DEVELOPING A LEARNING UNIT IN LIGHT OF THE INTEGRATION BETWEEN THE MATHEMATICAL PROFICIENCY AND THE 21st CENTURY SKILLS

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Abstract

This study aims to build a model based on the integration between mathematical proficiency and the 21st-century skills to develop the Saudi Arabia mathematics curriculum of the primary stage, and to develop a learning unit based on the proposed model. In addition, it aims to investigate the impact of the developed unit on the students' learning levels and perception's. The researchers used a qualitative approach to collect data. They used a variety of learning materials (the proposed model, a studying unit, the teacher's guide, exercises booklets, and a learning software). They utilized three different instruments: interviews, observations, and teacher's notices. The 4th grade students (No. 22) participated in the study for six weeks. The results illustrated that the students increased their: achievement, retention of the material, self-esteem in mathematics, and they understood the usefulness and importance of mathematics.

Based on the findings the research recommends curriculum developers and teachers to incorporate activities, statistics, and images from the students' surrounding environment in the lesson that considers the students' needs and interests. The researchers recommend teachers to design activities considering the mathematical proficiency and 21st century skills. They recommend teachers and students to participate in developing the mathematics curriculum.

Keywords: integration, mathematical proficiency, 21st century skills, 4th grade.

1 INTRODUCTION

Current trends in education consider the educational development very important, because it plays a role in adaptation with the age requirements and revolving needs, and it helps in creating a productive generation. The development should include curriculum for all stages in general and for the primary stage in specific, because this stage presents the origin of the generation education and it puts them on the right path regarding learning and education.

Accordingly, curriculum development on scientific basis that analyze facts, define problems, look ahead, identify requirements and consider available potentials to achieve sought goals is necessary. Generating mathematics-updated curriculum that meets age requirements and individuals needs is a vast community responsibility that needs exhausting efforts. While updated curriculum requires many efforts, due to its nature, it stands amid abstracting and implication, and amid fantasy and reality, mathematics prepares learners to think, create, show abilities, and confront problems. Mathematics is one of life pillars that organize and produce future; it has an essential social importance as it represents one of the social construction anchors, mathematics organizes this construction and maintains it. [1]; [2]

Mathematics textbooks present an important source in learning that develops learners' abilities and talents, enriches knowledge, benefits teachers in their teaching practices; therefore, curriculum designers and scholars should consider the contents and structure of mathematics textbooks. [3]; [4]; [5]; [6]; [7]

The term "mathematical proficiency" emerged in the modern teaching trends of mathematics and the National Research Council [NRC] [8] in the United States defined it. Mathematical proficiency combines the mathematics processes standards in one bundle as an integrated system that tightens each other and presents a system that transfers the learner to proficiency and creativeness. Mathematical creativeness involves five elements forming a systematic construct that can be consulted in developing curriculum and teaching, these elements are Conceptual Understanding, Procedural Fluency, Strategic Competence, Adaptive Reasoning, and Productive Disposition.

In the same context, the 21st century skills considers educational development to help learners in life, acquaint them with skills of positive interaction with learning requirements, life, and labor market. Partnership of the 21st century skills defined a set of basic skills allocated to three categories. The first category involves learning and creativity skills; it includes creative thinking, problem solving, communication and sharing, and creativity and innovation. The second category involves digital culture skills; it includes information literacy, media literacy, and information and communication technology literacy. The third category involves life and career skills; it includes flexibility, adaptation, self-direction and initiatives, social interaction and multicultural interaction, productivity and accountability, leadership and responsibility. ([9]; Pacific Policy Research Center [10]).

The current research idea stemmed to develop a model for the mathematics curriculum that establish a balance between mathematical proficiency in teaching and the 21st century skills, and attempted to establish a philosophical thought that helps to design mathematics textbooks curriculum, and improves mathematics-teaching strategies.

