Using Reigeluth's Model to Increase Achievement and Mathematical Literacy Self-Efficacy for Eleventh Grade Students

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Abstracts: Although mathematical literacy self-efficacy (belief that one can do mathematics) is essential to success in learning mathematics, it is not explicitly addressed in many educational institutions. The current paper used Reigeluth's Model of increasing achievement and self-efficacy for mathematical literacy. It is one of the educational models that depend on the constructivist theory that contributes to helping the student to link his or her previous information with his or her new experiences. The sample consisted of 141 male and female students in the eleventh grade from Al Nahda School in Dhofar region, Oman. Students in the experimental group (N = 70) received instruction according to the Reigeluth model, and students in the control group (N = 71) received instruction in the traditional way. Students achievement and self-efficacy in mathematical literacy increased significantly more for the experimental group. There was relationship between achievement and self-efficacy on mathematical literacy for the student sample. It is recommended that the mathematics curriculum for all courses of education be prepared according to the Reigeluth model, and that mathematics teachers be trained in modern models for developing the achievement and self-effectiveness of their students' mathematical literacy.

Keywords: Reigeluth's model, Achievement, Mathematical literacy self-efficacy, Eleventh grade students.

1. INTRODUCTION

It has been theorized by Reigeluth et al. (2017) that a significant component of educational achievement is self-efficacy; the belief that one can do something. For example, school pupils who struggle in mathematics may quickly develop the fatalistic idea that they "can't do Math," causing them to simply give up (Elsayed, 2015a). This is a serious problem because Mathematics contributes greatly to the development of achievement and thinking in its various patterns among students, and even helps them to solve the problems they may face in their everyday lives. It has many uses in everyday life, and has been called the Queen of Science (N.C.T.M., 2009).

Achievement in mathematics represents one of the main concerns of educators as it is part of the general achievement in which many decisions are determined, such as: the transfer of learners from one stage of study to another, the enrollment of learners in certain types of education (Elsayed & Abbas, 2021).

Students' difficulties in learning mathematics are related to their ability to read and write in mathematics (Yenilmez & Turğut, 2012). Students with mathematical knowledge, to be part of relevant mathematical cases (Elsayed, 2022); It is said that it effectively helps in benefiting from the use of mathematics in daily life (Yildirim, 2016). Self-efficacy is one of the fundamentals that you must utilize effectively to increase achievement (Zehir & Zehir, 2016). Achievement in mathematics is related to mathematical lself-efficacy which is a predictor of the ability to look at the state of mathematics in a broad perspective (Ibek, 2019).

A Sound organization of the mathematics curriculum content helps teachers to employ a teaching methods and strategies that is consistent with the philosophy of organizing the content of the curriculum. It also helps students to acquire and store information correctly, which reflects positively on their academic achievement (Elsayed, 2015a).

Reigeluth's Model is one of the models that stems from constructivist thought, and is based at the same time on cognitive psychology, through which the content of the curriculum is organized in an expansive manner from the general to the specific, in a way that helps students acquire their new knowledge based on their previous knowledge in an integrated manner (Cakiroglu, 2014).

Educational strategies based on Reigeluth's Model have achieved great success in teaching mathematics to learners of all stages of education, and have also contributed to the development of achievement and self-efficacy in Mathematics (Elsayed, 2015b; English & Reigeluth, 1996).

