Iranian Journal of Educational Sociology

Journal Website

Article history:
Received 06 February 2024
Revised 05 March 2024
Accepted 12 March 2024
Published online 12 May 2024

Iranian Journal of Educational Sociology

Volume 7, Issue 2, pp 106-113

Quarterly
Iranian Journal of Educational Sociology

E-ISSN: 2645-3460

Identifying Contextual and Moderating Components Affecting the Implementation of the Primary Mathematics Curriculum

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A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Mohammadi Naeeni, M., Ranjdoust, Sh., Tahmasabzadeh Sheikhlar, D. (2024). Identifying Contextual and Moderating Components Affecting the Implementation of the Primary Mathematics Curriculum. *Iranian Journal of Educational Sociology*, *7*(2), 106-113.
http://dx.doi.org/10.61838/kman.ijes.7.2.13

A B S T R A C T

Purpose: Given the importance of proper implementation of the primary mathematics curriculum, this study aimed to identify the effective contextual and moderating components in the implementation of the primary mathematics curriculum.

Methodology: This study was applied in purpose and qualitative in approach. The research population consisted of expert teachers in the field of primary mathematics curriculum in Tehran during the academic year 2020-2021, from whom 16 were selected based on theoretical saturation using purposive and snowball sampling methods. The research tool was a semi-structured interview, the face validity of which was confirmed by experts, and its reliability was obtained with a Cohen's Kappa coefficient of 0.86. The data were analyzed using thematic analysis in MAXQDA-2020 software.

Findings: The findings revealed that in the model of effective components in the implementation of the primary mathematics curriculum, for contextual components, 17 basic themes were identified under 4 organizing themes including social, cultural, economic, and structural, and for moderating components, 20 basic themes were identified under 3 organizing themes including advantages of learning mathematics, barriers to learning mathematics, and facilitators of learning mathematics. Ultimately, a model of effective contextual and moderating components in the implementation of the primary mathematics curriculum was illustrated.

Conclusion: According to the results of this study and considering the effective contextual and moderating components in the implementation of the primary mathematics curriculum, it is necessary for specialists and curriculum planners to utilize strategies compatible with the identified components to improve the educational system.

Keywords: *Curriculum, primary education, social theme, cultural theme, advantages of learning mathematics.*

[DOI: 10.61838/kman.ijes.7.2.13]

1. Introduction

Education is a complex process where any simplistic approach can lead to the wastage of resources and failure of efforts. Therefore, the development of education and its implementation requires an understanding of the educational process and awareness of modern methods, which further highlights the importance of curriculum in education (Soltan Mohammadi et al., 2023). At the onset and establishment of formal education globally, the duration of general education was short, and its primary aim was to develop basic literacy skills in reading, writing, and arithmetic, preparing individuals for various professional fields including administrative bureaucracy and industry. Following the writing of the first official curriculum book, it became evident that through needs assessment, a curriculum could be developed that is appropriate and tailored to the diverse needs and vocational expectations of general education audiences (Gooya et al., 2019). In every educational system, the curriculum undergoes changes and transformations according to educational, pedagogical, cultural, and even political needs and conditions. Teachers in centralized education systems are required to implement the designed curriculum and do not participate in its development, whereas in decentralized systems, they play an effective and prominent role in curriculum design (Zhang & Luo, 2022). In centralized educational systems, there is a general trend towards centralized control at all stages from design and development to implementation and evaluation of outcomes, which is the case with the educational and curriculum system in Iran (Khosravi & Mehrmohammadi, 2023).

The curriculum has always been a field of innovation and intellectual debate and serves as the focal point of educational activities and the most intense disputes in education. This is because objectives, content, implementation, and evaluation are included in the programs, which are among the most critical factors or variables affecting education in any country (Zweeris et al., 2023). The curriculum extends beyond textbooks and is essential, including the most fundamental operational policies to achieve educational goals. Therefore, it is necessary to carefully prepare and develop the curriculum even to meet rapidly changing scientific, technological, economic, and social needs (Jonker et al., 2019). This curriculum refers to all formal and informal content, the process of content, and explicit and implicit teachings that students learn under school guidance, experiencing changes in their knowledge, attitudes, and skills (Mahdian et al., 2022). Curriculum design provides a flexible and adaptable framework for organizing, implementing, and evaluating the curriculum, creating a set of learning opportunities (Shawer, 2017). This concept represents a set of educational opportunities, systematically designed from local and regional to national and international levels, preparing individuals to acquire necessary competencies for understanding and improving their situation and learning knowledge, attitudes, and skills (Nerlino, 2022).

