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Teacher's Perception of Math Applications in the New Era: A Case Study

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Abstract: ***Mathematics is a science known for symbols and concepts. Many students have negative attitudes toward learning mathematics and are not motivated to study it or select it as a future career. They may find it boring and difficult to apply to the world in which they live. Mathematics is a science of numbers, quantities, and shapes and the relationships among them; and learning mathematics builds a strong foundation for other sciences. Students need to make useful connections between math and other sciences. This case study examines math teachers' perceptions of mathematic applications to the field of computers. A total of 22 math teachers (grades 1-12) from Makkah, Saudi Arabia participated in this study. The participants were all attending a professional development session initiated by the District Supervision Office in Makkah. Data was collected using a survey that participants completed following a 4-hour lecture, entitled Math and the challenges of the era. Participants' responses to the survey revealed that they try to encourage students to learn math, they believe that math is important for student success in other subjects, and they relate math problems with real-world problems in their instruction.***

Keywords: Math, modern sciences, teaching strategies, learning styles

1. Introduction

In recent years, there has been a strong push to improve K-12 mathematics instruction to better prepare students for higher education and future careers (Star, 2016). Mathematics includes arithmetic, algebra, geometry, calculus, trigonometry, and probability. It emphasizes problem solving, modeling, critical thinking, and decision making (Ozgen, 2013), skills that students need for future success. However, most students have difficulty making connections between mathematical expressions without visual representations (Rubin, 1999).

Studied alone, pure mathematics is an abstract science; but when applied to other subjects, it can help us explain observed phenomena and predict new outcomes. If a mathematical structure represents a real-world model, learners can predict, analyze, and reason (Sugimoto et al., 2017; Ziegler & Loos, 2017). Thus, learning mathematics is a strong foundation for other sciences. Students need to make useful connections between mathematics and other sciences. However, few students understand that mathematics is an important tool for succeeding in many fields and are motivated to study it.

Mathematics and Modern Sciences

Mathematics is a foundational part of things that touch our daily lives, such as architecture, art, sports, and engineering, among others (Hom, 2013). Itis a tool that scientists use to describe the world around them. Mathematical observations often become useful to others in real world situations. Classic examples are the Pythagorean theorem used by builders in the construction industry; or the Fibonacci sequence or Golden Ratio that is seen in patterns of nature, architecture, and music. Helping students see these connections can spark their interest and enable them to develop the skills of seeing patterns and relationships.

The heart of mathematics in the real world is problem solving. Students are usually interested in solving problems and math problems are connected to real world problems (Kulkin, 2016). The diversity of students—their expectations, talents, and interests—leads them to different careers. The following are examples of the benefits of learning math for careers in the computer sciences and other fields.

- *Computer Science*

Many students disregard the importance of math skills, not realizing that they are essential to the computer field. Having a background in mathematics is a prerequisite for programmers (Rubin, 1999). Students who are strong in mathematics will perform well academically and succeed professionally in the computer science field. The fundamental operation of computers is based on the binary number system, and computer science requires math skills from basic arithmetic to highly advanced mathematical concepts. Most real-world problems are expressed mathematically, graphically, or numerically; so, mathematics and problem solving go hand in hand. Learning mathematics helps students of computer science succeed in design, analysis, programming, and testing. Furthermore, artificial intelligence and logic require a high-level mathematics; and variables in programming and algebra are math concepts as well (Beaubouef, 2002).

- *Sciences*

Other sciences, such as physics, chemistry, engineering, oceanography, meteorology, all require mathematics. Mathematical formulas, image processing, numerical modeling, and graphic programming are a few of the tools scientists in these fields use. Furthermore, all sciences, and many industries and sports, use research methods that require familiarity with statistical analysis, sampling, and measurements to analyze quantitative data (Oldmixon, 2018).

- *Project Management*

Project management is another field that requires math skills in determining critical paths. Flow diagrams, Gantt charts, and graphs are used to determine project durations and the costs of projects (Beaubouef, 2002).

- *Business*

Students pursuing higher education in business require an understanding of mathematics. Fields, such as accounting, economics, finance, marketing, and operations management, use math and computer science. Business applications manipulate and store large quantities of data sets to calculate financial reports (Beaubouef, 2002).

