

Designing a Proposed Strategy based on the Steps of Fuzzy Logic in Developing Mathematical and Psychological Based Culture among Students of the Department of Mathematics

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Abstract:

The current research aims to identify the effect of designing a proposed strategy according to the steps of fuzzy logic in the development of mathematical culture among students of the Department of Mathematics. The research sample consisted of students of the fourth stage of the Department of Mathematics in the College of Education for Pure Sciences / University of Mosul, as the researchers adopted the semi-experimental approach.

In order to achieve the goal of the research, the mathematical culture test was prepared, and the researchers came out with a set of results, most notably: the presence of a statistically significant difference between the average degrees of mathematical culture development in favor of the experimental group. In light of the results, the necessary recommendations and proposals were presented.

Keywords: fuzzy logic strategy, mathematical culture, psychological concept of flow, mathematical and computational models.

Introduction

In light of the tremendous and rapid developments that the world has been experiencing since the middle of the twentieth century in all areas of daily life, which witnessed wide interest in the educational process and its elements, and drew attention to investing energies to achieve the best results in it, and therefore the interest in teaching methods and innovation in them and interest in employing the appropriate ones in them were increased, which achieving the objectives of the teaching process. There have always been modern trends in diversifying and developing teaching methods. There is no doubt that this requires comprehensive knowledge of all the elements contributing to its success.

The education process is considered the most work and job that needs a great effort because the teacher is doing a great effort with people who have different ideas, inclinations, attitudes, mentalities and values. The educational process and the task of the teacher have been completed at the present time with the world's abundant technological development, knowledge explosion and the emergence of modern technologies. (Kaiser, 2020)

For this reason, the educational preparation programs, in addition to their interest in providing students with a deep understanding in the field of specialization, and in the educational field, they need to educate mathematics for the future teacher, so a balance must be made between the inevitability of mastering the basic topics that lie at the core of the method and the inevitability of having a culture of mathematics (Simamora, 2019).

Despite the emphasis of the Mathematics Standards Document NCTM on the necessity for a mathematics teacher to be able to master mainly the scientific content, in addition to have a high amount of mathematical culture to the extent that enables them to raise the level of their students in mathematical culture, in addition to providing them with knowledge and information. Through the interviews conducted by the researcher with the

teachers of the Department of Mathematics and the discussion with them, they all emphasized the weakness of the students of the Department of Mathematics in the aspect of mathematical culture, and this will be reflected in their unwillingness to learn and teach mathematics and their ability to employ life examples in mathematics, and this was confirmed by previous studies as a study (2021) Acharya.

In this direction, the researchers believe that the attempt to solve this problem was compatible with the diagnosis of previous studies and in line with the recent trends of teaching practical education in the Department of Mathematics, which employed fuzzy logic applications in its teaching, which focus on using life mathematical examples and practicing its steps as a teaching strategy during the lesson. This will perhaps help improve their mathematical culture. The problem can be formulated with the following question:

What is the effect of designing a proposed strategy according to the steps of fuzzy logic in developing mathematical culture among students of the Mathematics Department?

Importance of the Research

Interest of the university level is a good indicator of the progress of people and societies. Therefore, developed countries pay more attention to education than the rest of their possessions. Education is the main pillar on which the progress of societies in this world of accelerated knowledge and technological growth rests, and it is the responsibility of educational institutions to play a major role in caring for this wealth by caring for the individual and raising him in a sound and beneficial upbringing and making a successful individual in his society. The education process is considered the most work and job that needs a great effort because the teacher is doing a great effort with people who have different ideas, inclinations, attitudes, mentalities and values.

The educational process and the task of the teacher have taken place at the present time, with the abundant technological development and knowledge explosion in the world, and the emergence of modern technologies. (Crompton, H.& et. Al,2021).

Teaching and learning mathematics is not limited to developing cognitive aspects in terms of concepts, laws and theories, and in terms of developing algorithms and skills for performing mathematical operations in arithmetic, algebra, geometry and other components of mathematical activities. Rather, it extends to teaching and learning mathematics to form mental processes, develop positive sentimental tendencies, learn to read and write it, listen to its concepts and theories, and discuss its topics.(Renkl, A.,2023).