A curriculum that has attracted the attention of education system specialists is the mathematics curriculum, which is among the most important and fundamental scientific and educational systems. This is because mathematical concepts provide one of the most effective educational materials available to learners (Nelson et al., 2023). Two fundamental documents include the Fundamental Transformation Document of Education (2011) and the National Curriculum Document of Iran (2012), approved by the Supreme Council of Education and Training, which emphasize mathematics education. For example, the National Curriculum Document states that an important aspect of mathematics is enabling individuals to accurately describe complex situations, predict and control possible natural, economic, and social conditions. This document specifies that educational activities in mathematics should arise from the surrounding environment to help students observe, analyze, and understand mathematical concepts and find various interpretations of mathematical concepts in their environment (Ahmady et al., 2019). All human activities, especially those involving complexity and delicacy, cannot be outside the scope of qualitative review and continuous improvement, and this is also true for mathematics. Mathematics has always had a special place in the curriculum, and its volume, approach, methods, content, etc., are constantly changing, but what remains constant is the effective and permanent presence of mathematics in the curriculum (Azizi & Nili, 2019).

Mathematical concepts included in the mathematics curriculum are among the most effective educational materials, and the simplest explanation for learning mathematics is that it has become intertwined with human life and generally with the surrounding world to the extent that mathematics is called one of the methods of understanding the world (Bicer et al., 2024). The role of mathematics in various fields of science and technology and its utility in improving human living conditions is so effective, unparalleled, and tangible that it is called the

[DOI: 10.61838/kman.ijes.7.2.13]

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

mother of sciences. Therefore, the development and improvement of the mathematics curriculum should always be on the agenda of curriculum planners and educators so that the mathematics curriculum can provide more opportunities for the growth of knowledge, attitudes, and skills in students than before (Dietiker & Riling, 2018). Mathematics deals with observation, calculation, analysis, inference, induction, proof, and prediction, and as a communicative system, it helps an individual to gain a correct and precise understanding of information, patterns, and reasoning. Therefore, students' intellectual and mental abilities to improve their problem-solving skills in mathematics are among the most important features of students that can contribute to the education of thoughtful and intellectual individuals in the education system (Wakabayashi et al., 2020). Mathematics encompasses the entire lives of all individuals, including children, and from an early age, children engage with mathematical concepts and ideas in their environment. Therefore, mathematics has always had a key place in the curriculum and is considered an independent individual knowledge. Since its teaching is closely related to other sciences and life skills, mathematics education is essential (Makar et al., 2018). Over the past decade, the Iranian education system has undergone comprehensive changes in curriculum, textbooks, teacher training, and evaluation methods in educational periods, and the necessity of adapting curricula to two upstream documents including the Fundamental Transformation Document of Education approved by the Supreme Council of Education and Training in 2011 and the National Curriculum Document of Iran approved by the Supreme Council of Education and Training in 2012 (Gholamazad et al., 2021).

Although no research has been conducted on the contextual and moderating components effective in the implementation of the mathematics curriculum, research in this area has been conducted. For example, Gholami Pol Basreh, Mohammadi Naeeni, and Nateghi (2022) conducted research on the formal and experienced curriculum model of sixth-grade mathematics and concluded that the formal curriculum includes two categories of intellectual components with sub-components of thinking skills and understanding and reasoning, and a practical category with sub-components of problem-solving, creativity, and activities, and the experienced curriculum includes two categories of theoretical components with sub-components of problem-solving approach, purposeful teaching, and teaching principles, and a practical category with sub-components of practical teaching, research-based teaching method, exploratory teaching method, teaching in educational groups, modern teaching method, and motivating teaching method (Gholami Pol Basreh et al., 2022). Khodabakhshi, Assareh, Aminifar, and Khosravi Babadi (2021) conducted research on the curriculum model of primary mathematics with a mobile learning approach and concluded that 10 basic themes were identified under 3 organizing themes and 1 comprehensive theme; the organizing themes include the vision of mobile learning (with 3 basic themes of planning mathematics learning, improving the culture of mathematics, and attitudes and goals of mathematics), enriching mobile education (with 5 basic themes of enriching mathematics learning, performance and implementation of mathematics learning, competence of mathematics teachers, tools and methods, and interaction of individuals involved in mathematics education), and performance evaluation (with 2 basic themes of physical and qualitative evaluation and improvement) (Khodabakhshi et al., 2021). Kiss and Konya (2020) conducted research on the metacognitive components in the development of the mathematics class and concluded that the components identified included planning, learning process, belief change, problem-solving in mathematics, and students' understanding of the problem (Kiss & Kónya, 2020). Geary, Berch, and Koepke (2019) conducted research on the cognitive foundations of improving mathematics learning and concluded that the effective components in this area included problem-solving, exploratory learning, enhancing active memory, practicing information retention in memory, fluid intelligence, strengthening reasoning, and solving problems in real-life situations (Geary et al., 2019).