2 METHODOLOGY

The researchers used a qualitative methodology to gather data; they examined the previous literature related to mathematical proficiency and 21st century skills, to design a model that connects the two terms in order to develop mathematics curriculum accordingly. The researchers meet with teachers and experts and attended workshops to offer the model; the researchers' insights supported the model, they presented it in a teaching mathematics conference, and got feedback from the participants. Then, they designed the model as Fig. 1 illustrate.

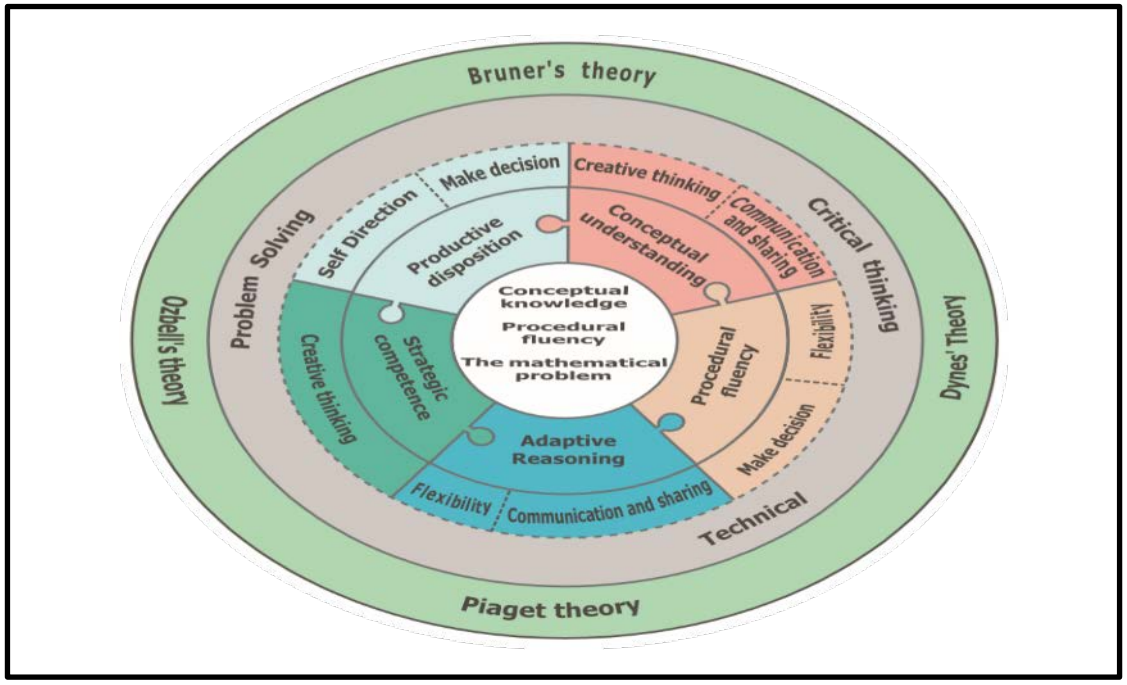

Figure 1. Integration between mathematical proficiency and the 21st century skills model

The researchers designed afterward a mathematics study unit for the primary stage according to the proposed model. The researchers taught an experimental group of students by the model, according to a teaching strategy guide prepared especially.

The researchers observed the students learning, interviewed them separately and in groups, to identify their viewpoints about the designed learning unit, the teachers monitored student's performance and interaction in class, and the researchers interviewed teachers to collect their feedback after teaching the unit.

3 RESULTS

The different information sources and the abundance of tools entails separating data and results into two stages involving the student's viewpoints about the designed unit, Fig. 2 below illustrates it.

