support, Hope and Allen (2009) reported that "When students are engaged in project-based learning, which is rich in collaboration and problem-solving, learning becomes more authentic" (p. 3853).

During project-based learning techniques, students work in groups to deal with curriculum-based, authentic, thought-provoking problems and often students decide what activities to pursue in dealing with a problem (Solomon, 2008). Furthermore, Solomon (2008) stated that students benefit from this technique in gathering information from a variety of sources, synthesizing, analyzing and deriving knowledge. As a result, students learn how to demonstrate the knowledge they have acquired and what they have learned is judged by how well they can communicate that new knowledge. The teachers' role is not to direct and manage students but to advise and guide them. These characteristics make project-based learning an appropriate assessment technique for soft skills as learning is assessed by how much students can demonstrate what they have learned.

A study on project-based learning conducted by Ravitz et al. (2012) employed a quasi-experimental design with 60 teachers who were selected based on having published peer-reviewed projects on problem-based learning and soft skills. The teachers selected taught Mathematics, Science, English, or Social Studies from grades 4 to 11. The findings were that through project-based learning, students gain more skills such as collaboration, communication and critical thinking, leading to learning deep content knowledge (Ravitz et al., 2012). Additionally, Ravitz et al. (2012) reported that teachers who used project-based learning were reported to have managed to develop and assess soft skills. This was established through a study that explored the impact of this technique (project-based learning) on the teachers' capacity to teach and assess soft skills.

A study by Holmes and Hwang (2016) , in Holland, Michigan, USA, examined the benefits of project-based learning to secondary-mathematics students' skills development and techniques for learning. The study employed a mixed-method, longitudinal design using a test, interviews and a survey to collect data. A total of 532 secondary students from grades 8 and 9 participated in the study. The findings were that project-based learning intrinsically motivated the students in learning mathematics, and they showed an increase in their critical thinking abilities. The study further reported a decrease in the achievement gap among different demographic clusters and achievement levels in secondary mathematics among students. The study, which reviewed literature to address two subjects, regarding project-based learning in Mathematics and its effect on developing and assessing soft skills, concluded that "topic-specific assessments tended to show gains in achievement" (Jacques, 2017, p. 430).

Holmes and Hwang (2016) further reported that gains were noted to have been transferred to state assessments with the use of project-based learning. Research has established that the use of the project-based learning technique, depends on the subject area and grade level, as well as carefully planning, managing, and assessing the connection between academic content and soft skills (Ravitz et al., 2012). Thus, it is the teachers' responsibility to determine the kind of projects appropriate to the grade level and how soft skills can be assessed.

2.2.4 The portfolio assessment model

Students' work may also be evaluated through portfolios. A portfolio is defined as an accumulation of a student's work collected over a period and varies in form, function and content (Cicmanec & Viechnicki, 1994). Applying the definition to Mathematics, a portfolio is "a showcase for student work, a place where many types of assignments, projects, reports, and writings can be collected as well as students' progress in, attitudes toward, and understanding of Mathematics are monitored comprehensively" (Stenmark & NCTM., 2007, p. 35).

The student's portfolio is one of the assessment tools that weigh the progress made and the work that has been accomplished (Khuzzan & Mahdzir, 2020; Wilson, 2014). Over the years "mathematics teachers have used portfolios in their classrooms to make instructional decisions" (Wilson, 2014, p. 698). Also, Fukawa-Connelly and Buck (2010) reported that "students have developed the ability to read and write about Mathematics through portfolios and have submitted more self-directed, higher-quality work on other assignments" (p. 650). Fukawa-Connelly and Buck (2010) admitted that the use of a portfolio as an assessment tool is challenging and consumes time. However, the tool has enhanced students' ability to read and write in Mathematics. Hence, besides assessing the progress made and work accomplished by the students' portfolio, the assessment tool can be used to assess communication skills.

A study by Cicmanec and Viechnicki (1994) evaluated the use of portfolio tools for assessing students' learning in Mathematics and reported that there was a "weak support for claims that Mathematics portfolio assessments enhance student learning and promote effective communication among teachers, students, and parents" (p. 167). The authors recommended that a strong rationale needs to be established for selecting a portfolio as a tool for assessment in Mathematics.
However, recent studies reported the contrary. For instance, it is argued in a study which investigated students' mathematical thinking through the use of portfolio tools, that students' achievement proficiency improved in Mathematics and that the "portfolio assessments played a major role in the successes" (Fukawa-Connelly & Buck, 2010, p. 650).