The level of Omani students in international tests is lower than the international average. For example, indicators of performance of Omani students in (TIMSS 2019) showed that their average of 457 points, well below the international average of 500 points (Omani Ministry of Education, 2022). The current author conducted an exploratory study on 160 students in secondary school in Oman, by analyzing their performance in the final exam in mathematics at 2020/2021, as their average performance in that exam did not exceed 60%, which indicates their poor performance in mathematics. A scale of mathematic self-efficacy was also applied to them, and their average performance on that scale was 57%, which indicates their poor performance also in mathematic self-efficacy, and that they have insufficient mathematical skills. Many studies in the Arab environment, such as: (Ahmed, 2016; Elsayed & Abbas, 2021; Elsayed, et al., 2021; Elkahtany, 2015; Khalifa, 2010) recommended the need to increase achievement in mathematics among students at various stages of education. Many studies in the Arab environment, such as: (Al-Khidr, 2020; Abu Aqil, et al., 2017; Ezz El-Din, 2020; Mohamed, 2019; Obeida, 2018) have also recommended the need to develop mathematical self-efficacy among students at various stages of education, especially the secondary stage. So far no studies have addressed this issue in Oman and, therefore, this study will contribute to this body of research by exploring the potential impact of mathematical self-efficacy on mathematical achievement employing an Omani sample.

We used Reigeluth's Model in teaching mathematics and we tested its effectiveness in increasing achievement in Mathematics for eleventh grade Students in Oman.

1.1. Reigeluth's Model

Reigeluth's Model is based on constructivist theory and cognitive psychology at the same time. It is concerned with the mental processes within the minds of learners, and how they acquire new knowledge and experiences based on their previous experiences in a way that helps crystallize that knowledge into an integrated structure. It provides clear instructions and guidelines for organizing curriculum content from generality to specificity, and from simplicity to complexity (English & Reigeluth, 1996).

Reigeluth's Model is an important model related to designing and logically organizing the content of the curriculum from generality to specificity, from simplicity to complexity, and from general knowledge and issues to knowledge and issues, provided that it provides broad details of those knowledge and issues little by little, while making internal and external connections to it with other aspects of learning in the curriculum (Elsayed, 2015a; Tosone et al., 2008). It is based on three principles: (1) Learning begins from an interest in abstract issues to providing material and tangible support for them, (2) Content organization moves from presenting general knowledge to precisely specific knowledge, (3) learning begins with a review of a general, comprehensive and brief introduction to the content elements, then precise details of those elements are gradually presented, provided that all the pre- and post-learning steps are integrated with each other (Kutlu, 2013).

Reigeluth's Model is a set of standard diagrams of knowledge and aspects of learning to be presented to the student in a way that helps to take into account the individual differences of students, and to meet their different needs, by training them to acquire new knowledge in an integrated manner based on their previous experiences. (Rigluth and Darwaza, 1982)

Reigeluth & Darwazeh (1982) describes the steps for using the Reigeluth model in providing educational content to students through an integrated team of curriculum designers and teachers as follows: 1) Determining the appropriate time to present the educational content; 2) Determining the concepts that will be taught and organizing them logically; 3) Determining which concepts are the most comprehensive and general, 4) Arranging those concepts sequentially from the most general to the most detailed, 5) Identifying the ideas and other facts associated

with those concepts, while clarifying their precise connections to each concept separately, 6) Distributing those concepts and facts in a balanced manner; 7) Logically arranging curriculum content, 8) Designing test items and instructions in a way that takes into account individual differences; and 9) Building integrated test items and specific instructional components.

According to Kutlu (2013) and Reigeluth, et al. (1980), the content of the curriculum was organized according to Reigeluth's Model, as follows: 1) Epitome: It includes the main knowledge and ideas associated with the content of the curriculum, with explanatory examples of those knowledge and activities for training; 2) Analogy: Through this step, the concepts of the content of the curriculum are compared with other concepts familiar to the learners and existing in their living environment, which contributes to linking the new knowledge with the knowledge in their mental and cognitive structure; 3) Levels of Elaboration: Through this step, gradual details of the knowledge, concepts, and skills that have been referred to are presented in a gradual way, in a logical manner, from the general to the specific, from the mere to the tangible, and from the simple to the complex; 4) Relating: Through this step, precise and comprehensive links are made for each detailed stage with the previous or next stage, which contributes to the formation and acquisition of knowledge by the learners in an integrated manner; 5) Summarizing: Through this step, a comprehensive summary of the knowledge, experiences, and aspects of learning included in the content of the curriculum is provided, but without providing examples or training experiences, as is the case with the expanded summary; 6) Synthesizing: Through this step, the relationships and connections between the subjects of the curriculum content are clarified with each other in an integrated manner, which contributes to achieving meaningful learning for the learner. This can be achieved by creating a graph or map that shows the relationships between these topics; 7) Expanded Epitome: Through this step, the relationships and connections between the content topics of the curriculum and other related topics in the content of other curricula are clarified, in order to work on the transfer of the impact of learning from the topics of this content to the topics of the content of other curricula.

