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Mathematics teachers' conceptual understanding of soft skills in secondary schools in Zambia

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Abstract

Teachers' conceptual knowledge contributes to the quality of teaching and learning of mathematics. The purpose of this study was to explore how mathematics teachers show understanding of soft skills and if they are aware of the methods that incorporate them in teaching and learning of mathematics. The sample consisted of 91 mathematics teachers, comprising 48 males and 43 females, who were purposively selected from secondary schools in Mazabuka district in Zambia. The parallel mixed design was used to collect data through a conceptual understanding test, developed using literature. Data were analyzed using JASP, SPSS software, and an excel spreadsheet. The findings revealed that the majority of mathematics teachers did not possess enough conceptual understanding of soft skills, and most of them were not aware of the methods and assessment strategies that incorporate soft skills. Additionally, mathematics teachers' demographical factors such as age, gender, level of education and teaching experience were not found to have influenced teachers in the way they classified teaching and assessment strategies as very appropriate, appropriate, or not appropriate except in a few instances were gender and age had shown to have an influence. The study provides an insight into the needs of mathematics teachers to have adequate knowledge and preparation in the integration of soft skills in mathematics.

Keywords: mathematics teachers, conceptual understanding, competence, soft skills, assessment

INTRODUCTION

The era of the fourth industrial revolution is fundamentally changing the way we work, live, and relate to one another and every part of society is reconsidering transforming to keep up with the demand (Schwab, 2017). The fourth industrial revolution was initiated to shift from hand to digital production approaches. It is known to conceptualize the skills such as innovation, rapid communication and high order thinking in all sectors of business (Huda et al., 2021).

Equally, the education system is being reshaped not only to incorporate development in the social, economic, technological and political spheres but also equipping students with dynamic skills, values and knowledge necessary for the development of the whole person (Curriculum Development Centre [CDC], 2013d). It is this observation that has influenced many countries including Zambia to revise their curriculum. In the revised curricula, the focus is not only on knowledge and values but on all the skills that are necessary for contributing to the development of all students and society (CDC, 2013d; Kenya Institute of Curriculum Development [KICD], 2017; Rwanda Education Board [REB], 2015). Soft skills are emphasized as among the skills that every teacher should demonstrate. They include critical thinking and problem-solving, creativity and innovation, communication, cooperation, entrepreneurship, and management skills (CDC, 2013a, 2013d).

Mathematics teachers' conceptual knowledge of soft skills is a precursor to their capacity of developing an

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Contribution to the literature

- To raise awareness of mathematics teachers' conceptual understanding of soft skills in the secondary schools in Mazabuka district in Zambia.
- To update mathematics teachers with the teaching methods and assessment strategies that involve soft skills.
- To provide an insight into the need for mathematics teachers to have adequate knowledge and preparation in the integration of soft skills in mathematics.

understanding of mathematics among students during teaching and learning. Research has indicated that teachers can acquire soft skills through training and the process of continuous professional development (Huda et al., 2021). It is also imperative for teachers to properly possess both hard and soft skills to deliver a lesson effectively (Crawford et al., 2020).

Fernández-Arias et al. (2021) adds that when teachers have a high self-conception of soft skills, they incorporate them in the teaching and learning process. However, if teachers lack conceptual knowledge about soft skills, it will lead to the inability to integrate them during the teaching and learning process. Therefore, we found it very imperative to conduct this study to explore how mathematics teachers conceive and apply soft skills in the classroom. This will provide an insight into how mathematics teachers are capable to assist their students to develop these skills. In addition, mathematics teachers will be exposed to new methodologies and assessment techniques required in the integration of soft skills, adopted in the 2013 revised curriculum.

Mathematics teachers are expected to ensure that students are exposed to tasks that help them acquire the six soft skills reflected in the 2013 revised curriculum. However, this study focused on establishing mathematics teachers' conceptual knowledge of the four soft skills namely communication, collaboration, problem-solving/critical thinking, and creativity and innovation. This study intended to find answers to the following research questions:

1. To what extent do mathematics teachers in secondary schools express the conceptual understanding of soft skills?
2. Is there any relationship between mathematics teachers' demographic factors and the classification of teaching and assessment strategies that involve soft skills?

LITERATURE REVIEW

The literature focuses on the conceptualization of soft skills, the teaching methods and assessments strategies that require the integration of soft skills, and the theoretical framework.

The Conceptualization of Soft Skills

Soft skills have been conceptualized as skills, which are not tangible or touchable. According to Lippman et al. (2015), soft skills refer to

> "a broad set of skills, competences, behaviors, attitudes, and personal qualities that enable people to effectively navigate their environment, work well with others, perform well, and achieve their goals" (p. 4).

The Partnership for 21st Century Skills [P21] (2015) referred to soft skills as 21st-century skills and grouped them into three categories namely: learning skills, literacy, and life skills. On the one hand, learning skills embrace four main features, that is, critical thinking, creativity, collaboration, and communication. On the other hand, literacy skills capture the notion of information literacy, technology literacy and media literacy, while life skills are reflected in flexibility, productivity, initiative leadership, and social skills. The Zambian curriculum documents refer to soft skills as "key competences" (CDC, 2013a, p. x, 2013d, p. 6). It is very important to note that competences by definition are a collection of knowledge, skills, values and attitudes (CDC, 2013d; KICD, 2017; Organization for Economic Cooperation and Development [OECD], 2018). Hence, soft skills are a subset of competences. In this study, the term soft skills have been used to represent the learning skills referred to as key competences in the 2013 revised curriculum.

There is a clarion call for the integral development of students where the soft skills are to be developed. This is because soft skills enable students to deepen their understanding of the subject content and apply what they learn in a variety of circumstances (CDC, 2013b). Soft skills among scholars are of paramount importance, though there is still a lack of agreement on what these skills are. Marin-Zapata et al. (2021) conducted a systematic review to establish how soft skills are conceptualized and the results show a lack of consensus on what these skills are. Thus, the referring of soft skills to competences or other terms is not only synonymous with Zambia. For instance, Lippman et al. (2015) augment that an increasing focus on soft skills has been reflected in different terms linked to subject including

> "21st century skills, life skills, essential skills, behavioral skills, non-cognitive skills, youth development assets, workplace or work readiness competences, social-emotional learning [SEL], transferrable skills, employability skills, and character skills" (p. 13).

The truth of the matter is that some of these terms are not identical to soft skills and may not be used interchangeably. For example, soft skills are not synonymous with 21st century skills in the sense that they have existed even before the 21st century, and only that they were delineated from the learning outcomes (Quieng et al., 2015). Additionally, Silva (2009) argues that the concept of soft skills might sound modern, and referred to as 21st century skills. Similarly, Ananiadou and Claro (2009) make it clear that soft skills are referred to as 21st century skills to show that they are more required to cope with the developing models of economic and social advancement currently prevailing. Therefore, limiting soft skills to the 21st century may mean they are for a specified period and may not be necessary for the coming centuries.