The process of generating portfolios to monitor students' progress raises their expectations, which attracts appropriate instruction and support from the teacher. It also shows that teachers do care about the students' learning and that working hard was key to success (Fukawa-Connelly& Buck, 2010; Khuzzan & Mahdzir, 2020). Therefore, mathematics teachers are urged to embrace the use of portfolios in teaching and learning Mathematics, to be able to assess soft skills like communications skills, which are not assessed through standardized tests.

Therefore, assessing what students know and can do is not only done through standardized tests but also performance assessment tasks, standard-based projects, rubrics and assignments (Care et al., 2018; Ministry of General Education, 2019). Nevertheless, even after the revision of the curriculum in Zambia, test items in the assessment papers for Mathematics and other subjects are still based on the cognitive domain (Ministry of General Education, 2019). The cognitive domain largely covers cognitive aspects of the student (Anderson et al., 2001), yet the revised curriculum covers a full spectrum of the students' development, including soft skills captured under the affective domain developed by David Krathwohl (Krathwohl et al., 1964). This shows that the soft skills and competences on focus may not be adequately assessed when Bloom's taxonomy of the cognitive domain is used as the assessment guide. Based on the reviewed studies, this study intends to examine mathematics teachers' practices which involve the assessment of soft skills. Since the implementation of the ZECF of 2013, very little is known about how mathematics teachers assess soft skills in teaching and learning Mathematics. Therefore, this study was necessary since there had been no such a study conducted in Zambian secondary schools.

3. Theoretical Framework

The control theory guided the study, which takes into consideration the vital concerns of the cognitive and emotional dimensions of learning in the soft skills assessment (Gibb, 2014). Carver and Scheier (1982) expounded that control theory provides a model of self-regulation required to operate effectively and is useful in the analysis of human behavior. It is argued that when assessment is done well, it can reveal gaps and prompt curative measures to reduce the discrepancy (Gibb, 2014). The important aspect of self-regulation in control theory is the feedback loop. The feedback loop is defined as "Information about the gap between the reference level and the actual level of a system parameter used to close up the gap" (Gibb, 2014, p. 8). The theory fits well with this study because it aimed at examining the extent to which the assessment techniques that mathematics teachers use in secondary schools assessed soft skills. This is because the sole purpose of assessment, among many others, is to diagnose student learning difficulties, provide feedback, help in planning how to carry out instruction, and maintain social balance in the learning process (Guevara-Bazán et al., 2020). Gibb (2014) summarizes that in control theory, the assessor (teacher) can diagnose the lack of capacity in the attainment of soft skills on the part of the recipient (student) and adjust instructions and provide feedback to close the gap.

4. Methodology

4.1 Research Design

A sequential multi-phase design, involving multiple phases of data collection and analysis by Saunders et al. (2016), guided the study. A sequential multi-phase research design is a research process, which recognizes that mixed methods research is interactive, where one phase subsequently informs and directs the next phase of data collection and analysis (Ridenour & Newman, 2008; Teddlie & Tashakkori, 2009).

Data were collected in two phases. The first phase involved the collection of data through a questionnaire. The second phase involved the collection of data using a lesson observation schedule involving 124 videos.

4.2 Participants and Their Demographic Factors

The participants, purposively selected for the study, were mathematics teachers from secondary schools in Mazabuka District in Zambia. A total of 91 participants were drawn from 22 secondary schools, which included non-public and public schools. Of the 91 participants, 81 returned the questionnaires after completing them and 31 had four of their lessons captured through a video recording. The distribution of the mathematics teachers according to the type of school, gender, age and experience is shown in Table 1.

Table 1: Distribution of mathematics teachers according to their gender, age, teaching experience, qualifications and type of school (n=91)

Factors	Description	Frequency
Gender	Male	48 (53%)
	Female	43 (47%)
Age (in years)	$25 \leq X \leq 34$	36 (40%)
	$35 \leq X \leq 44$	35 (38%)
	$45 \leq X \leq 54$	20 (22%)
Teaching experience (in years)	≤ 10	50 (55%)
	> 10	41 (45%)
Qualifications	Diploma	46 (51%)
	Bachelor	45 (49%)
Type of school	Non-public schools	45 (49%)
	Public schools	46 (51%)

The gender of mathematics teachers, as indicated in Table 1, were 48 (53%) male and 43 (47%) female. Mathematics teachers who participated in the study were of ages ranging from 25 years to 54 years. The study took place in two different types of schools namely public and non-public. There were 45(49%) from Non-public schools and 46(51%) from public schools.