Many studies, whether in mathematics teaching and learning or other cognitive fields, have focused on the use of Reigeluth's model as an approach to effective teaching and active learning. All studies concluded that the Reigeluth model contributes effectively to the development of cognitive achievement and some other variables that have a direct relationship to it for all learners in the various stages of education, as we will explore below. This gives a preliminary indication of the feasibility of this model in the current research. First, the development of cognitive and consumer awareness of Egyptian women through a proposed program in education based on the Reigeluth's Model (Rashwan, 2015). Second, developing cognitive achievement and positive attitude among student teachers at the Faculty of Education, Mansoura University through a program based on Web 2.0 according to the Reigeluth's Model (Alsayed, 2012). Third, Developing cognitive achievement, deductive thinking, and the attitude towards subject matter among first-year secondary students (Omran, 2009). Fourth, increasing the cognitive achievement and decision-making skills of blind students in the third intermediate grade in the Kingdom of Saudi Arabia (Foada, 2006). Fifth, increasing the cognitive achievement and decision-making skills of blind students in the third intermediate grade in the Kingdom of Saudi Arabia (English & Reigeluth, 1996). Sixth, The development of learning principles and scientific concepts in Newton's laws of motion among university students of all levels of education (Riber, 1996).

It should be noted that in the current study, the Reigeluth model was used as a teaching input for the content of mathematics curricula for eleventh grade students in Amman schools through the previous five consecutive stages.

1.2. Cognitive Achievement and Mathematical Literacy Self-Efficacy

Cognitive achievement in mathematics is considered one of the main indicators indicating the success of educational systems in all countries of the world, given that it is an important part of general cognitive achievement, on the basis of which students move from a certain educational level to another educational level. Cognitive achievement in mathematics is also closely related to future job prospects (Elsayed, 2022; Soni & Kumari, 2017).

Therefore, the issue of low cognitive achievement of students in mathematics and the corresponding decline in general cognitive achievement has become a major threat to the future of education in most countries (Rafiepour & Elsayed, 2021; Hemmings, et al., 2011). There are many internal and external factors that can affect the level of knowledge achievement of students in mathematics, such as: anxiety about mathematics (Tobias, 1978) and the attitude towards mathematics (Elsayed, 2022; Nicolaidou & Filippo, 2003), the roles and responsibilities of mathematics teachers (Olatunde, 2009), and strategies and approaches Teaching (Tyanck & Cuban, 1995), parental roles (Kleanthous & Williams, 2010), and several psychological variables are used as students' motivation towards learning mathematics (Chen & Lin, 2020).

Parents have an important role in developing the cognitive achievement of their children in mathematics, as parental support and encouragement for their children during learning mathematics contributes clearly to the development of their cognitive achievement (Cruise, 2012; Fan & Chen, 2001). Parents' positive beliefs about their children's self-efficacy in learning mathematics also contribute to the development of their cognitive achievement (Aunola, et al., 2003; Elkahtany, 2015).

The results indicated that teaching and learning mathematics within classrooms characterized by discussions and the practice of research and inquiry methods clearly contributes to the development and enhancement of students' cognitive achievement in mathematics according to oral and written measures of achievement (Banes, et al., 2020; Rafiepour & Elsayed, 2021).

The results also showed that the use of information technology within the school and at home, and the continuous follow-up of parents on the level of their children and their level of progress in learning mathematics through direct communication with teachers and the school contributed significantly to enhancing the level of cognitive achievement in mathematics for them (Lishchinsky & Zavelevsky, 2020; Shapira & Zavelevsky, 2020).