Frymier and Houser (2000) conducted two studies at Midwestern University, where they compared males and females on how they conceptualized soft skills, particularly communication skills. The findings were that in the first study, gender differences were noted where females conceptualized soft skills better than males while in the second study there was no statistical difference based on gender. Furthermore, the authors reported that

> "while the correlations between communication skills and learning and motivation were greater for females than for males. The differences were not significant with two minor exceptions" (Frymier & Houser, 2000, p. 217).

In the first study, there were 93 respondents while in the second one, there were 257 selected purposively and, in both situations, a survey was used to collect data. The alpha reliabilities, mean and standard deviations were used to analyze data.

Huda et al. (2021) conducted in-depth interviews with a phenomenological approach to collect data involving 15 purposively selected respondents from five universities. The data were analyzed through horizontalization, structurally, texturally, and critical descriptions phases. The results established that teachers showed an understanding of soft skills through the hidden curriculum designs. However, the study recommended that soft skills integration could be done through a structured curriculum to have teachers gain better abilities. Mathematics teachers are expected to ensure that students are exposed to tasks that help them acquire the six soft skills reflected in the 2013 revised curriculum. However, this study focused on establishing mathematics teachers' conceptual knowledge of the four soft skills namely collaboration, communication, problem solving/critical thinking, and creativity and innovation.

Collaboration skills

Collaboration is the process whereby two, three, or more students work in teams to achieve shared objectives. Collaborative learning is a mechanism in which two or more students work together in a learning situation, where there is sharing and contributing to each other's understanding and completion of a given task (KICD, 2017; Ngang et al., 2015a). The main role of collaboration is that students work in groups on tasks assigned by the teacher, which leads to the development of positive moral and ethical attitudes to socially acceptable behavior (REB, 2015). Thus, engaging students in collaborative learning groups in the teaching and learning of mathematics is very critical.

Collaboration is further referred to as one of the soft skills because when students engage in collaborative learning groups, they are supported to achieve higher as opposed to competitive and individual work (Huss, 2006). Collaboration skills also involve the capacity to work in small groups with people from different social and cultural backgrounds to attain a shared goal (MINEDUC & REB, 2015; Ngang et al., 2015a), which will result in positive ethical moral values and respect for the rights, views and feelings of others (REB, 2015). Research has shown that one of the ways to address some of the instructional challenges of struggling students is to use collaboration because the knowledge one student brings can address the challenge of the other (Delinda et al., 2009).

Webb (2009) reviewed several studies that focused on teachers promoting collaboration through small groups led by students in the context of learning. The review exposed some roles that teachers play in ensuring that students benefit from the group dialogue. The review also revealed that it is the teachers' responsibility to engage students in collaborative work through the creation of groups, preparing the tasks, encouraging interactions and fostering useful dialogue among the students (Webb, 2009). Thus, the embracing of collaboration in teaching and learning mathematics reduces pressure on teachers to respond to challenges students face as each student brings to the joint effort a unique contribution and members support each other to achieve the goal.

Communication skills

The other soft skill is communication, which is referred to as the capacity of the students to describe, express their ideas and coherently discuss mathematical concepts in a clear manner (Lomibao et al., 2016). In other words, when students' communication skills are

developed in mathematics, it helps their conceptual understanding to be deepened. According to KICD (2017), communication is the action involving the transfer of information from one point to another, which could be visually, vocally, or non-verbally. On the other hand, Spitzberg and Cupach (1989) argue that communication is the capability to interact in a way with others with clarity, accuracy, coherence, comprehensibility, expertise, appropriateness and effectiveness. The skill of communication can be measured effectively by determining whether the goals of interaction are achieved or the degree to which individuals fulfil their objectives in a given social context without endangering their capacity to follow the other goals that are more significant (Parks, 1994). Communication can also be referred to as the conveying of ideas, and information through speaking, writing and other forms using correct language structure more effectively in different social and cultural settings (REB, 2015).

Ngang et al. (2015b) indicate that mathematics teachers and students should be able to express their point of view with clarity, and confidence both in spoken and written forms. Thus, students should be taught to be active listeners while teachers are providing the necessary responses. This is not far from what MINEDUC and REB (2015) emphasize that students should be taught to communicate confidently, in a clear manner and convey ideas more efficiently through speaking, writing, and using the correct language structure with appropriate vocabulary. Studies have established that

> "challenging students to communicate both orally and in writing in a mathematics class help deepen their conceptual understanding, improve their performance, and reduce anxiety towards mathematics" (Lomibao et al., 2016, p. 378).

The integration of communication skills in the teaching and learning of mathematics is to enable students develop the ability to effectively communicate the findings through the construction of arguments, explanations and drawing relevant conclusions. Ngang et al. (2015b) conducted a study to investigate the gaps in the soft skills teachers acquired before employment on 250 novice teachers using a quantitative approach, in Malaysia. The findings showed that communication and collaboration skills were the most gained by novice teachers during their training. Furthermore, Lomibao et al. (2016) used a mixed-method design with 188 secondary school students in a study, which focused on establishing the impact mathematical communication has on the students' performance in mathematics. The findings are that students with developed mathematical communication skills significantly achieved higher and exhibited a conceptual understanding of the subject (Lomibao et al., 2016). From these findings, we note that the measure of how well students' communication skills are developed is by rating their ability to transmit and receive information. It is, therefore, the responsibility of mathematics teachers to make sure students use the proper language of instruction.

Critical thinking and problem-solving skills

The central aspect of quality education is teaching students how to think critically and solve various problems around the world. According to British Council (2015), and Minda (2015), there are different kinds of higher-order thinking skills namely reasoning, decision making, problem solving and expertise. Critical thinking skills enable students to learn that there are different ways of solving a problem. Ngang et al. (2015b) share similar ideas that developing critical thinking skills can improve the generation of ideas and use alternative methods to solve a problem. Students develop critical thinking skills through the utilization of logical reasoning to arrive at meaningful conclusions. KICD (2017) expresses that critical thinking skills help students

> "to have an open mind, and be ready to listen and appreciate the information, and opinions that may sometimes conflict with their earlier held beliefs and positions" (p. 24).

The developers of the revised curriculum expect that students while in secondary school develop mathematical thinking by constructing, using symbols, applying, and generating mathematical ideas (CDC, 2013c).