4.3 Research Instruments

A questionnaire and observation schedule were used in this study. The items in the questionnaire and observation schedule were adapted from a Validation of Modified Soft Skills Assessment Instrument (MOSSAI) (Aworanti et al., 2015) and the Reformed Teaching Observation Protocol [RTOP](Piburn et al., 2000). The adapted items were measured using literature and standards set in the Framework for 21st Century Learning developed by the Partnership for 21st Century Learning (P21) (Global Partnership for Education [GPE], 2020). In particular, the adapted items were the learning and innovation skills comprising creativity and innovation, critical thinking and problem solving, communication and collaboration.

4.4 Validity and Reliability of the Instruments

The 5-point Likert scale used in the study was found to have a good internal consistency, with a Cronbach’s alpha coefficient of .725. The Cronbach's alpha coefficient for the scale used to establish the assessment techniques that mathematics teachers use to assess soft skills in Mathematics was slightly above 0.7. The scales were considered reasonably reliable based on the sample. For the data from the observations, inter-rater reliability of the observers was done using Spearman’s rho to establish the level of agreement among the observers (Saunders et al., 2016). The results for the computed Spearman correlation coefficient are presented in Table 2.

Table 2: Spearman correlation coefficient among the four observers on the extent to which the assessment techniques mathematics teachers used captured soft skills

Correlations			Evaluator 01	Evaluator 02	Evaluator 03	Evaluator 04
Spearman's rho	Evaluator 01	Correlation Coefficient	1.000	.989**	.994**	.983**
		Sig. (2-tailed)				
	Evaluator 02	Correlation Coefficient	.989**	1.000	.994**	.972**
		Sig. (2-tailed)				
	Evaluator 03	Correlation Coefficient	.994**	.994**	1.000	.977**
		Sig. (2-tailed)				
	Evaluator 04	Correlation Coefficient	.983**	.972**	.977**	1.000
		Sig. (2-tailed)				

**. Correlation is significant at the 0.01 level (2-tailed).

4.5 Data Analysis

The data from the questionnaire and the observation schedule were analyzed and presented in frequencies, percentages, mean (M), standard deviations (SD) and chi-square statistics, using the Statistical Package for Social Sciences (SPSS) (IBM Corp., 2015).

4.6 Limitation of the Study

The study explored assessment techniques that integrate soft skills in teaching mathematics in secondary schools in Zambia and were subject to a sample size limitation. This is because the 91 participants were not representative of all the teachers in the country. The implication is that the results may not be generalized.

5. Results

5.1 Research Question 1

To what extent do the assessment techniques mathematics teachers use in secondary schools in Zambia assess soft skills?

5.1.1 Data from the self-reporting questionnaire

The assessment techniques that mathematics teachers used to assess soft skills

To establish the extent to which the assessment techniques mathematics teachers, used in secondary schools in Zambia to assess soft skills, mathematics teachers were asked to put a tick (√) in the appropriate box that suited their response to the given statement in the self-reporting questionnaire. Table 3 reports the frequencies, percentages, means (M) and standard deviations (SD) where **SD, D, U, A** and **SA** represent strongly disagree, disagree, uncertain, agree and strongly agree, respectively.

Table 3: Frequencies, percentages, mean and standard deviation according to mathematics teacher's assessment of soft skills in Mathematics (n = 81)

SN	Statement	Frequency					M	SD
		SD	D	U	A	SA		
1	I assess students' development of soft skills through Mathematics long term tasks that I administer to the class.	3 (4%)	4 (5%)	11 (14%)	46 (57%)	17 (21%)	3.86	0.93
2	I assess and monitor students' progress in Mathematics by keeping records of the students' development of soft skills.		1 (1%)	8 (10%)	34 (42%)	38 (47%)	4.35	0.71
3	I assess students' performance by administering Mathematics assignments.	1 (1%)	2 (2%)	2 (2%)	43 (53%)	33 (41%)	4.30	0.75
4	I use Mathematics tailored rating scale in class to assess students' development of soft skills.	2 (2%)	2 (2%)	25 (31%)	44 (54%)	8 (10%)	3.67	0.79
5	I administer Mathematics quizzes to assess students' performance.	3 (4%)	5 (6%)	5 (6%)	36 (44%)	32 (40%)	4.10	1.02
6	I assess students' mathematical understanding by administering games.	4 (5%)	11 (14%)	17 (21%)	38 (47%)	11 (14%)	3.51	1.05
7	I administer mathematical activities to assess students' critical thinking/problem-solving skills.		1 (1%)	1 (1%)	28 (35%)	51 (63%)	4.59	0.59

The analysis portrayed in Table 3 shows a high mean score on the assessment approaches mathematics teachers claimed to use in the integration of soft skills, ranging from performance tasks, project-based learning, quizzes, rubrics, portfolio, and assignments. The mean score, on average, was between M ≥3.51 and M ≤ 4.59. The high mean score could indicate that mathematics teachers used the assessment approaches that allow the integration of soft skills in the teaching and learning of Mathematics. However, a variation in responses, ranging from strongly disagree to strongly agree may indicate a lack of clarity on the assessment approaches Mathematics teachers use as to whether they assess soft skills or not.