Teaching and Learning Mathematics

Many students have misconceptions about mathematics, such as one must be intelligent to understand mathematics; one does not have to excel in it because few people do; and it is not used in the real world (Willis, 2010).However, students become motivated when the content they learn is related to their experiences, skills, and knowledge and real world activities and scenarios (Sugimoto et al., 2017). Mathematics is usually taught through memorization and to succeed in tests. If students do not succeed using this approach, they develop negative attitudes toward mathematics (Willis, 2010). Students' perspectives often depend on the teacher's efforts to make mathematics acceptable and relatable. Teachers must apply teaching and learning tools and strategies to make mathematics easier for students to learn and to link it to real-world applications.

Math Anxiety

One of the main hindrances in teaching mathematics is students' math anxiety. Math anxiety refers to the anxiety individuals experience when using numbers and solving problems. Math is perceived as threatening to one's self-esteem (Tatar, 2012). Students' negative experience with math is mainly the result ofa lack of understanding. Students can build confidence and overcome math anxiety by teachers setting math problem-solving activities in everyday contexts or by using math concepts to construct something. This approach helps motivate students and develops mastery (Kulkin, 2016).According to Ozgen (2013), there is a significant relationship between math anxiety, the brain, and learning styles. To help students overcome their anxiety, teachers must also present material in a variety of ways to reach students with different learning styles.

Learning Styles

Learning styles are an important concept in mathematics education. Learning styles are defined as the waya person approaches, processes and forms information (Tatar, 2012). A learner's learning style is their preferred method of learning (or how they learn best), although they might not be aware of their preference. Students perform poorly when their learning style does not match the teacher's teaching style (Chen et al., 2014). Teachers must pay attention to students' learning strengths, background knowledge, and levels of achievable challenges (Willis, 2010).

The main types of learning styles correspond to sensory effects, and include visual, auditory, or kinesthetic (Kumar, 2017). Learning styles depend on students' preferences, and students can often identify their style when given descriptions of these three sensory learning styles. Teaching and learning methods, such as personalized and experiential learning, can address different learning styles. In personalized learning, a customized learning plan—based on how the student learns, what they know, and what their skills and interests are—is implemented to ensure that the learner achieves the standards that will allow them to move to the next level. (Kumar, 2017). However, aligning instruction with the learner's preferences can be challenging and difficult to apply (Clark et al., 2015). Furthermore, many learners learn best with illustrations and real-life examples that are related to them (Sugimoto et al., 2017). Experiential learning focuses on learning through lived experience (Chen et al., 2014). Knowing students' learning styles can help improve learning processes, instruction methods, and teaching and learning materials (Clark et al., 2015).

Generally, retesting and giving students a sense of control can also help improve their outcomes. Retesting helps students re-evaluate their answers, build skills, correct their mistakes, and apply independent learning (Willis, 2010). Students learn from their mistakes. Teachers need not only pass knowledge on to students; they need to create opportunities for students to solve problems by acquiring thinking, learning, and dialogue skills, resulting in positive attitudes toward these methods (Alsharif & Alamri, 2020). Using a variety of teaching strategies can address the variety of learning styles students present in a single classroom. Finally, teachers must always adapt their teaching strategies to students' skills and levels of achievement (Alsharif & Alamri, 2020); and students must be comfortable with math before learning coping strategies (Willis, 2010).

2. Methodology: A Case Study

The purpose of this case study was to examine math teacher's perception of math applications in the computer science and other fields, as they had difficulties relating math to modern sciences.

Participant Sample

A total of 22 math teachers from Makkah, Saudi Arabia participated in the study. All participants helda bachelor's degree, taught math in grades 1-12, and had at least 1 year of teaching experience. Participants were recruited among math teachers who attended a professional development session given at the request of the District Supervision Office. The Department of Mathematics in Makkah is interested in teaching and improving cognitive and skill learning outcomes, targeting them with support and correction, monitoring the level of improvement and documenting it both quantitatively and qualitatively to ensure that the learning outcomes correspond to the requirements of development while supporting the programs, events and activities implemented in the school. However, they had some difficulties relating mathematics to today's modern sciences.

Data Collection and Analysis

Data was collected using a survey that focused on the main problems that math teachers face in the math curriculum and the teaching strategies they use. Surveys included 12 questions and were distributed to the participants following a 4-hour lecture, entitled *Math and the challenges of the era*, which was part of the professional development session. Data was analyzed using Microsoft Excel.