A study conducted by Al-Mutawah et al. (2019) in Bahrain, measured high school graduates' conceptual understanding, problem-solving and procedural knowledge. The study collected both quantitative data through a test and qualitative data through conducting interviews targeting 350 students. Data were analyzed using Pearson correlation, Scheffe's test and ANOVA. The findings indicate that problem solving provides chances for students to utilize content knowledge in mathematical domains and provide an opportunity for students' mathematical thinking (Al-Mutawah et al., 2019). Also, Al-Mutawah et al. (2019) state that problem-solving involves students applying four processes in mathematics such as communication, reasoning, representation and connections. Researchers have further argued that when students develop problem-solving competences, they become more disciplined, self-directed and self-monitored thinkers (Elder & Paul, 2010). The inclusion of critical and problem-solving skills is to enable students to use different approaches in solving mathematical problems linked to real-life situations. Therefore, the need for developing problem-solving skills cannot be under emphasized, as they are important mathematical skills.

Creative and innovation skills

The 2013 revised curriculum in Zambia has an inclusion of developing students, creative and innovative skills, which teachers should develop through teaching, including creating an enabling atmosphere that offers all the students' a chance to discover their full potential. The processes of imagining things that are not really in the mind, forming pictures and turning them into what is real are what creativity and innovation are all about (British Council, 2015; KICD, 2017; REB, 2015). Creativity and innovation skills are considered among the most critical skills of the time by various organizations and institutions that can be cultivated in students (Kaufman & Beghetto, 2009; Umeghalu & Obi, 2020; van Harpen & Sriraman, 2013).

In support, the British Council (2015) states that creativity and innovation involve the capacity to form perceptions, and new imageries in the mind to turn them into reality. Regarding education, creativity and innovation refer to the capacity of students and teachers to form mental imageries or simply ideas in the mind and turn them into reality (KICD, 2017).

The acquisition of creativity and innovation skills helps students to take up the initiative and use imagination rather than the knowledge provided by the mathematics teachers to generate and construct new ideas (Duffy, 2006) innovation refer to the capacity of students and teachers to form mental imageries or simply ideas in the mind and turn them into reality (KICD, 2017).

The acquisition of creativity and innovation skills helps students to take up initiative and use imagination further than the knowledge provided by the mathematics teachers to generate and construct new ideas (Duffy, 2006). In support, the MINEDUC and REB (2015) indicate that the acquisition of creativity and innovation skills can be attained through mathematics contests and competitions so on and so forth.

Bicer et al. (2020) reviewed 30 studies that were conducted from 1964 to 2018 and investigated the relationship between students' mathematical achievement and their creativity. The review concluded that there was a positive correlation between students' achievement and creativity (Bicer et al., 2020). In addition, the authors indicated that among the studies reviewed, those conducted after the year 2000 showed

> "a stronger relationship between general creativity and mathematics achievement than did findings from studies conducted before 2000" (Bicer et al., 2020, p. 1).

From these views, it is noted that the integration of creativity and innovation skills in teaching and learning mathematics is at the core of developing students with creativity and innovation skills.

Teaching Methods and Assessment Strategies Incorporating Soft Skills

The integration of soft skills can be implemented successfully when teachers understand what these skills are, identify appropriate teaching methods, and assessment techniques that capture them (Hirsch, 2017; Marin-Zapata et al., 2021). In 2013, education curriculum framework for Zambia directs teachers to use appropriate teaching methods that promote student participation and interaction. Teachers are encouraged to use methods that support students to reflect, think and act rather than reproducing from rote learning (AlHouli & Al-Khayat, 2020; CDC, 2013a). The adaptation of appropriate teaching and assessment methods, especially, those that place the learner at the center of the teaching and learning process are key in the integration of soft skills. Additionally, the CDC equally echoes that the shift to a learner-centered approach should include group work, paired oral questioning, debates, discussions, role play, investigations, presentations, projects, assignments, problem-solving, tests, quizzes and field visits (CDC, 2013d). Since these approaches allow the integration of soft skills, mathematics teachers need to embrace them otherwise their integration will not be possible.

Assessment has been an important process in the integration of soft skills thus, mathematics teachers should be aware of and embrace appropriate assessment strategies that capture soft skills. For instance, CDC recommends performance tasks, which include assignments, and standard-based projects which students require to apply their skills, values and positive attitudes, well defined rubrics to ensure consistent and fair assessment of students' work and well-defined performance goals (CDC, 2013a). The fourth industrial revolution was initiated to change from hand production approaches to digital production approaches. It is known to conceptualize the skills such as innovation, rapid communication and high order thinking in all sectors of business (Huda et al., 2021).

Equally, the education system is being reshaped to include soft skills. However, the integration of these skills in the teaching and learning of mathematics is dependent on the teachers' conceptual understanding of the skills. Conceptual knowledge can be referred to as the understanding of theory, skills and principles needed to do a teaching or learning activity. Rittle-Johnson et al. (2001) classifies conceptual knowledge as an implied or clear understanding of ideologies that direct a domain and interrelations between units of knowledge in a domain. It involves cognitive and socio-emotional aspects such as awareness, understanding and insightful evaluations of the subject under consideration (Lankshear & Knobel, 2008).

In teaching mathematics, teachers should possess the required conceptualization of knowledge about the

appropriate teaching and assessment strategies that incorporate soft skills. A study conducted by Hendriana (2017) to explore the secondary school teachers' soft skills in the teaching and learning of mathematics on 17 mathematics teachers in Indonesia, using interviews, observations and tests, showed that mathematical soft skills are developed by using innovative teaching and learning methods than the conventional methods. Hendriana (2017) adds that to be able to integrate soft skills, teachers must possess appropriate pedagogical competences, which include the understanding of the curriculum, methodologies, and assessment techniques required in teaching mathematics.

This allows to say that innovative approaches could help students develop critical thinking and problem-solving skills. In their qualitative study about exploring the soft skills that teachers developed using innovative methods in secondary mathematics, Hidayati et al. (2021) found that several skills such as problem-solving, verbal and non-verbal mathematics communication, critical thinking, creativity and teamwork were developed. Thus, innovative approaches are the core of the development of soft skills, and teachers are required to create opportunities to help their students to innovate, independently and collaboratively.

THEORETICAL FRAMEWORK

Cognitive constructivism based on the work of Piaget (1968) guided the study. This theory fits well in the study which explored how mathematics teachers demonstrated understanding of soft skills and if they are aware of the methods that incorporate them in teaching and learning mathematics. Piaget's (1968) theory of cognitive development advocates that intelligence undergoes modifications as a person grows and that the theory is about the acquisition of knowledge through the construction of a mental model of the world. According to Piaget (1968), this occurs through the interaction of innate capabilities and events in the environment. Further,

> "constructivists view that concepts are not simply facts to be memorized and later recalled, but rather knowledge that a person develops through an active process of adapting to new experiences" (Meir, 2006, p. 162).