5.1.2 Data from the observation schedule

The study captured and evaluated 124 video-recorded lessons from 31 mathematics teachers. Each of the 31 teachers had four of their lessons captured. The evaluation was done by the researcher and other three evaluators who together made 496 observations.

5.1.3 The extent to which assessment techniques mathematics teachers used in Mathematics assess soft skills

After establishing the Spearman correlation coefficient among the four observers which was ≥ .972, data were analyzed and presented in Table 4.

Table 4: Frequencies, percentages, Mean and standard deviation according to Mathematics teacher's assessment of soft skills in Mathematics (n = 496)

Statement	Frequency		M	SD
	Yes	No		
1. The teacher assessed students' performance through Mathematics projects that he assigned to the class.		496 (100%)	0.000	0.000
2. The teacher assessed and monitored students' progress in Mathematics using portfolios.		496 (100%)	0.000	0.000
3. The teacher assessed students' performance through administering Mathematics class exercise.	379 (76%)	117 (24%)	0.764	0.425
4. The teacher assessed students' performance through administering Mathematics assignments.	5 (1%)	491 (99%)	0.010	0.100
5. The teacher used Mathematics tailored rubrics in class to assess students' performance.		496 (100%)	0.000	0.000
6. The teacher administered Mathematics quizzes to the class to assess students' performance.		496 (100%)	0.000	0.000
7. The teacher assessed students' mathematical understanding by administering games.		496 (100%)	0.000	0.000
8. The teacher administered mathematical activities to assess students' critical thinking/problem-solving skills.		496 (100%)	0.000	0.000

Table 4 indicates a comparatively low mean on the assessment approaches mathematics teachers used in the teaching and learning of mathematics based on the 496 observations made on the 124 videos. The results from the observations have shown a mean score on average between M ≥ 0.00 and M ≤ 0.76. The mean M = .76 was the class exercises the teachers administered during the teaching and learning of Mathematics which does not elicit high-order thinking skills, such as problem-solving, critical thinking and creativity and innovation (Minarni & Elvis, 2019; Ministry of General Education, 2019). The small mean indicates that from the videos observed the assessment techniques mathematics teachers use in secondary schools in Zambia do not assess soft skills.

5.2 Research Question 2

Is there any relationship between mathematics teachers' demographic factors and the assessment techniques they used in the teaching and learning of Mathematics?

This research question was explored by examining the effect of teachers' gender and the type of school where they were teaching based on the data from the observation schedule. To establish the effect of demographic factors on the teachers' choice of assessment techniques, a chi-square statistic was computed (Morgan et al., 2011).

5.2.1 Teachers' demographic factors and the assessment techniques they used in the teaching and learning of Mathematics

Gender

The study investigated whether male and female mathematics teachers differed in the assessment techniques they used in the teaching and learning of Mathematics (ref. Table 4). The findings suggest that there was no statistical difference between them ($\chi^2 = 2.794$, $df = 1$, $N = 496$, p-*value*=.095).

Type of school where teachers were teaching

The study also examined the effect of the type of school where mathematics teachers who participated in the study were teaching and the assessment techniques they were using in the teaching and learning of Mathematics, as reported in Table 4. The findings showed that mathematics teachers from non-public schools were likely to slightly differ from those from public schools ($\chi^2 = 5.163$, $df = 1$, $N = 496$, p-*value*=.023).

6. Discussions

6.1 The Extent to Which the Assessment Techniques Mathematics Teachers, Used in Secondary Schools in Zambia to Assess Soft Skills

The results from the observations show a mean score on average between $M \geq 0.00$ and $M \leq 0.76$. The mean M = .76 was the class exercises the teachers administered during the teaching and learning of Mathematics, which does not elicit high-order thinking skills such as problem-solving, critical thinking and creativity and innovation (Minarni & Elvis, 2019; Ministry of General Education, 2019). The small mean indicates that from the videos observed, the assessment techniques mathematics teachers use in secondary schools in Zambia do not assess soft skills. This is not far from the results obtained by Blom et al. (2017), who reported that curricula in Zambia, Botswana and Lesotho presented little evidence that soft skills, such as problem-solving, collaboration, entrepreneurship, and self-management, were assessed in the teaching and learning. Similarly, a study by Mkimbili and Kitta (2019), that critically analyzed the assessment of competencies in secondary schools in Tanzania, reported that teachers were still using written tests as assessment tools, which did not develop competencies, such as soft skills, in students. The study recommended that attaining a better assessment level requires restructuring the assessment techniques to include portfolio assessments, oral examinations and projects (Mkimbili & Kitta, 2019). These techniques ensure that students are engaged in critical thinking skills (Mkimbili, 2018).

