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*Research Article*

# Mathematics textbooks content development at the primary stage: a proposed vision

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**Abstract**

The paper presents a proposed vision to develop mathematics textbooks content for the primary stage. It offered a framework to organize the content of the mathematics textbooks and indicated the content of each part of the framework. Furthermore, it explained ways of including various theories in the textbooks content, and showed how the developed content facilitates the tests of Trends in International Mathematics and Science Study (TIMSS).

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## Introduction

Modern tendencies consider curriculum development very important, because it participates in confronting today's challenges and helps in building a modern generation. This development should account for curriculum in general and the primary stage in specific.

The process of developing curriculum is inevitable, developer's efforts should be exhausted based on scientific foundations that study facts, determine problems, foresight future and determine its requirements, and consider available possibilities to achieve sought goals. Setting modern mathematics curriculum complying time and individuals needs is a big responsibility that requires reconsideration of mathematics textbooks of all stages. Because mathematics is one of basic foundations that prepare the individual to think, create, show abilities, and face problems. Mathematics grew to be a pillar of present organized and productive life, it has an essential social importance because it represents one of the social construct anchors; it organizes the structure and maintains it (Mohammad, 2015; Alshorofat and Ghneimat, 2016)

The school textbook position is apparent in many modern systems; it is cared for in all phases from planning to assessment of its impact on the learning process. Therefore, curriculum designers explained the strong relationship between the curriculum and the textbook considered the content fount that represents one of the curriculum elements and a learning source that contribute in achieving the curriculum goals, it includes knowledge, skills and values (Bin Salamah & Al-Harthi, 2005). The same idea is confirmed by Al-Hussein (2017), he said that the textbook represents a means that allows the learner to reflect on the education he receives and for the teacher to think deeply in the material represented for his students, the textbook resembles a pathway in the right way for the teacher, and for the

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society to ensure that the sciences and knowledge presented in schools meets age requirements and it is appropriate to prepare learners for job market and future. It develops scientific, critical and innovative thinking among learners; it acquires desired values and tendencies, and provides a joint background between the teacher and his students (Saeada and Ibrahim, 2016)

Scholars consider the mathematics textbook one of the basic foundations of education development. It is an important source of learning that participates in the learners' talents development and enriches his knowledge. Its benefits include the student and the teacher to perform teaching tasks to achieve the sought goals in addition to its importance to the society, in terms of future and market needs and requirements. (Khalil, 2019)

Although there are many practical educational resources, but using the textbook dominates in teaching mathematics, it impacts the learning process in general and the teaching practices in specific, therefore, its content and structure should be considered to teach various mathematic topics. (Zhu & Miao, 2013; Lepik, Grevholm & Viholainen, 2015; Tesfamicael & Lundeby, 2019; Remillard, Reinke & Kapoor, 2019)

The mathematics textbook importance manifests in providing students with positive learning opportunities that influence the learning and teaching culture. Mathematics books include various routine and non-routine problems to develop students' higher thinking skills and different mental abilities; it includes scientist's photos to provoke students to follow up these scientists methods, added to that the importance of data, statistics and graphs accuracy which tackles societies cultures existence. (Ahl, 2016; Van Zanten & Heuvel – Panhuizen, 2018; Lehtonen, 2018; L. Jones, et al, 2015; Clinton & Walkigton, 2019; Koljonen, Ryva & Hemmi, 2018; Akar & Dikkartin, 2018; Castaneda, et al, 2019)

**Aims of the Study**

The research sought to:

- Design a proposed model of the lesson framework to organize mathematics textbooks content for the primary stage.
- Explain the importance of the learning theories in the development of mathematics textbooks content in the primary stage.
- Explain how to improve achievement based on (TIMSS) levels in the mathematics textbooks at schools.

**Importance of the Study**

The current paper importance stems from its theoretical and implicational contributions. It proposes a model to organize the content of mathematics textbooks in the primary stage; the model considers the modern trends that highlight importance of mathematics textbooks content development, it provides determined procedural steps to develop textbooks content, it improve achievement levels in TIMSS tests, improves practices performance levels in mathematics teaching lessons.