In a study conducted by Wang et al. (2012) on eighth-grade students in the United States of America, Russia, Singapore and South Africa, factors affecting mathematics achievement were identified, including: students' self-concept of ability in mathematics, mathematics values, school perception, and teachers' perceptions and administrators for the school and other properties related to the classroom and the school. Accordingly, an achievement model was built through hierarchical linear modeling.

So, it became important to prepare our students a strong and intelligent preparation in mathematics by creating an educational environment to understand the concepts of mathematics, and master the skills through community attitudes and realistic contexts (Epaid, 2004).

Banes, et al. (2020); Elsayed & Abbas (2021); Hilal (2013); Lishchinsky & Zavelevsky (2020); Soni & Kumari (2017) identified a set of characteristics that must be found in the educational environment for achieving a good learning for mathematics. They are: 1) The Learning Environment should be out of tension for the student because there is an inverse relationship between the physical environment that raises tension and the failure of the student and his concentration; 2) The Learning Environment should be out of threat for the student (the threat and learning), students who are exposed continuously to the threat and tension of a high rate in the early stages of their childhood have got a behavior away from teaching and the learning process; 3) The Learning Environment must not be suggestive that the student is stupid, as this impairs his determination to learn, so that the teacher must reduce the circumstances that cause this feeling and uses personal strategies to teach students such as: Time Management, Games and Diverse Discussions Strategies.

The cognitive achievement of students in mathematics at various stages of education has been developed through the employment of several teaching models and strategies in Arabic environment, for example: A suggested teaching strategy in light of the communicative theory (Elkahtany, 2015); The six thinking hats strategy (Ahmed, 2016; Habib, 2013; Hilal, 2013); A program based on the use of six thinking hats model (Al-Sa'idi, 2015);

Educational games (Khalifa, 2010); Cooperative learning strategy (Abdel-Karim, 2010); and the Bybee's model (Abdel Moneim & Adam, 2008).

It should be noted that in the current study, cognitive achievement in mathematics was used as the amount of knowledge acquired by the eleventh grade students in Oman as a result of studying the unit of sequences and series. This is measured by the score obtained by these students in the cognitive achievement test in mathematics designed in the current research for this purpose.

Cognitive achievement in mathematics is associated with many variables, the most important of which is mathematical literacy, which is seen as a person's ability to produce, think and make decisions about mathematical problems that he faces today or in the future through the practice of various mathematical thinking skills (Elsayed, 2015b; OECD, 2006). Therefore, the comprehension of mathematical reading and writing by the student is very important in practicing mathematics during his daily life and solving life problems that he encounters (Elsayed, et al., 2021; Özgen & Bindak, 2008).

As for self-efficacy, it can be defined as these three results which are, individuals' ability to express, reveal and believe their knowledge correctly (Bandura, 1997). Based on this definition, the student's belief that she/he will move towards correct results with numbers by relying on his/her calculus skills may lead to the judgment of self-efficacy in a good manner (Rafiepour & Elsayed, 2021). However, the knowledge and equipment may not be sufficient to qualify the person as successful in the field of numbers.

In studies that determine the level of mathematics self-efficacy, there are results in which self-efficacy beliefs are found to be high (Walsh, 2008) as well as moderate or low (Yaman & Dede, 2006). Based on these studies, it can be said that there is no common opinion in the literature about mathematics self-efficacy of secondary school students.

Several studies on self-efficacy for mathematical literacy were examined, in which university students studying in the field of teaching were identified in the sample of most of them (Dinçer, et al., 2016). The subject studied, the self-efficacy of visual mathematical literacy (Katrancı & engül, 2019; İlhan & Aslaner, 2019) and PISA applications (Sezgin, 2017) were selected.