The teachers are well-positioned to take up a very important role in developing students' soft skills, which demands a high level of thinking (Soh et al., 2012). Although the ZECF of 2013 demands this, the assessment tasks in Mathematics at both school and national levels do not incorporate adequate tasks that demand high-level thinking (Ministry of General Education, 2019). Thus, teachers are constrained to focus on integrating soft skills that enhance higher levels of thinking.

Mathematics teachers require knowledge on techniques that embrace student-centered approaches to develop soft skills and employ performance-based assessments. However, teachers have continued with the same assessment methods despite the curriculum being changed from content-based to competency-based. The consequence of not assessing soft skills could be that mathematics teachers may not see the need to focus on the development of soft skills.

6.2 Mathematics Teachers' Demographic Factors and the Assessment Techniques They Used in the Teaching and Learning of Mathematics

The study investigated the relationship between mathematics teachers' demographic factors and the assessment techniques they used in the teaching and learning of Mathematics. The results show in the choice of assessment techniques used in the teaching and learning of Mathematics, males are not more likely to differ from females. The phi was .075, indicating a weaker association between the two variables (Morgan et al., 2011). Furthermore, the results suggest that mathematics teachers from non-public schools slightly differed in the choice of assessment techniques they were using in the teaching and learning of Mathematics from teachers from public schools. However, the phi was -0.102, showing a weaker association between the two variables (Morgan et al., 2011).

7. Conclusion

This study investigated assessment techniques mathematics teachers used that signify the integration of soft skills in secondary schools in Mazabuka District in Zambia. In conclusion, the study established that the assessment techniques mathematics teachers were using did not assess soft skills based on the data from the observation. The findings further suggest that mathematics teachers' choice of assessment techniques used in the teaching and learning of Mathematics was not related to gender but to the type of school where teachers were teaching, even though the association between the two variables was weaker. These findings could be an indication that secondary school mathematics teachers do not focus on the assessment of soft skills. The consequence of this may be that secondary school leavers may not be good communicators, innovators, creators and critical thinkers. However, the results may not be generalized as the sample was not representative of the whole country. The importance of assessing soft skills cannot be over overlooked as it is the only way of confirming that soft skills are integrated in the teaching and learning of Mathematics. Therefore, it is recommended that mathematics teachers be upskilled in the use of a variety of assessment techniques such as performance-based tasks, rubrics, assignments, observation, portfolio and standard-based projects that would capture soft skills.

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Appendix

A SCALE FROM THE QUESTIONNAIRE

INSTRUCTIONS:

Put a tick (√) in the appropriate box that suits your response to the given statement where **SD** (Strongly Disagree), **D** (Disagree), **U** (Uncertain), **A** (Agree), and **SA** (Strongly Agree)

SN	Statement	SD	D	U	A	SA
1	I assess students' development of soft skills through Mathematics long-term tasks that I administer to the class.					
2	I assess and monitor students' progress in Mathematics by keeping records of the students' development of soft skills					
3	I assess students' performance by administering Mathematics assignments					
4	I use Mathematics tailored rating scale in class to assess students' development of soft skills.					
5	I administer Mathematics quizzes to assess students' performance.					
6	I assess students' mathematical understanding by administering games.					
7	I administer mathematical activities to assess students' critical thinking/problem-solving skills					

A SCALE FROM THE LESSON OBSERVATION SCHEDULE

Part 3: Assessment approaches that capture soft skills in the teaching and learning Mathematics

Instructions: Tick (√) either YES or NO against the statements regarding the lesson observed concerning the approaches used in the assessment of soft skills. Give a brief description of the lesson observed concerning the assessment of soft skills

SN	STATEMENT	NO	YES
1	The teacher assessed students' performance through Mathematics projects that he assigns to the class.		
2	The teacher assessed and monitored students' progress in Mathematics using portfolios.		
3	The teacher assessed students' performance by administering Mathematics class exercise		
4	The teacher assessed students' performance by administering Mathematics assignments		
5	The teacher used Mathematics tailored rubrics in class to assess students' performance.		
6	The teacher administered Mathematics quizzes to the class to assess students' performance.		
7	The teacher assessed students' mathematical understanding by administering games.		
8	The teacher administered mathematical activities to assess students' critical thinking/problem-solving skills		