In addition to the great development that took place through the use of mathematics in all sciences. Which led to obtaining changes in mathematics itself, and this development included all of them arithmetic, algebra, geometry.....) and its association with other knowledge systems, and was also accompanied by a development in the quality and quantity of mathematics, which should be covered by the mathematical curriculum in the different educational stages, Martin (2019). Mathematics contributes to the benefit of mankind in all walks of life, as it appears to the follower the entry of mathematics through its various branches and specializations into many affairs of life, especially with regard to competition and advancement in various aspects of knowledge. As any science in this time does not dispense with mathematics through its branches. Even the legal sciences and disciplines have become closely linked to mathematics, and they benefit from it in determining the times of worship. The life applications of mathematics are a basic requirement in preparing mathematics teachers due to its connection to mathematics in the daily life of the learner and its role in developing mathematical culture. (Acharya, 2021)

Due to the importance of fuzzy logic as one of the new theories of science, which has properties

more vitality and relating to the technology of the age and its applied importance in many fields and sciences. So the teacher must benefit from it to be more creative in developing his teaching of mathematics so that learning it is a fun and attractive process that stimulates the independence of learning mathematics with love and appreciation. (Athanassopoulos, E., & Voskoglou, M. G.,2020).

The methods of teaching mathematics have witnessed a remarkable development in the modern era due to the large increase in mathematical knowledge and the change of its nature. As a result the students are facing rapid increasing in knowledge and rapidly and permanently changing social and economic conditions which led to the change in Mathematics that student must study to suit the age of technology and information and new production methods that require qualified individuals with a high level of efficiency and technology. Therefore, modern mathematical standards have become emphasizing the promotion and employment of effective mathematical thinking, justification, and communication strategies, focusing on mathematical relationships and links, and what this requires of exploring the depth of mathematics in order to employ it in various life tasks to keep pace with the global development movement that reflects the needs of society in the age of economy, knowledge, and information technology. Lynch-(Arroyo, R. L., & et. Al., 2023)

The Mathematical culture contributes to building the individual by providing him with many skills, applications and educational concepts that help him interact with the life of the group in order to contribute and make him more loving and receptive to his profession, more belonging to his society and more able to adapt to it. The mathematical culture also contributes in building the individual throughout giving him many of educational skills, applications and concepts that help him interact with group life to contribute and make him more loving and accepting for his profession and more belonging to his community and more ability to modify with it. The Mathematical culture also contributes in forming the personality of the student and raising him and his level and increase his ability to carry out his responsibilities and duties entrusted to him in the best way. In addition, the teacher's display of the ethics of his profession makes him a model and role model for his students in his behavior and actions.

The aims of the Research

The research aims to:

- Identifying the impact of designing a proposed strategy according to the steps of fuzzy logic in developing mathematical culture among students of the Mathematics Department.

Hypotheses of the Research

In order to achieve the research objective, the following hypothesis was formulated:

"There is no statistically significant difference at the level (0.05) between the mean scores for the development of mathematical culture among the students of the Mathematics Department between the experimental group that studied according to the employment of fuzzy logic and the control group that studied in the usual way."

Definition of Basic Terms

1. Fuzzy Logic:

The researchers define it procedurally: as employing the applications of fuzzy logic to teach the subject of practical education used by the teacher of the subject, as it begins to draw the attention of students when presenting a mathematical topic that constitutes a blur for students, then the students extract the fuzz by offering their opinions, and then it moves them to the stage of decoding the fuzz by each group presenting their ideas through the representative of the group, and then the role of the teacher comes in the last step, which is the feedback or conclusion as the teacher explains the mathematical situation to the students correctly.

2. Mathematical culture:

The researchers define it procedurally: it represents the extent to which the students of the fourth stage in the Department of Mathematics / College of Education possess pure sciences / University of Mosul, possess mathematical concepts and skills and their practical applications in their local environment in order to achieve success and adapt to society, and this is achieved by following up and taking the latest global developments in

teaching and learning mathematics while preserving the mathematical cultural heritage, represented by knowing the history of mathematics, and measured by the degree that the student obtains through a test prepared for that.

Theoretical Background

Fuzzy logic

Aristotle introduced a new concept, which is the “machine of science.” As for the main and real subject of this machine, it is science itself. Based on this definition, the rules of science for Aristotle constitute and are considered an introduction to sciences. Aristotle introduced the concept that “science is an inferential system,” as Aristotle says that the basic premise of science is the truth, and knowledge of this truth depends on experience, and this experience depends on the mind that perceived the truth through the senses. Knowing the matter through the senses contributes to clarifying its foundations and advantages to the mind in an abstract manner later on. This Aristotelian concept of science, according to which science is an inferential system based on axioms that are accepted, had an impact on the sciences and their development. Aristotle did not use the word logic, and he was not famous in his time, and he called what he produced analytical science. So he used the word *Analytiques*, i.e. analyzing thought into inferences, inference into measurements or criteria, and measurement into statements and limits. Late Greek writers pointed out that the Peripatetics, followers of Aristotle, were the ones who put the word logic, not Aristotle, so they used the Greek word *Logos*, which included rational systematic studies, and the following expressions spread in their writings: logic, logical science and logical art, such as Cicero, Alexander of Aphrodisia and Galen. (Hagras, 2013).