In the direction of Meir (2006), this simply means that new concepts change permanently what a person has learned, the way one thinks about the fact encountered, the way to process events and solve problems. Further, Skemp (1986) states that

> "to understand something is to assimilate it into an appropriate schema" (p. 43),

which involves a network of interrelated functioning and conceptual schemata. Thus, if mathematics teachers have the conceptual knowledge of soft skills, then it is something they had assimilated and appropriated to the schemata.

On the other hand, if mathematics teachers do not exhibit the conceptual understanding of soft skills, then it means they have not assimilated the concept and cannot apply it in the teaching and learning of mathematics. In support, Meir (2006) directs that in mathematics, conceptual knowledge involves understanding concepts and recognizing their applications in many situations. Also, the Graduate Student Instructor Teaching and Resource Center [GSITRC] (2016) states that in cognitive constructivism

> "knowledge is something that is actively constructed by a person based on their existing cognitive structures" (p. 5).

Furthermore, cognitivist methods of teaching and learning assist a person

> "in assimilating new information to existing knowledge and enabling them to make the appropriate modifications to their existing intellectual framework to accommodate that new information" (GSITRC, 2016, p. 6).

Thus, if mathematics teachers understand the concept of soft skills and their application, they would devise strategies of teaching and learning that would aid students to assimilate the concept into their already existing intellectual framework.

METHODOLOGY

Paradigm

Pragmatism is the paradigm that guided the study and provided an understanding of mathematics teachers' conceptual understanding of soft skills in secondary schools (Stangor, 2011). This is because pragmatism as an approach to research focuses on framing and answering the research problem, methods of data collection, and analysis employing both quantitative and qualitative approaches. Mixed approaches were further used in analysis, where we used statistical program and inductive reasoning to analyze the data.

Research Design

This study employed a parallel mixed design. Parallel mixed designs are those in which both qualitative and quantitative approaches run simultaneously but independently in addressing research questions and that both probability and non-probability samples can be selected (Cohen et al., 2018; Teddlie & Tashakkori, 2009). This design was appropriate as the instrument used in

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

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

this study was seeking both qualitative and quantitative data.

Sample Size

The population for the study consists of mathematics teachers in secondary schools in Mazabuka district in Zambia. A sample of 91 mathematics teachers was drawn purposively from 22 secondary schools in the district. A conceptual understanding test was administered to the sampled mathematics teachers. They were requested to write the test within 30 minutes. The following are demographic factors of mathematics teachers obtained through the conceptual understanding test.

Distribution of mathematics teachers by their demographic factors

Table 1 shows that the study included 48 (53%) males and 43 (47%) females. The observed ratio of males to females may be attributed to the nature of the subject, which is believed to be male-dominated (Simuchimba & Mbewe, 2021). In support, Farooq and Shah (2008) state that the female folk is in most cases discouraged from mathematical work as early as primary, secondary, and dropout at higher levels. Thus, the consequence of this is fewer women in areas like the teaching of mathematics in secondary schools.

The test was administered to teachers in three different types of schools, which were 10 non-governments (private, grant-aided) and 12 governments. In addition, the mathematics teachers who took part had varying qualifications from diplomas to bachelor's degrees in education trained from various training institutions ranging from colleges of education to universities, which were either non-public or public. The distribution of teachers according to the type of school included 46 (51%) from the public schools and 45 (49%) from non-public schools which included private as well as grant-aided schools. Of these teachers, 46 (51%) were diploma holders and 45 (49%) were degree holders.

The age of mathematics teachers who took part in the study ranged from 25 to 54 years as indicated in **Table 1**. The majority of these participants were in the age range between 25 and 34 years, constituting 40 (53%); followed by those whose age was between 34 and 44 years constituting 36 (47%) and 20 (22%) were greater than 44 years but less than 54 years. The teaching experience of participants ranged from 1 to 30 years. A good number of the participants had less than or equal to 10 years of experience in teaching mathematics, whereas the rest had more than 10 years of experience, which constituted 50 (55%) and 41 (43%) respectively. Most participants whose age range less than 34 years old and experience of less than or equal to 10 years could have been pupils, trainee teachers or trained teachers at the time the 2013 revised curriculum, which includes soft skills was being actualized.

Instrument

The data collection instrument was a conceptual understanding test. The test comprised of open-ended and closed-ended questions and some asked the respondent to put a tick under not appropriate, (NA), appropriate (A), or very appropriate (VA) to show their opinion. Furthermore, question three and four of the test in the attached **Appendix A** was adapted from a validation of modified soft skills assessment instrument (MOSSAI) (Aworanti et al., 2015). Items in question five (**Appendix A**) of the test were adapted from the reformed teaching observation protocol (RTOP) (Piburn et al., 2000).

The test items were adapted from various instruments using the comparative judgement method (Bisson et al., 2016; Pollitt, 2012b). According to Pollitt, (2012a), comparative judgement is an approach borrowed from psychophysics Thurston, which can produce extremely trustworthy results for educational assessment. Also, the comparative judgement approach was based on unstructured tasks, open-ended questions and depends on expert judgment (Bisson et al., 2016). This implies that concepts are measured by how they are perceived, understood, and used by a group of practitioners.

It was an effective alternative method of measuring mathematics teachers' conceptual understanding of soft skills and was a useful approach in this study in the sense that the test items were developed based on how soft skills are understood and perceived by practitioners. It does not require a standardized rubric or test. In support, Bisson et al. (2016) articulate that the comparative judgment method involves test questions on the particular subject of study and does not need a comprehensive rubric to determine conceptual understanding of the subject.

Validity and Item Analysis

The validation of the test was done by the experts from the African Centre of Excellence for Innovation in Teaching and Learning Mathematics and Science (ACEITLMS), University of Rwanda-School of Education, Department of Mathematics as well as from the University of Dar es Salaam, School of Education who read through and offered direction on the instrument which was later piloted (Cohen et al., 2007). The test was piloted among 10 mathematics teachers at selected secondary schools in Mazabuka district in Zambia. This was done to determine whether the test was adequate and appropriate (Bless & Higson, 2000) to be used for data collection.

The process of piloting was aimed at leading to the refinement of the instruments and identification of other unforeseen hitches (Bless & Higson, 2000). The pilot study was necessary to expose the strengths and deficiencies of items in the instruments which were revised. In particular, questions three and four were open-ended questions and respondents gave a wide range of responses hence the questions were replaced with the question in the attached **Appendix A**.

Data Analysis

The quantitative data from the conceptual understanding test were analyzed using JASP software package (JASP Team, 2021) to generate the frequency tables; the SPSS software package (IBM, 2015) to conduct some cross-tabulation and excel was used to derive the themes that emerged from the qualitative data.