**Problem of the Study**

The current paper attempted to answer the following questions:

- What is the proposed framework to organize the lessons content included in the mathematics textbook in the primary stage?
- What theories may be used to develop the content of the mathematics textbook in the primary stage?
- How can the proposed framework to organize the content consider achievement based on the Trends in International Mathematics and Science Study (TIMSS) levels?

## Method

**Research Model**

The paper in tackling the first question "What is the proposed framework to organize the lessons content included in the mathematics textbook in the primary stage?" first defined the main topics of the unit (including ideas, concepts, and the main skills in the unit), then resolved the problems by presenting the four methods of problems-solving and selecting right solutions. The researcher designed a model that presents the lesson framework as the following figure illustrate.

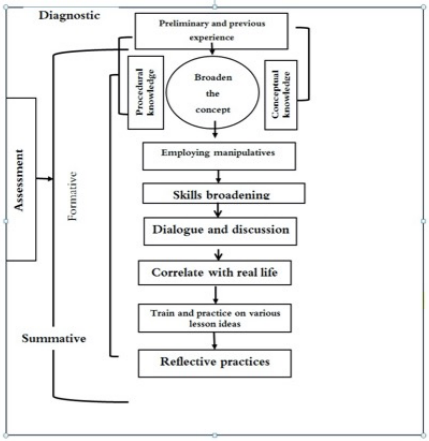


**Figure 1.**

*A Framework to Organize the Main Topics of the Lesson*

## Results and Discussion

As figure 1 illustrated the framework stages are explained in details;

**Theme 1. Stages of The Lesson**

***Preliminary and previous experience.*** This stage stresses the correlation between the previous and future experiences, motivates students to recall previous experience, offers students the opportunity to interact with the lesson concepts, skills, and problems, and confirms the correlation between the ideas, skills, and mathematical concepts. The stage depends mainly on Ausubel theory that refers to the importance of correlating previous and future experiences.

***Concept broadening***. This stage follows the stage of preliminary and previous experience; it correlates with it and offers questions that depend largely on critical thinking and higher thinking skills, it supports conclusion and evaluation to broaden the concept and thorough understanding and it emphasizes the correlation and spiral organization of the curriculum which is confirmed by Brunner's theory.

***Manipulatives.*** In this stage the students age is the concern, students are active and mobile, and by this way are more able to deeply understand the mathematical concept and retain learning. The important skills are identified in the lesson. The stage depends on the Theories of Deans and Piaget.

***Skills broadening***. This stage correlates with the concept in the lesson to stress the importance of correlating the conceptual and procedural knowledge rather than focusing on one of them, as figure 2 illustrate.

***Dialogue and discussion.*** The stage enhances understanding concepts and mathematics skills; it develops few skills such as communicating, sharing, and self-direction toward learning. It offers a summary of the main ideas in the lesson and aims to facilitate the revision and recalling processes.

***Correlate with real life.*** This stage includes activities and problems from the students surrounding environment to show the role of mathematics importance in daily life.

***Training and practice.*** The stage is important to understand the lessons skills; it develops the higher thinking skills and includes a set of various activities that consider the skills of critical thinking, sharing and communication, solving daily problems, decisions taking. In this stage the student is able to solve the questions in the class and homework which covers all the lesson ideas.

***Reflect.*** This stage supports reflection in general and reflective writing in specific. Students are offered organizers and asked to design them to develop their creativeness by defining the main ideas of the lesson. The stage develops students' skills of writing.

**Theme 2. Investigation and Problem Solving**

These lessons focus on using the four methods of finding solutions; it develops students problem-solving skills, and selecting the appropriate plan to resolve the problem.

***Resolve the problem in groups.*** The lesson starts by presenting a problem from the daily life followed by a table that includes a set of inquiries that attracts student's attention to the important information in the question and enables their ability to define what is required.