The researchers built the fuzzy logic strategy according to the fuzzy logic steps.

The steps of the proposed strategy according to fuzzy logic

The first step: detect the fog.

The second step: fuzzy reasoning.

The third step: removing or (decomposing) the fogging.

The fourth step: conclusion or feedback.

The concept of Mathematical culture

The mathematical culture represents an important part of the scientific culture. All other sciences show on Mathematics, and no branch of science can progress or develop without the existence of Mathematics.

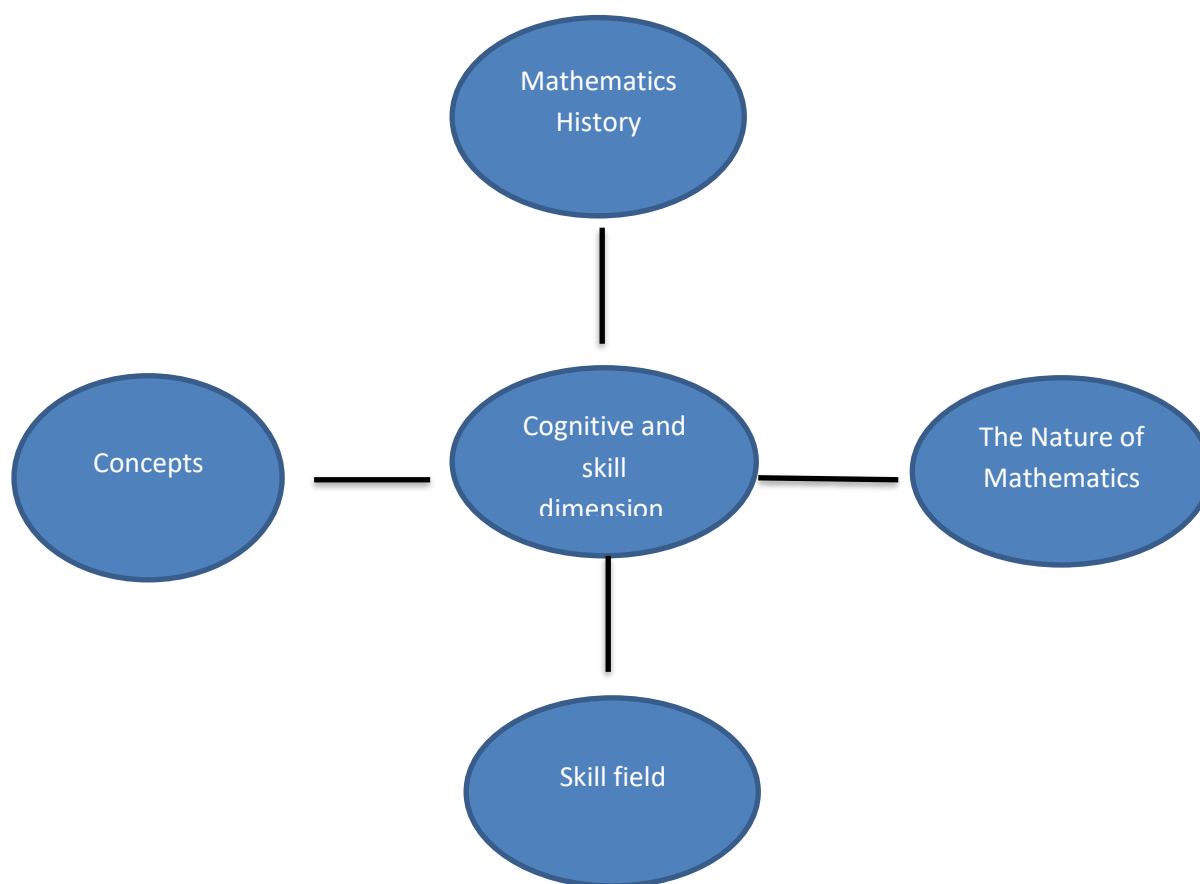
Mathematical culture is important for every individual as it helps students to follow scientific and technological developments and to be more adaptable to the society in which they live. (Ruppert, 2022)