Limitation of the Study

The sample size was a limitation in a way because the study was seeking to establish mathematics teachers' conceptual understanding of soft skills and the 91 participants may not be a representative of all the teachers in the country.

FINDINGS AND DISCUSSIONS

The findings and discussions highlight the extent to which mathematics teachers in secondary schools expressed the conceptual understanding of soft skills and to establish if there was any relationship between mathematics teachers' demographic factors and the classification of teaching and assessment strategies that involved soft skills.

RQ1. To What Extent Do Mathematics Teachers in Secondary Schools Express the Conceptual Understanding of Soft Skills?

To establish a conceptual understanding of soft skills, mathematics teachers were tested in four areas. Firstly, they were asked to describe what soft skills were from their understanding. Secondly, they were asked to state three examples of soft skills they were aware of. Thirdly, mathematics teachers were tested to classify as not appropriate, appropriate, or very appropriate teaching methods and assessment techniques from a suggested list that can be used to integrate and assess soft skills in mathematics. Fourthly, mathematics teachers were asked to identify the soft skill, which was being developed during the teaching and learning of mathematics when certain activities were conducted (question five in the **Appendix A**).

In addition to this, mathematics teachers were also asked to indicate the documents related to the 2013 revised curriculum, which they had access to which impacts their conceptual understanding of soft skills.

Mathematics teachers' description of soft skills

The first question in the conceptual understanding test was about establishing whether mathematics teachers could describe soft skills in their understanding. There was a wide range of ways on how mathematics teachers perceived soft skills. After coding, seven different groups of participants emerged. The groups that emerged include participants who perceived soft skills as teaching methods or approaches, computer software, skills that are easy/simple or basic, skills relating to abstract learning, abilities, or requirements to manipulate something/initiate an activity or navigate the environment, concepts related to or to be accomplished in mathematics and personal or interpersonal attributes.

There were eight participants who conceptualized soft skills as teaching methods that can be used in the teaching and learning of mathematics. A good number of mathematics teachers, that is ,11, related soft skills to computer software. Probably what came to their minds was that since it is 'soft' then it had to do with computers. Furthermore, 13 mathematics teachers conceptualized soft skills as easy, simple and basic, which, does not require effort. The concept of the term 'soft' could have played a role in the responses that mathematics teachers gave. Ten of the participants described softs skills as the ability or requirements to manipulate something, initiate an activity or navigate the environment. The ability to manipulate available technology, numbers or to initiate mathematical ideas and concepts that translate into new knowledge and ideas. The ideas were not coherent in a manner that one can understand how soft skills were conceptualized as ability.

About 14 participants conceptualized soft skills as concepts related to or to be accomplished in mathematics. This thought is not in any way related to what soft skills are in the teaching and learning of mathematics. Other participants, that is, 12, conceptualized soft skills in terms of abstract learning skills. Their description attributed soft skills to something abstract, not manual, which one can do

Table 2. Frequency and percentages of mathematics teachers' conceptualization of soft skills (n=91)

Statement	Expected correct response	Incorrect response	Correct response
		Frequency (%)	Frequency (%)
Which soft skill is being integrated?			
When students are engaged to actively participate in a mathematics lesson in small group discussions or pairs.	Collaboration	69 (76%)	22 (24%)
When students are actively engaged in thought-provoking mathematical activity that often involves a critical assessment of procedures to arrive at the correct solution.	Problem solving/critical thinking	54 (59%)	37 (41%)
When students interact and express themselves orally as well as in writing during the mathematics learning process.	Communication	72 (79%)	19 (21%)
When students form new images and sensations in the mind and turn them into reality.	Creativity & innovation	81 (89%)	10 (11%)

Table 3. Frequency and percentages of soft skills that mathematics teachers were aware of (n=91)

Activity	Category of responses	Frequency (%)
Q1. Write down at least three examples of soft skills that you are aware of:	All incorrect responses	53 (58%)
	One correct response	18 (20%)
	Two correct responses	12 (13%)
	All three correct responses	8 (9%)

without academic knowledge. While one respondent stated that he/she had no idea of what soft skills are. Six participants did not respond to the question. These descriptions of soft skills given by 75 participants are far from what they are conceptualized. However, 16 participants were able to describe soft skills correctly in terms of personal, interpersonal attributes and characteristics. Thus, these participants exhibited a correct conceptualization and were able to give the correct examples of soft skills.

The findings are that only 16 out of 91 mathematics teachers who took part in the study were able to give a correct description of soft skills which is similar to that of Pachauri and Yadav (2013) who define soft skills as

> "personal attributes that enhance an individual's interactions, job performance and career prospects" (p. 22).

The same authors add that soft skills also refer to personality traits, social grace, personal habits, fluency in language and friendliness. This indicates that mathematics teachers' conceptualization of soft skills needs improvement as only a small fraction of the participants could give a correct description of them. Furthermore, mathematics teachers were assessed to establish if they were able to identify a particular soft skill being integrated when some activities are conducted in the teaching and learning of mathematics. The participants were expected to state the correct soft skill against a particular statement. **Table 2** reports mathematics teachers' conceptualization of soft skills.

Table 2 shows the distribution of mathematics teachers according to their ability to identify a particular soft skill being integrated when some activities are conducted in the teaching and learning of mathematics. As described in **Table 2**, most mathematics teachers who were not able to give a correct response ranged from 54 (59%) to 81 (89%) while those who gave correct responses ranged from 10 (11%) to 37 (41%). The results show that majority of mathematics teachers were not able to identify the correct soft skill being developed because they lacked appropriate conceptualization of the soft skills.

Soft skills that mathematics teachers were aware of

The second question in the conceptual understanding test was about establishing whether mathematics teachers could give three examples of soft skills. This was also in response to question one. **Table 3** reports the responses to this question classified as either incorrect or correct responses.

Table 3 shows that more than half (58%) of the respondents gave all incorrect responses, whereas only 9% gave all correct responses. Incorrect responses were characterized by the way the soft skills were perceived. For instance, those who perceived them as teaching methods gave examples of teaching methods such as teacher exposition, demonstration, and discovery method among others. On the other hand, correct responses included; teamwork, collaboration, communication, critical thinking, problem-solving, and creativity.

This finding suggests that the majority of mathematics teachers were not aware of soft skills because they lacked a conceptual understanding of the skills.