***Individual activity.*** The individual activity is provided to develop the students' critical thinking by evaluating the students resolving plan shared with his peers. Individual activities and develop students creative and critical thinking to search for an alternative plan.

***Deepen thoughts and broaden skills***. Problems that are more complex are offered to students, these problems consider higher thinking skills to motivate students' deep and aware reading, to be able to define what is required and develop ability to resolve more complex problems.

***Training and practice.*** Repetition and training are important to understand the lessons skills; this stage considers developing the higher thinking skills, it includes various activities that consider the skills of critical thinking, sharing and communication, solving daily problems, and decisions taking. In this stage the student can resolve the questions in the class and at home; it covers all the lesson ideas.

***Mathematics reflective writing.*** This stage stresses students training on reflective writing, develops higher thinking skills and connects the ideas of the lesson by asking the student to write a problem he faces in daily life and correlates with the previous lessons.

To answer the second question "What theories may be used to develop the content of the mathematics textbook in the primary stage" the researcher recommends depending on a set of theories that support constructive learning and focus on the learner such as Bruner Theory, Dienes Theory, Ausuble Theory, Piaget Theory, and Gagne Theory. These theories correlate with the mathematical framework (concepts, generalities, skills and problems solving).

**Developing Mathematics Education in the Light of Learning Theories**

Theories are one of the most important sources of learning; Because it provides us with knowledge of the principles organizing and interpreting environmental events that occur around us, and provides us with the conceptual relationship in which multiple events are linked, and contributes to guiding and organizing work, and is a guide to accessing new knowledge and the growth of experiences (Qatami, 2005).

Mathematics has its own nature in making use of theories to develop its curricula in line with the nature of mathematics and the school stage. Therefore, in this part, the researcher will address the theories on which he relied when developing the educational unit, namely: (Jean Piaget's theory, Brunner's theory, Osbel's theory, Dennis' theory).

**Piaget Theory**

Those responsible for developing mathematics curricula benefited from it (Al-Tamimi, 2016). Piaget concluded that the stages of cognitive development pass through four hierarchical stages with varying ages, which are: the sensory-motor stage, the pre-operational stage, the sensory operations stage, and the abstract operations stage (Al-Maqoushi, 2001).

The theory considers the learner's characteristics in the primary stage that the sensory processes stage. Teachers offer learners activities that enable them to move in class and work with manipulatives to acquire the mathematics concepts and correlate the main ideas of the lesson. Teachers also offer preliminary questions to motivate them to perform logical mental processes in order to learn mathematics, and to develop their thinking level in terms of mathematical thinking styles consideration (such as: inference, conclusion, and coding .etc.)

**Ausuble Theory**

Meaningful learning is the core of Osbel's theory, and it means the real integration of new information into the individual's cognitive structure; To contribute to the survival of the impact of learning, and to facilitate the task of developing concepts (Al-Kasbani, 2008). The theory is concerned with organizing the content of school curricula (Abdul Qadir and Shadid, 2013).

Teachers implement the theory by connecting previous and new concepts through providing activities and experiences to certify relationally. The implementation of the theory is apparent in the preliminary and previous experience stage defined in the proposed model of the lesson. The activities selected are correlated with the surrounding environment of the student; they are fit to his age, interests and tendencies. Furthermore, the theory allows students to prepare organizers for the lessons main ideas, at the end of each lesson, there is an activity to motivate students to reflect on the main ideas and concepts in the lesson and correlate them, in addition to the opportunity of setting organizers that achieves students creativeness in representing the correlation between all experiences included in the lesson.

**Bruner Theory**

Brunner's interest in discovery replaces traditional teaching methods, in which the learner rearranges, organizes, or alters data or evidence; To reach other information and new generalizations (Abu Cel, 1999).

Brunner's theory calls for focusing on the mathematical structure, including concepts, inferences, theories, and laws, in a logical format that makes mathematical information more understandable, in addition to his emphasis on taking into account the spiral organization when organizing the content of mathematics; That is, the presentation of mathematical concepts and skills in a sequential manner, provided that they are presented at different and escalating levels, in terms of abstraction and generalization, provided that the characteristics of mental development at each level are taken into account (Affana et al., 2012).