The implementation of new changes in school mathematics education in Iran began with a transformation in the curriculum and mathematics textbooks from the first grade in 2011 and ended with the implementation of the new twelfth-grade mathematics program in 2019. The basis for producing newly authored textbooks during these periods was the Mathematics Curriculum Guide from the first grade to the end of secondary education, which was produced by the Mathematics Group of the Office of Curriculum Planning and Textbook Production and approved by the Mathematics Group Council (Gholamazad et al., 2021). Among school curricula, mathematics is a descriptive and explanatory science that deals with identifying and understanding distinctive and special aspects of the world and involves a dynamic interplay of questioning and responding, invigorating and perceiving a different sense of

[DOI: 10.61838/kman.ijes.7.2.13]

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

knowing and knowledge. Therefore, mathematics education and the mathematics curriculum must be revised and reviewed, and for this purpose, recognizing the contextual and moderating components effective in its implementation is necessary and essential. Given the importance of proper implementation of the primary mathematics curriculum, the present research aimed to identify the contextual and moderating components effective in the implementation of the primary mathematics curriculum.

2. Methods and Materials

2.1. Study Design and Participants

This study was applied in its objectives and qualitative in its implementation approach. The research population consisted of expert teachers in the field of primary mathematics curriculum in Tehran during the academic year 2021-2022, 16 of whom were selected based on theoretical saturation using purposive and snowball sampling methods. According to the principle of theoretical saturation, sampling ends when new samples cannot add any new findings to the previously extracted data from earlier samples. In other words, a research is considered complete when it is theoretically saturated. In this study, saturation was reached after the fourteenth interview, but to ensure theoretical saturation, interviews were also conducted with the fifteenth and sixteenth participants. Moreover, the sampling using purposive and snowball methods began with identifying 30 expert teachers in the primary mathematics curriculum, among whom five agreed to participate in the research and undergo interviews. These five were selected through purposive sampling and were asked to refer other experts to the researchers, and the selected samples were chosen through what is called snowball sampling. The inclusion criteria for this study were a minimum of 15 years of work experience, at least a bachelor's degree, willingness to participate in the research, and consent to recording the interviews. Additionally, the exclusion criteria included withdrawal from participation in the research and refusal to allow recording of the interviews.

The operational steps of this study were as follows: initially, questions for interviewing experts about identifying effective contextual and moderating components in the implementation of the primary mathematics curriculum were designed with the help of professors. Subsequently, samples were identified using purposive sampling, and they were also asked to refer other experts for participation in the study. The sampling process continued with each method until the research findings reached saturation. It is important to note that the importance and necessity of the research and conditions for participation, such as recording interviews and scheduling the time and place, were explained to the samples, and they were reassured about ethical considerations before being interviewed at the pre-arranged time and place. During the interview recording, the interviewer also noted important and key points, which were confirmed by the interviewees. The reason for recording the interviews was to review them at an appropriate time to ensure no details were overlooked. After completing the interview with each expert, they were thanked for their participation in the research.

2.2. Data Collection

Two tools were used in this study: a demographic information form and semi-structured interviews. The demographic information form, designed by the researchers of this study to better understand the samples, included questions about the level of education, field of study, and work experience. Additionally, the semi-structured interview consisted of two main questions and several sub-questions, which were designed based on theoretical foundations with the help of professors. The two main research questions were: What are the contextual components effective in the implementation of the primary mathematics curriculum? and What are the moderating components effective in the implementation of the primary mathematics curriculum? In this study, the two main questions were asked of all samples, but sub-questions were only asked of those who had difficulty understanding the main question or who deviated from the question framework during their responses. The interviews were conducted individually at a pre-determined time and place, and they lasted approximately 25 to 40 minutes each. The face validity of the interviews was confirmed by experts (other than the current study's samples), and their reliability was obtained with a Cohen's Kappa coefficient of 0.86.

2.3. Data Analysis

Following the collection of data for this study, thematic analysis was conducted using MAXQDA-2020 software.

3. Findings and Results

In this study, 16 experts underwent semi-structured interviews, with most interviewees holding a Master's

[DOI: 10.61838/kman.ijes.7.2.13]

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

degree (56.25%), from fields of curriculum planning and other disciplines (each 25%), and having a work experience of 26-30 years (43.75%). The semi-structured, individual interviews led to the thematic analysis summarized in Table 2 for identifying effective contextual and moderating components in the implementation of the primary mathematics curriculum.