The teaching and assessment approaches that can be used to integrate soft skills

The third and fourth question in the test aimed at establishing whether mathematics teachers were able to

Table 4. Frequency and percentages of rating the teaching methods that can be used to integrate soft skills (n=91)

Classifications	Suggested methods that can be used to integrate soft skills	Frequency	
		Incorrect rating (%)	Correct rating (%)
Very appropriate	Problem-based learning	43 (47%)	48 (53%)
	Cooperative learning	53 (58%)	38 (42%)
	Self-discovery	50 (55%)	41 (45%)
	Discussion	35 (38%)	56 (62%)
	Question and answer	51 (56%)	40 (44%)
	Project	48 (53%)	43 (47%)
	Demonstration	36 (40%)	55 (60%)
Appropriate	Quiz	44 (48%)	47 (52%)
	Roleplaying	54 (59%)	37 (41%)
	Direct instruction	76(84%)	15 (16%)
	Interviewing	43 (47%)	48 (53%)
	Differentiated learning	50 (55%)	41 (45%)
Not appropriate	Case study	52 (57%)	39 (43%)
	Simulation	50 (55%)	41 (45%)
	Mapping	59 (65%)	32 (35%)
	Teacher exposition	73 (80%)	18 (20%)
	Rote memorization	19 (21%)	72 (79%)
Total responses		**836 (54%)**	**711 (46%)**

Table 5. Frequency and percentages of rating the assessment techniques that can be used to assess soft skills (n=91)

Classifications	Suggested methods that can be used to assess soft skills	Frequency	
		Incorrect rating (%)	Correct rating (%)
Very appropriate	Performance assessment tasks	55 (60%)	36 (40%)
	Rubric (rating scales)	70 (71%)	21 (23%)
	Projects	44 (48%)	47 (52%)
	Portfolios	80 (88%)	11 (12%)
	Assignments	38 (42%)	53 (58%)
Appropriate	Observations	62 (68%)	29 (32%)
	Oral tests	45 (49%)	46 (51%)
	Norm referenced tests	46 (51%)	45 (49%)
	Criterion referenced tests	44 (48%)	47 (52%)
Not appropriate	Essay tests	52 (57%)	39 (43%)
	Power test	68 (75%)	23 (25%)
	Objective tests	72 (79%)	19 (21%)
Total responses		**676 (62%)**	**416 (38%)**

identify teaching and assessment approaches that were appropriate in the integration of soft skills. They were also asked to classify as not appropriate, appropriate or very appropriate teaching methods and assessment techniques from a suggested list that can be used to integrate and assess the skills in mathematics, respectively.

The teaching methods that can be used to integrate soft skills: Table 4 reports the distribution of mathematics teachers according to the rating of the teaching methods that could be used to integrate soft skills during the teaching and learning of mathematics.

The responses were reported as 836 (54%) incorrectly rated while 711 (46%) correctly rated as shown in Table 4. The small difference between the correct and incorrect rating could be attributed to the fact that the respondents were rating according to teacher- or learner-centered methods as opposed to the methods appropriate or not appropriate to integrate soft skills.

Several studies have suggested approaches that reinforce the integration of soft skills such as team-based learning, investigation, problem-based learning, inquiry-based learning, focus group discussion, experiential learning and role-play (Dawe, 2002; Kechagias, 2011; National Centre for Vocational Education Research [NCVER], 2003; Talavera & Perez-Gonzalez, 2007). Therefore, mathematics teachers are required to provide learning experiences, which encourage the development of soft skills (Theodora & Marti'ah, 2018), where both number concepts and social meanings are developed by students through learning mathematics.

The assessment techniques: The distribution of mathematics teachers according to the rating of the assessment techniques that can be used to assess soft skills during the teaching and learning of mathematics is presented in Table 5.

Table 6. Frequency and percentages of documents relating to the 2013 revised curriculum (n=91)

Documents	No	Yes
	Frequency (%)	Frequency (%)
a. Zambia education curriculum framework 2013	53 (58%)	38 (42%)
b. Mathematics syllabus grades 8 - 9	11 (12%)	80 (88%)
c. Mathematics syllabus grades 10 -12	7 (8%)	84 (92%)
d. Additional mathematics syllabus grades 10 -12	53 (58%)	38 (42%)
e. Teachers' curriculum implementation guide: Guidance to enable teachers to make best use of the Zambia education curriculum framework 2013	69 (76%)	22 (24%)

The distribution of mathematics teachers according to the classification of the assessment techniques based on a three-point scale (very appropriate, appropriate, and not appropriate) is shown in **Table 5**. **Table 5** indicates that 676 (62%) were incorrectly rated while 416 (38%) were correctly rated. The big difference between the correct and incorrect ratings can be attributed to the fact that most of the respondents were not familiar with the assessment techniques that could be used to assess soft skills.

Furthermore, determining whether teaching and learning have taken place can be evaluated through assessment. According to Care et al. (2018), measuring soft skills directly is a challenge through a written test. However, they can be measured with tools designed to capture their indicators. Subsequently, soft skills are seen through behaviors, hence requiring appropriate assessment tools to measure them. Therefore, innovative teaching and assessment approaches support mastery of mathematics concepts by students and provide a window for the development of soft skills. Several studies have indicated that soft skills can be assessed through conferencing, assessing products given in projects, tasks, portfolios, fieldwork, assignments, written test, research and examination (Dreyer & Schoeman, 2003; Mulenga & Kabombwe, 2019). Thus, if mathematics teachers are to assess soft skills, they have to be familiar with appropriate assessment techniques.

Documents review

The study further explored to establish documents related to the 2013 revised curriculum that mathematics teachers have accessed that could impact their conceptual understanding of soft skills. Mathematics teachers were asked to indicate the documents related to the 2013 revised curriculum that they had accessed. The responses are presented in **Table 6**.

Table 6 illustrates that the majority of the mathematics teachers had not accessed the two documents that highlight the integration of soft skills in the teaching and learning process across all subjects (CDC, 2013a, 2013d). **Table 6** shows that 53% and 69% of the teachers had not accessed Zambia education curriculum framework 2013 and teachers' curriculum implementation guide; the guidance to enable teachers to make the best use of the Zambia education curriculum framework 2013, respectively. Also, the results show that mathematics syllabus grades 8-9, and mathematics syllabus grades 10-12, were the most accessed documents by mathematics teachers by 80% and 84% respectively. However, these two syllabi do not elaborate on soft skills as such, but just recommend the methodologies and assessment tasks that mathematics teachers should be able to employ in the teaching and learning process (CDC, 2013b, 2013c). The finding is that mathematics teachers in secondary schools in Mazabuka district in Zambia had no access to the documents that highlight the integration of soft skills in teaching. Thus, this could have impacted negatively mathematics teachers' conceptual understanding of soft skills.

RQ2. Is There Any Relationship Between Teachers' Demographic Factors and the Teaching and Assessment Strategies That Involve Soft Skills?

This research question was explored by examining the effect between teachers' age, gender, level of education and teaching experience in the way they classified the teaching and assessment strategies based on a three-points scale (very appropriate, appropriate, and not appropriate) in as far as integration and assessment of soft skills were concerned.