The concept of Mathematical culture is relatively nostalgic, and it has been dealt with from many angles. Some people see that Mathematical culture is a compound consisting of three components: a symbolic component, a societal component, and a cultural component, as each complements the other, and these three components contribute to the process of Mathematical education. The symbolic component develops mathematical cognitive abilities, and the social component produces the applied value of mathematics. The cultural component looks at techniques and alternatives to understand the mathematical phenomenon. (Vijayalakshmi, 2004:22)

Therefore, the mathematical relationship is to link mathematics with real science and the use of mathematics in a range of diverse academic subjects and communication using the language of mathematics and analysis and evaluation of the mathematical thinking of others, and appreciating the usefulness and beauty of mathematics and understanding and realizing what has been learned in mathematics. Therefore, the way students are educated mathematically is the same way they are educated in reading, mathematics is not just numbers only, as reading is not just abstract letters, and Burton believes ((that communication and encouragement to read and

write when learning mathematics plays an important role in raising the level of mathematical culture of the students by teaching dialogue, discussion, thinking and expressing opinions when solving mathematical problems and using life topics and getting to know the historical context and mathematical topics and that may achieve acceptable educational and mathematical level of the students. (Burton, 2009)

Bishop adds another dimension in the process of mathematical education that focuses on values, and according to him, education is an interpersonal process, which is an interactive and creative process for those who live with it, and Bishop believes that the main goal of mathematical education is to enable the learner of values and build concepts related to mathematical culture (1988: Bishop), and there is a third dimension of mathematical culture that focuses on the pleasure, beauty and satisfaction that the learner tells when he suddenly reveals the mathematical model by organizing a gathering of facts and ideas. (2004:23, Vijayalakshmi).



Scheme (1) shows the areas of mathematical culture of the researchers' work

Research methodology and procedures

To achieve the objectives of the research and test its hypotheses, the semi-experimental approach was adopted by the researchers, the semi-experimental design and sample selection after the research community was identified, as well as the preparation of its tools. The application was as follows:

First: study methodology and experimental design

In this study, the researchers followed the semi-experimental approach, and in order to facilitate the procedures of applying the current study, the design of the experimental and control groups was chosen with a pre-post measurement, and it is expressed in the following procedural form in Table (1):

table (1) Semi-experimental design for the experimental and control groups, with pre-post measurement

The group	Pretest	independent variable	the dependent variable (post-test)
Empirical	Mathematical culture	employing fuzzy logic	Mathematical culture
control		the usual way	

Second: Determine the research community:

The research community was represented by all fourth grade students in the Department of Mathematics, College of Education for Pure Sciences, University of Mosul for the academic year (2022-2023), consisting of (1200) male and female students.

Third: Choosing a sample of the research

The research sample was chosen randomly from the fourth grade students, where the choice was made as the AB section to be the experimental group and the EF group to be the control group, as shown in Table (2).

Table (2)

Division	Group	Teaching method	Number of students before exclusion	Number of students who failed	The number of students after exclusion
A	experimental	fuzzy logic strategy	90	5	85
B	control	the usual method	86	4	82
The total number of students			196	9	167

In the experiment, the researchers were keen to make the two research groups statistically equitable in some variables, design integrity procedures, prepare teaching plans, prepare the research tool, implement the research experiment, and then apply the research tool using the (spss) program.

View and discuss search results:

After collecting data from the research sample on the pre and post mathematical culture test, the researchers will present the results as follows:

Results related to the research hypothesis

"There is no statistically significant difference at the level of significance (0.05) between the mean scores for the development of mathematical culture among the students of the Mathematics Department between the experimental group and the control group." In order to verify this hypothesis, the researchers extracted the arithmetic mean and standard deviation for the members of the two research groups, and then applied the (t-test) for two independent samples through the statistical bag program, and the results are included in the following table (3):

Table (3) The results of the t-test are average scores of the experimental and control groups in mathematical culture

Groups	Number	arithmetic mean	standard deviation	t-value calculated	Sig
Experimental	85	13.80	5.284	2.466	0.015
Control	82	11.62	6.530		

It is clear from the table that the value of the significance level is (0.015), and this indicates that there is a difference between the experimental group and the control group and in favor of the experimental group. The researchers attributed this result to the fact that the use of fuzzy logic applications opened horizons for students to learn about the importance of mathematics and its role in society and its use for life applications, which generated positive attitude towards the nature of mathematics and its applications, and teaching using the teaching strategy prompted students to acquire the basic concepts, skills and operations of mathematics, and this result agreed with the study of Al-Taie (2016).

Conclusions

Fuzzy logic applications enhanced students' mathematical culture, and fuzzy logic teaching contributed to consolidating the importance of mathematics among students.

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