3. Findings

Among the 22 math teachers who participated in the study, 22% teach elementary school, 52% teach middle school, and 26% teach high school. Table 1 shows the years of teaching experience of the participants.

Table 1: Participants' Years of Teaching Experience

Years of Experience	Percentage
1-5 years	14%
6-10 years	40%
11-15 years	14%
More than 15 years	32%

In the survey, teachers were asked about the most teaching strategy used in their classroom. Table 2 shows the percentages of eleven most common used strategies.

Table 2: Subjects' Teaching Strategies

Teaching Strategy	Percentage of teachers using the strategy
Cooperative Learning	91%
Technology in the classroom	77%
Problem-based Learning	77%
Peer Learning	77%
Gaming	59%
Project-based Learning	18%
Differentiation	14%
Visualization	14%
Blended Learning	14%
Experiential Learning	14%
Inquiry-based Instruction	9%

Table 2 shows that cooperative learning is the most applied teaching strategy. Cooperative learningputs learners in small groups interacting during the instructional session. They work and compete together to accomplish a certain goal. Technology in the classroom, peer learning, and problem-based learning are the second most applied strategies.

The use of problem-based learning gives students opportunities to apply math skills to real world scenarios and cooperative learning has the capacity to address the needs of visual, auditory, and kinesthetic learners. The lower ranking strategies may be used more often to make math relatable – for example an experiential learning experience where students "buy" stocks and monitor the stock market.

To gauge their perspective on math applications, the teachers surveyed were asked what they believed to be the relationship between math and modern sciences. The following is a sampling of their responses:

Teacher #1 "Math is the main study for other sciences"
Teacher #3 "Math is one of the important sciences to have the brain work and able to evolve."
Teacher #10 "Math is related to all sciences."
Teacher #13 "Math is the king of sciences."
Teacher #14 "Math the mother of sciences."
Teacher #22 "Math is the key for all sciences."
Teacher #21 "Excellence in mathematics means clearness of mind and strong focus."

All 22 teachers encouraged students to learn math and to think that math is important for success in other fields and in life. They all attended professional development sessions. They also report that when teaching mathematics, they try to relate math problems with real-world problems, however, most teachers feel they have limited planning and instructional time, and resources (Sugimoto et al., 2017). Therefore, teachers need to prepare and plan early according to the curriculum. Teachers site the following as advantages and disadvantages of the math curricula they are using:

Advantages in the current math curriculum:

- Simplicity
- Variety and connection of topics
- Relating problems with reality
- Several ways to solve a problem
- The diversity and expansion of information that is credited with distinguishing the student's future
- A comprehensive variety covering the needs of the learner in which the intended repetition is to install information
- Applying critical thinking in high school curriculum

Disadvantages in the current math curriculum:

- A lot of information not enough with time/ too much content
- The intensity of the curriculum and the lack of clarification of its association with other sciences clearly and understandably to the student
- Rigidity of the subject, not relating it with reality and programming
- Curriculum intensity and repetition of lesson ideas

4. Conclusion

Every problem if expressed by a mathematical equation can be easier to solve. Mathematics is essential in modern sciences; therefore, it is important to apply mathematical skills in students' daily life by helping them identify and solve problems, enhance their critical thinking, and apply their skills in every daily life (Alsharif & Alamri, 2020). A great way to enhance students' skills is by providing STEM workshops to students of different ages.

In addition, teachers need to be aware of students' learning styles and select suitable teaching strategies for the students to accommodate their needs (Brady, 2013).Using appropriate strategies to build the missing foundation such as prediction, estimation and scaffolding are important. Planning achievable, but challenging work for students builds confidence and motivates students to pursue higher levels. Teachers may also need to implement their own creativity in relating lessons to real world scenarios or collaborate with teachers of the sciences to integrate math and science curricula. All these techniques can help teachers change students' negative attitudes toward math by drawing connections and making it enjoyable. Making math relatable and helping students understand that math gives them a second language to describe the world around them and solve problems can help remove the stigma of math and thus make it accessible to those who might otherwise think it is beyond their abilities. Remember, students "aha" moments of understanding are when teaching is a success (Willis, 2010).

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