Teachers' demographic factors and teaching and assessment methods that involve soft skills

Gender: The study investigated whether males and females differed in classifying the suggested teaching and assessment methods as very appropriate, appropriate and not appropriate regarding the integration of soft skills (**Table 4**). When Chi-square statistic (Morgan et al., 2011) was computed, it was found that there was only a statistically significant difference by gender in classifying the 17 suggested teaching methods. The findings showed that 62% of the males and 38% of the females correctly classified the demonstration method as one of the most appropriate methods to integrate soft skills ($\chi^2(1)=4.590$, p-value=.032). On the other hand, 66% of the males and 34% of the females, as well as 72% of males and 28% of the females, were able to correctly classify the simulation and case study as not appropriate methods to integrate soft skills ($\chi^2(1)=5.143$, p-value=.023) and ($\chi^2(1)=9.935$, p-value=.002), respectively. Similarly, 62% of the females were more likely to suggest correctly that essay tests

were not appropriate methods to assess soft skills than 38% of the males ($\chi^2(1)=5.588$, p-value=.018).

This finding suggests that the male teachers showed more understanding of teaching and assessment methods regarding soft skills than the female teachers. This result is not surprising as teaching mathematics is male dominated in Zambia (Simuchimba & Mbewe, 2021). Thus, much effort is needed to support female teachers to enhance their knowledge of appropriate teaching and assessment methods.

Type of school: The study also examined the effect of the type of school where participants were drawn from and the classifying of the suggested teaching methods that involve soft skills as reported in **Table 4**. The findings showed that 63% of the teachers from non-public schools were more likely to suggest that self-discovery was a very appropriate teaching method that involves soft skills than 37% of the teachers from public schools ($\chi^2(1)=5.821$, p-value=.016).

The results probably are an indication that non-public schools have better facilities that enable them to excel in performance, which the public schools do not have (Banda, 2016). In addition, it is argued that the

> "quality of the teaching staff, the size of the class and availability of certain facilities normally lead to good academic performance among the learners" (Banda, 2016, p. 38).

These facilities are a common feature in most non-public schools. However, the findings showed that there was no statistical difference between teachers from non-public schools and public schools in classifying the assessment methods.

Qualifications: The study also explored the qualifications of the participants if it affected the manner mathematics teachers classified the teaching methods as very appropriate, appropriate, and not appropriate (**Table 4**). The findings suggest that there was no significant difference between those with a diploma in education and a bachelor's degree in education except on the quiz method. Therefore, it was found that 66% of the teachers with a diploma in education were more likely to suggest correctly that the quiz method is an appropriate teaching method that allows the integration of soft skills than 34% of the teachers with bachelor's degree in education ($\chi^2(1)=9.232$, p-value=.002). The findings concur with the findings by Ingersoll et al. (2014) who reported that mathematics teachers with degrees tend to have more subject matter than pedagogical preparation as opposed to teachers with diplomas. They added that most mathematics teachers with degrees most likely could not have entered teaching with the intent to do an education program and hold non-education degree.

In terms of assessments that involve soft skills, the findings suggest that there was no significant difference between those with a diploma in education and a bachelor's degree in education except on the norm-referenced tests and performance assessment tasks. The findings showed that 60% of the teachers with bachelor's degrees in education were more likely to suggest correctly that the norm-referenced tests method is an appropriate assessment method that allows the assessment of soft skills than 40% of the teachers with a diploma in education ($\chi^2(1)=3.963$, p-value=.046). On the other hand, 64% of the teachers with bachelor's degrees in education were more likely to suggest correctly that performance assessment tasks are a very appropriate assessment method that allows the assessment of soft skills than 36% of the teachers with a diploma in education ($\chi^2(1)=4.967$, p-value=.026). This finding suggests that teachers with bachelor's degrees in education show some understanding of teaching and assessment methods that incorporate soft skills than teachers with a diploma in education. Seemingly, the level of education has little influence on the teachers determining the assessment technique as very appropriate, appropriate and not appropriate. This could be confirmed by the assertion that mathematics teachers with degrees tend to have more subject matter than teachers with diplomas (Ingersoll et al., 2014). This gives an impression that the teachers with lower qualifications needed more support.

Age: The effect of teachers' age and their suggested teaching methods that involve skills which were reported in **Table 4** was examined. The findings show that 59% of the mathematics teachers aged between 25 and 34 years were more likely to suggest that a case study was not an appropriate teaching method that involves soft skills than 10% of the mathematics teachers aged 35 and 54 years old ($\chi^2(2)=11.819$, p-value=.003). The results suggest that the young generation could have benefitted from various training or who have been taught using innovative approaches, hence they can apply them in classifying the teaching methods regarding the soft skills. But, the findings show that there is no statistical difference between teachers aged 25 and 34 years and teachers aged 35 and 54 years in the manner they classified suggested assessment methods.

Teaching experience: We also studied the impact of teaching experience on their suggested teaching methods (**Table 4**). On one hand, the study found that 77% of teachers with teaching experience between 1 and 10 years, were more likely to suggest that a case study was not an appropriate teaching method that involves soft skills compared to 23% of teachers with teaching experience ranging from 11 to 30 years ($\chi^2(1)=13.317$, p-value=.000). Also, 64% of the teachers with teaching experience between 1 and 10 years, were more likely to confirm demonstration method would be an appropriate teaching method that involves soft skills than 36% of teachers with teaching experience ranging from 11 to 30 years ($\chi^2(1)=4.242$, p-value=.039). On the other hand,

32% of the teachers with teaching experience ranging from 11 to 30 years, were not likely to suggest that question and answer method was a very appropriate teaching method that involves the usage of soft skills compared to 68% of the teachers with teaching experience between 1 and 10 years ($\chi^2(1)=4.545$, p-value=.033). The findings suggest that mathematics teachers with experience of 1 to10 years were better in classifying teaching methods as very appropriate, appropriate and not appropriate regarding the integration of soft skills than teachers with teaching experience between 11 and 30 years. Probably, it might be that a young generation could have benefitted from various training or have been taught using innovative approaches. The results are almost similar to what Stronge (2010) found that teaching experience between 1 and 3 years generally has a positive effect on student achievement although the teaching experience beyond 3 was not conclusive. It was established that there was no statistical difference regarding teaching experience between teachers with less than 10 years and those with more than 10 years of experience in the manner, where suggested assessment methods involving soft skills are classified.