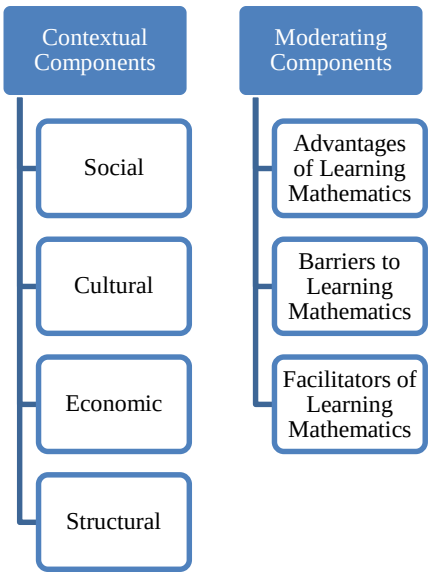
Table 1

Summary of Thematic Analysis of Interviews for Identifying Effective Contextual and Moderating Components in the Implementation of the Primary Mathematics Curriculum

Main Theme	Organizing Theme	Basic Themes
Contextual Components (4 Organizers, 17 Bases)	Social	1. Ignoring community needs, 2. Interference of mother tongue in learning mathematics, 3. Community awareness, 4. Presence of mathematical education institutions
	Cultural	1. Lack of cultural background, 2. Attitudes of all educational stakeholders towards mathematical culture, 3. Issues related to the country's educational culture
	Economic	1. Lack of necessary facilities and resources, 2. Limited learning resources, 3. Lack of a suitable learning environment
	Structural	1. Use of inappropriate teaching models and methods, 2. Lack of practical approach to learning mathematics, 3. Unreasonable evaluation in the mathematics education program, 4. Lack of appropriate educational content, 5. Exclusion of teachers, administrators, and parents from school decision-making, 6. Textbook-centric nature of the Iranian educational system and teachers' over-reliance on textbooks, 7. Issues related to students
Moderating Components (3 Organizers, 20 Bases)	Advantages of Learning Mathematics	1. Strengthening higher mental processes, 2. Activation of the brain cortex and enhancing learning level, 3. Effective enhancement of children's memory, 4. Strengthening long-term memory and aiding learning retention, 5. Proficiency in problem solving and creative thinking, 6. Helping the growth and facilitation of learning other subjects, 7. Success in interpersonal relations and improving competitive edge in the job market
	Barriers to Learning Mathematics	1. Value barriers, 2. Operational barriers, 3. Unclear or inaccessible realization of mathematical objectives, 4. Lack of family-related cultural issues in mathematics books, 5. Age limitations for starting mathematics education, 6. Teacher's inability to use modern teaching methods and to implement an activity-based approach, 7. Inadequate educational facilities and conditions and non-use of teaching aids, 8. Inappropriate and competitive evaluation, 9. Limited teaching time and large number of students
	Facilitators of Learning Mathematics	1. Teachers, 2. Support from senior administrators, 3. Structure of the educational system, 4. Parents and students

Figure 1

Final Paradigm Model



[DOI: 10.61838/kman.ijes.7.2.13]

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

As observed in Table 1, in the model of effective components in the implementation of the primary mathematics curriculum, 17 basic themes were identified under 4 organizing themes for the broad theme or contextual component including social, cultural, economic, and structural, and 20 basic themes were identified under 3 organizing themes for the broad theme or moderating component including advantages of learning mathematics, barriers to learning mathematics, and facilitators of learning mathematics. Based on the broad and organizing themes, the model of effective contextual and moderating components in the implementation of the primary mathematics curriculum is visible in Figure 1.

4. Discussion and Conclusion

The curriculum in the educational system is one of the most important and fundamental elements for students to achieve national goals and ideals regarding the education and development of future generations. Numerous factors and variables have significantly increased the importance and sensitivity of this essential component of the educational system, including the diversity and rapid change and acceleration of human needs and demands today. Therefore, the contextual and moderating components of the mathematics curriculum can play an important and effective role in improving and enhancing the curriculum. Consequently, the present study was conducted with the objective of identifying the effective contextual and moderating components in the implementation of the primary mathematics curriculum.