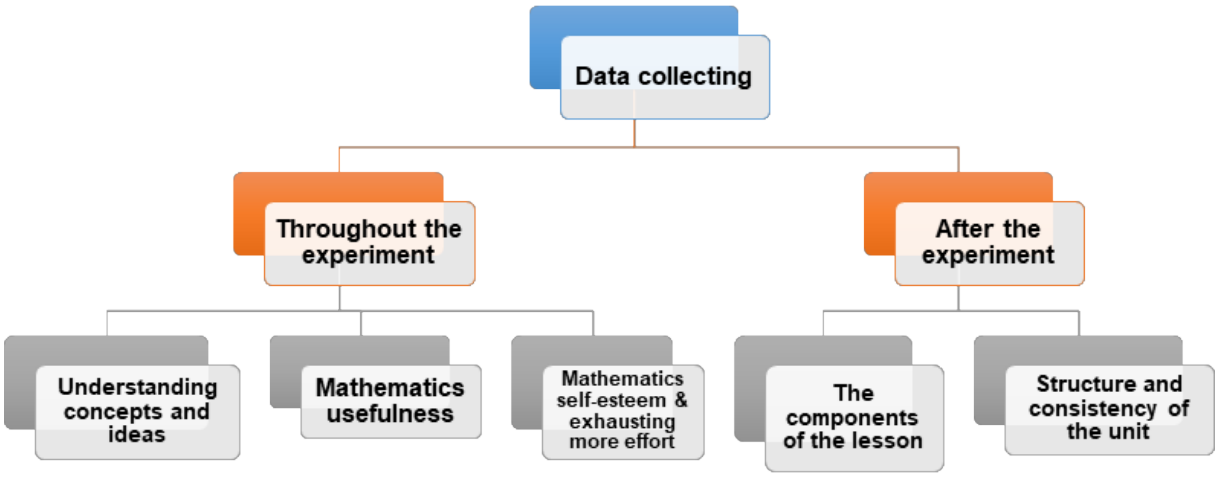

Figure 2. Student's viewpoints about the designed unit

3.1 First Stage: Throughout the experiment

The researchers tracked, from the first class, implementation of the teaching strategy created for the proposed model, they used the teachers' discussion notices. They aimed to identify the student's direct reactions and impressions. A gradual interaction emerged, referring to occurrence of a real experiment that differs from reality. Reviewing the student's views or observing them in class resulted in the following:

- Understanding the concepts and skills of the lesson:

  The first step in the lesson (preliminary and previous experience) made the lesson easier to understand after preparation. The students group of low achievers said (the first step, by time, represent a review of what has been learnt previously), one student said (it helps me to interact with the new lesson). The students group of high achievers agreed that the first step helped them to start solving many activities of the lesson, one student said that it helped him to understand the concepts and skills of the new lesson (he said: I knew the ideas of the new lesson at the beginning of the class). The teacher confirmed the students' views toward the first item and its turn in understanding the new lesson and interaction in class. The students agreed that using hands in numbers presentation, reading, comparing, and organizing participated in developing a mental image about the numbers places names and values, which helps to recall information in a short period. The teacher said that representing the concepts and skills in various ways enabled a large number of students from understanding the lesson in class, and the student's interaction level increased.

- Importance and usefulness of mathematics

  All the students agreed that the embedded images in the designed unit largely attracted their attention to review the lessons and read information related to it. Moreover, the availability of images and community statistics from the environment they live in convinced them with the importance and usefulness of mathematics in everyday life. A group of students said that the item (mathematics in our life) participated in motivating their thinking in different life situations related to the lesson. One of the students mentioned a similar situation showing the cost of renting a space in a garden and said (I will do the cost of renting the space for my family next time), one high achieving student said in the lesson of millions that he can read the numbers in the bank invoice. A group of students agreed on the role of mathematics in life such as dealing with statistics (pilgrims numbers, counties population account, commercial markets…etc.) This result agreed with [11] results, he said that community statistics help students to understand community issues, interact with it, and develops the statistical sense among the students. Moreover, one of the students said, "Mathematics improves mind," this result agreed with the

findings of [12], it means the teachers' cognition of mathematics usefulness in life transfers to his students.

- Mathematics self-esteem and exhaustion of more effort.