A similar study was conducted to establish the effectiveness of innovative teaching approaches in developing soft skills by Blom et al. (2017). In their study they scrutinized the influence of innovative teaching approaches as far as the development of students' soft skills in secondary schools is concerned. The study partly looked at the development of hard and soft skills achieved through learning mathematics and examined the perceptions of students regarding the teaching approaches used in teaching and learning mathematics (Blom et al., 2017). The study provides empirical evidence that innovative teaching approaches are more effective than conventional teaching ones in improving mathematical soft skills. However, the study reports that 54% of mathematics teachers' responses were incorrectly rated while 46%were correctly rated as shown when the teachers were asked to rate the suggested teaching methods as very appropriate, appropriate or not appropriate. Even though the results show a small difference between the correct and incorrect ratings, this may not be an indication that mathematics teachers are familiar with the innovative teaching methods required to integrate soft skills. The small difference could be attributed to respondents rating according to teacher or learner-centered methods as opposed to the methods appropriate or inappropriate to integrate soft skills.

CONCLUSION

The purpose of this study was to investigate the conceptual understanding of soft skills mathematics teachers in secondary schools possessed, and examine whether there would appear any mathematics teachers' demographic factors that impact their conceptualization of soft skills. The study further looked at how knowledgeable teachers were of methods that incorporate soft skills in teaching and learning mathematics.

The findings have revealed that the majority of mathematics teachers teaching in Mazabuka district in Zambia do not possess a conceptual understanding of soft skills. Most mathematics teachers could not state the examples of soft skills; they were not able to indicate the teaching and assessment approaches, which appropriately incorporated soft skills. Furthermore, the majority of mathematics teachers were not able to relate soft skills such as communication, problem-solving/critical thinking, collaboration and creativity and innovation to the mentioned classroom activities (only a fourth of teachers could provide the correct answer). It also appeared that the majority of mathematics teachers had not accessed two important documents (Zambia education curriculum framework 2013 and teachers' curriculum implementation guide; the guidance to enable teachers to make the best use of the Zambia education curriculum framework 2013), which highlight the integration of soft skills. This could have possibly impacted negatively on mathematics teachers' conceptual understanding of soft skills as the study has established.

The findings further showed that teachers' conceptualization of soft skills, was related to their demographical factors such as age, gender, type of school where teachers were teaching, teaching experience and level of education. For instance, the male teachers showed more understanding of teaching and assessment methods regarding soft skills than the female teachers on demonstration and simulation methods. This is due to the fact that teaching mathematics in Zambia is male-dominated. The findings showed that mathematics teachers from non-public schools were more likely to suggest that self-discovery was a very appropriate teaching method that involves soft skills than those from public schools The results could be an indication that non-public schools have better facilities that enable them to excel in performance, which the public schools do not have.

Furthermore, on one hand, the results suggest that mathematics teachers with a diploma in education were more likely to suggest correctly that the quiz method is an appropriate teaching method that allows the integration of soft skills than teachers with a bachelor's degree in education. On the other hand, the findings suggest that teachers with bachelor's degrees in education show some understanding of teaching assessment methods that incorporate soft skills than teachers with a diploma in education.

The teachers aged 25 to 34 years understand that case study was not among the appropriate methods that allow the integration of soft skills than those who are

aged from 35 to 54 years. Maybe this is so because sometimes teachers' enthusiasm deteriorates as age advances probably due to the tediousness of teaching for several years (Shah & Udgaonkar, 2018). The findings also suggest that mathematics teachers with experience of 1 to10 years were better in classifying teaching methods as very appropriate, appropriate and not appropriate regarding the integration of soft skills than teachers with teaching experience between 11 to 30 years. This could be attributed to the fact that teachers with teaching experience of less than 10 years were either pupils, trainee teachers or trained teachers at the time the 2013 revised curriculum has been actualized.

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APPENDIX A-MATHEMATICS TEACHERS' CONCEPTUAL UNDERSTANDING OF SOFT SKILLS TEST

The Zambian education curriculum, which is currently being implemented, incorporates soft skills. Thus, the purpose of the survey is to establish your conceptual understanding of soft skills. Your honest responses are highly appreciated. The information collected will be treated with anonymity and confidentiality.

Instructions

Attempt all the questions by:

1. Giving brief answers where spaces are provided
2. Putting a tick (√) in the space provided
3. Circling the number that corresponds with your opinion

Duration: 30 minutes

1. From your understanding, how do you define soft skills?

_____
_____
_____
_____
_____
_____
_____

2. Write down at least three examples of soft skills that you are aware of

_____
_____
_____
_____
_____
_____
_____

3. Read carefully the suggested methods that can be used to integrate soft skills during the teaching and learning of mathematics. Please put a tick (√) under not appropriate (**NA**), appropriate (**A**), or very appropriate (**VA**) to show your opinion about each method.

S/N	Suggested methods that can be used to integrate soft skills in mathematics	NA	A	VA
1.	Direct instruction			
2.	Demonstration method			
3.	Teacher exposition			
4.	Simulation method			
5.	Discussion method			
6.	Rote memorization			
7.	Self-discovery method			
8.	Question and answer method			
9.	Interviewing method			
10.	Project method			
11.	Case study			
12.	Mapping method			
13.	Cooperative learning method			
14.	Differentiated learning			
15.	Roleplaying			
16.	Quiz			
17.	Problem-based learning			

4. Read carefully the suggested assessment techniques that can be used to assess soft skills during the teaching and learning of mathematics. Please put a tick (√) under not appropriate **(NA)**, appropriate **(A)**, or very appropriate **(VA)** to show your opinion about each method.

S/N	Suggested methods that can be used to integrate soft skills in mathematics	NA	A	VA
1.	Projects			
2.	Essay tests			
3.	Portfolios			
4.	Power test			
5.	Rubric (rating scales)			
6.	Oral tests			
7.	Norm referenced tests			
8.	Observations			
9.	Objective tests			
10.	Assignments			
11.	Criterion referenced tests			
12.	Performance assessment tasks			

5. From the soft skills incorporated in the 2013 revised curriculum, which soft skill is being developed?
   a. When students are engaged to actively participate in a mathematics lesson in small group discussions or pairs _____
   b. When students are actively engaged in thought-provoking mathematical activity that often involves critical assessment of procedures to arrive at the correct solution _____
   c. When students interact and express themselves orally as well as in writing during the mathematics learning process _____
   d. When students form new images and sensations in the mind and turn them into reality _____
      _____
6. Identify and tick (√) against the document (s) related to the 2013 revised curriculum, which you have come across, and /or use in the teaching and learning of mathematics:
   a. Zambia education curriculum framework 2013: ____
   b. Mathematics syllabus grades 8-9: ____
   c. Mathematics syllabus grades 10-12: ____
   d. Additional mathematics syllabus grades 10-12: ____
   e. Teachers' curriculum implementation guide: Guidance to enable teachers to make the best use of the Zambia education curriculum framework 2013: ____