The findings of the current study revealed that in the model of effective components in the implementation of the primary mathematics curriculum, 17 basic themes were identified under 4 organizing themes including social, cultural, economic, and structural for contextual components, and 20 basic themes were identified under 3 organizing themes including advantages of learning mathematics, barriers to learning mathematics, and facilitators of learning mathematics for moderating components. Although no research on the contextual and moderating components effective in the implementation of the mathematics curriculum was found by the researchers of the current study, these findings are consistent with the results of prior studies in this area (Geary et al., 2019; Gholami Pol Basreh et al., 2022; Khodabakhshi et al., 2021; Kiss & Kónya, 2020).

In interpreting the contextual components with seventeen basic themes across four organizing themes—social, cultural, economic, and structural—and the moderating components with twenty basic themes across three organizing themes—advantages of learning mathematics, barriers to learning mathematics, and facilitators of learning mathematics—it can be stated that based on interviews with experts, the four themes had a direct and significant role in shaping the primary mathematics curriculum in the Iranian educational system. Experts noted factors influencing the primary mathematics curriculum that currently exist in the educational system and have not been adequately addressed. If measures have been taken, they were either incomplete or lacked coherence among the factors to solve the problem. Therefore, we still witness many problems and deficiencies in the educational system of Iran concerning mathematics education and curriculum, which can disrupt the implementation of the mathematics curriculum and challenge the entire educational system. To improve and amend the curriculum towards success, a balanced and holistic approach is necessary. Focusing on one aspect without proper implementation will not necessarily lead to significant success. According to the principles of curriculum for achieving success, a systemic rather than a fragmentary focus is required. Although paying attention to details is necessary, it must be preceded by and accompanied by attention to the overall execution. A curriculum will be successful and can move in the right direction when more attention is paid to the relationships between parts than to the parts themselves. Essentially, the science of curriculum is about the appropriateness between components, and if we do not have a balanced view between components and parts, undoubtedly the focused parts will develop, leading to what might be called a caricatured curriculum.

Another important point is that the novelty of the curriculum, especially the mathematics curriculum in Iran, is one of the factors that have caused the development of curriculum, textbook composition, teaching methods, and other actions to not be comprehensive, all-encompassing, and reflective of Iranian and Islamic culture, which will lead to numerous damages, weaknesses, and deficiencies. An examination of documents related to the educational transformation in Iran indicates that although there was great enthusiasm for human education and scientific development and steps have been taken in this regard, these efforts were scattered. As a result, scientific and research productions in the field of curriculum and even mathematics curriculum have been conducted, but no ensemble that could truly

[DOI: 10.61838/kman.ijes.7.2.13]

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

combine and develop mathematical education and curriculum was found. In mathematics education, due to the lack of active and dynamic methods and the curriculum's misalignment with the individual and intellectual needs of students, mathematics has become one of the most challenging subjects. In the current mathematics curriculum of the Iranian education system, despite the importance of the application of mathematics in real life, not much attention has been paid to practical problems. Based on this, it is necessary and essential that significant changes and transformations take place in the mathematics curriculum, including the primary mathematics curriculum, to make it more practical for students and allow them to benefit more from the learned content in real life. Another important point is that in the centralized educational system of Iran, teachers are required to implement a type of curriculum in which they have no role in its production and thus feel alienated from it. Therefore, an important issue in this area is the transition from a centralized to a decentralized or semi-decentralized educational system, which while creating new challenges, can eliminate many issues and problems of the centralized mathematics curriculum.

The main limitations of the current study include the scant research background on the mathematics curriculum and the inability to find research on the effective contextual and moderating components in its implementation, the limitation of the research population to expert teachers in the field of primary mathematics curriculum in Tehran, and the use of non-random sampling methods including purposive and snowball sampling. Therefore, further research is recommended on identifying effective components in the implementation of the primary and even secondary mathematics curriculum, and if possible, using expert teachers from other educational stages or other cities and members of the Faculty of Education University familiar with school mathematics books. The results and findings of this study have practical implications for specialists and curriculum planners, and based on the results and findings of the current study, they can take effective steps to examine the current situation of effective contextual and moderating components in the implementation of the primary mathematics curriculum and, in addition to that, seek solutions for improving the primary mathematics curriculum. Generally, according to the results of this study and considering the effective contextual and moderating components in the implementation of the primary mathematics curriculum, it is necessary for specialists and curriculum planners to use strategies compatible with the identified components to improve the educational system.

Authors' Contributions

The first author was responsible for conducting the interview and collecting data, and the other authors were responsible for analyzing the data and writing the article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We hereby thank all participants for agreeing to record the interview and participate in the research.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethics Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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[DOI: 10.61838/kman.ijes.7.2.13]

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[DOI: 10.61838/kman.ijes.7.2.13]

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460