This theory is based on discovery, and it manifests when the concepts are provided in a safe and age-suitable method. It offers students activities that permit discovering concepts and mathematical skills included in each lesson, following graduate presenting of experience and activities to motivate the student to reach new generalizations and adopt the spiral curriculum design.

**Dienes Theory**

Deans' theory includes four general principles: the dynamic principle: it is intended to provide an effective and organized environment for training and play; and the constructivist principle: through organized sports play, it is possible to build and construct enjoyable sports combinations that help in building the mathematical concept correctly, and the principle of change: the greater the number of variables. In the mathematical structure, this was called for thinking, and the principle of embedding aims to reach the formation of correct mathematical concepts (Salama, 2005).

The idea of this theory and its acquisition stages defined by Deans are considered when working with concepts. The stage includes activities and experiences that allow students to discover the concept, it is possible also to consider the dynamic principle where students are allowed to move and play while processing sensory experiences. This is confirmed by adding manipulative framework that allows the student play free and represent the main concepts of the lesson then transfer to the coding stage.

**Gagne Theory**

Advocates of the theory depend on sequential and simple to complex hierarchy in learning mathematics concepts to transfer the student to problem-solving stage. Therefore the theory consider in the proposed content starting from providing the previous concept then pass gradually in depth in the new concept through supportive activities and tasks. Such as non-routine problems that allow the student to use his experience to overcome problematic new situations.

**Theme 3. Proposed Framework to Organize the Content of Mathematics Textbooks**

To answer the third question "How can the proposed framework to organize the content consider achievement based on the Trends in International Mathematics and Science Study (TIMSS) levels?", the levels of TIMSS domains (knowledge, Applying and Reasoning) are considered according to the proposed framework to organize the content of mathematics textbooks as follows:

***Preliminary and previous experience.*** In this stage recalling of information, terms, and definitions are correlated with the new lesson tackled, i.e. the level of knowledge is considered.

***Concept broadening.*** Here, students are allowed to implement familiar strategies to answer questions, which are normally expansion of previous concepts to achieve the goal of understanding the new concept and to reflect it on a wide range of activities and ideas. That means the level of applying is considered in addition to allowing the student to judge mathematical relationships between the lessons ideas and various skills and to reach new generalizations. This indicates the level of reasoning is cared for.

***Manipulatives.*** This component allows students the opportunity to describe and conclude the main ideas and concepts of the lesson that is the level of reasoning is cared for.

***Skills broadening.*** Here, students are allowed to confirm information and skills tackled in the lesson, this supports the knowledge level in addition to using familiar procedures in answering the questions, and this means that the applying level is considered.

***Dialogue and discussion.*** In this part the students can stress the important information in the lesson, ease information retention and guide the students to discuss, summarize and confirm the main ideas in the lesson, this means the knowledge level is considered.

***Mathematics in Our Lives.*** In this part the student is provided with situations from the surrounding environment to allow him to use familiar procedures in resolving the problem, the student is aware of the possibility of implementing the concepts and skills of the lesson on different situations and life problems. Here the implementation level is applying.

***Training and practice.*** The student is allowed to resolve the questions by familiar methods, considering the applying level. It includes paragraphs to evaluate the student's peers methods used in resolving the questions and criticize it, in addition to providing non-routine problems to reach for student's reasoning in answers.

***Reflect.*** Here a set of paragraphs motivate the student to reflect on the lesson ideas, correlate them together, and support creative thinking by guidance to make organizers in a special way considering the correlation and logical relationships between the ideas of the lesson, to use them in a wide range of situations, here the reasoning level is cared for.

## Conclusion

The current paper focused on providing a theoretical proposal to organize the content of mathematics textbooks of the primary stage. Examining the proposed model practically and finding the relation of the proposed framework in developing the teaching practices and achievement development in general, and increasing achievement in TIMSS levels in specific is available. Furthermore, it offers a potential chance to study students and teachers attitude about the proposed organization.

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