  The researchers and the teacher noticed that while teaching the designed model all student's interaction with the activities of the lesson was graduate. The teacher noticed a change and improvement among low achieving students in lesson interaction, lots of them had the desire to justify their answers, and they were confident in their proposals. The teacher said that the first step in the lesson (preliminary and previous experience) increased student's interaction by the third lesson, while it consumed lesson time at the beginning. However, by time the students became more confident and welling to participate. One high achieving student said that the (lessons and activities motivated him to justify and express his opinion. This result agreed with the teacher's observations that "the level of the students thinking deepened."

  The researchers observed the students answers about the place value, one student answered that the place value of (8) in (61485671) is eighty thousand because number 8 falls in the ten thousands place, without saying the procedure he used to answer, that is counting the places that preceded number (8). Another student referred to the same idea by saying "when I forget the name of the place, I count the numbers that precede the needed number and replace them by zeroes"

  One student said that (the hands paragraph reminds him with the place name and value, which makes it easier to read number), the researchers believe that the diversity in students confident brainstorming indicates that they trust themselves. This result agreed with [13], [14], and [15], who said that mathematics practices in everyday life and introducing environmental problems enhances student's confidence and involves them in work. Al-Saeed [16] examined the role of mathematical proficiency development in improving tendencies, trends, and beliefs about mathematics.

  The diversity of ideas and styles of presentation match the group work activities; a student said (group work helps me to know all the ideas of right and wrong answers, which makes it easier to answer). This result agreed with [17], they said group activities makes learning interesting, it increases the value of the scientific material, and create a positive trend toward the course.

3.2 Second Stage: after completing the experiment

The researchers and the teacher monitored the student's opinions about the designed unit, they found that all students agreed that the unit activities, colorfulness, and divisions caught their attention, and helped to understand the lessons in many ways. One high achieving student mentioned that the organization of the lessons made them more correlated. He said "now that I have finished the whole unit, I notice that the lesson on millions includes the ideas of the whole unit that I studied in the passing few weeks". Then he explained by giving an example "in the lesson on millions I was able to implement all the ideas of organization, comparing, approximation, reading and writing of numbers." The students discussed their colleague opinion and they all agreed that it was right; they all reached the same conclusion.

A group of the students mentioned that the organization of "solving the question" section helped them to interact with the activities, because there was an organized table of the solution steps that includes a set of questions and spaces guiding them to rethink the question, solve it and organize their ideas.

All the students agreed that the elements of the lesson helps to understand it and to assimilate the ideas, a group of them mentioned that the discussion section helps to review the lesson at home, and that it includes the idea of the lesson.

The elements of the lesson comprise the most notable changes in the textbook structure. To identify the impact of the change on the student's achievement, the researchers interviewed the teacher who demonstrated a difficulty explaining the unit at the start of the lesson, he was late in explain the first lessons, but he overcome this obstacle when he acquired practice and experience, understood the idea of each element and the students reaction. He added that the organization facilitated dealing with various ideas and made him recognize the student's individual differences and that reduced the teaching burden.

4 CONCLUSION

The textbook is the main source of information for the students in general and for primary stage students in specific, therefore, coordinating and creating it to achieve standards and goals is important. There is a strong relationship between the structure of the lessons in the textbook and the methodology of teaching mathematics topics; this requires teacher's participation in developing the curriculum. Developing mathematics curriculum in light of integration between mathematical proficiency and the 21st century skills is expected to have positive tangible results in learning outcomes, developing performance skills in mathematics, forming positive trends toward learning mathematics, increase self-confidence, self-esteem, motivating learning, and achievement.

The 21st century skills flexibility and comprehensiveness alleviated its integration in the mathematics textbook. Correlating the activities of the textbook with the surrounding environment, and to include images from the environment motivates the students in the primary stage to read and interact with the activities, it emphasizes the usefulness of mathematics and its importance in solving daily problems in the community.

The preliminary and previous experience motivates low achieving students to interact with the new ideas and gain self-confidence in their abilities; it guides high achievers to expect new ideas. The mathematics textbook activities should consider images and figures that express the cultural diversity from internal and external environments. The activities should consider students trends and tendencies, to show mathematics role and importance and attracts them to participate. All of which agrees with the structural theory of learning ideas.

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