Also, many studies have been conducted through which various teaching approaches and models have been employed to develop the competence of students in various stages of education. Al-Khidr (2020) prepared a study aimed at exploring the effectiveness of a training program based on mathematical literacy within the framework of PISA in improving the self-efficacy requirements of middle school teachers in Buraydah, and its impact on mathematical literacy for their students. Ezz El-Din (2020) conducted a study to investigate the impact of an online training program to develop beliefs of self-efficacy and literacy towards science, technology, engineering, and mathematics (STEM) on middle school science teachers. Mohamed (2019) conducted a study to build an educational unit in mathematics according to the (PISA) program to develop the self-efficacy of mathematical literacy among secondary school students. Obaida (2018) conducted a study to verify the effectiveness of a proposed program in the light of the educational evaluation guide, the Info Graphic, and the Egyptian Knowledge Bank in developing the self-efficacy of mathematical literacy among middle school students. Abu Aqil, et al. (2017) conducted a study aimed at determining the dimensions and levels of mathematical enlightenment among pre-service mathematics teachers in Palestine.

It is worth noting that in the current study, mathematical literacy self-efficacy was used as the beliefs of eleventh grade students in the Sultanate of Oman about their possession of mathematical skills and knowledge, and their ability to employ them in solving realaity problems facing them, and their perseverance to learn mathematical content successfully through practicing the skills of mathematical thinking and communication, and employing mathematical reasoning, representations and models in a social context within the classroom. It is measured by the

degree obtained by the student in the scale prepared for this purpose, which consists of four dimensions: mathematical ability, personal experience, scientific modeling, and social context.

As a result of the literature review, it can be said that there is not a study in Oman that used Reigeluth's Model to development Cognitive Achievement and the self-efficacy of mathematical literacy Oman's eleventh grade students.

2. PROBLEM STATEMENT

2.1. What is the effect of Reigeluth's Model on improving the cognitive achievement in mathematics for Oman's eleventh grade students?
2.2. What is the effect of Reigeluth's Model on developing the self-efficacy of mathematical literacy for Oman's eleventh grade students?
2.3. What is the relationship between the cognitive achievement in mathematics and the self-efficacy of mathematical literacy among Oman's eleventh grade students?

3. RESEARCH GOALS

The study aimed to use the Reigeluth's Model to improve the cognitive achievement in mathematics and the self-efficacy of mathematical literacy for Oman's eleventh grade students, as well as to find out the relationship between them among these students.

4. RESEARCH HYPOTHESES

2.4. Reigeluth's Model has a substantial effect on improving the cognitive achievement in mathematics for Oman's eleventh grade students.
2.5. Reigeluth's Model has a substantial effect on developing the self-efficacy of mathematical literacy for Oman's eleventh grade students.
2.6. There is a direct relationship between the cognitive achievement in mathematics and the self-efficacy of mathematical literacy among Oman's eleventh grade students.

5. METHOD

5.1. Research Model

This research determines the effectiveness of Reigeluth's Model in increasing the Cognitive Achievement and mathematical literacy self-efficacy for Oman's eleventh grade students, as well as to find out the relationship between them among these students. It represented the independent variable of the current research in Reigeluth's Model, while the dependent variables were the cognitive achievement in mathematics and the self-efficacy of mathematical literacy.

Therefore, to determine the effectiveness of Reigeluth's Model, a quasi-experimental design based on the experimental method was used, where the students of the experimental group received special instruction using Marzan's Model, while the students of the control group received instruction as usual. A comparison was made between the performance of the experimental and control group students in the pre and post applications of the research tools. The experiment took place over 7 weeks in the classroom, five times a week, with a total of 35 lessons. As for knowing the relationship between the Cognitive Achievement and mathematical literacy self-efficacy, the non-experimental design based on the descriptive method (correlational research) was relied upon, in terms of using data derived from two pre-existing variables. There is typically no cause-effect relationship in the correlational survey model. The advantage of this method is that it gives information about the strength of the relationship between the variables (Ary, et al., 2018).

5.2. Sample

In order to increase the population representation of the sample, the simple random sample was selected. The random process is used to reduce the cost of testing a sample model and increase the efficiency of the estimator in terms of precision (Parsons, 2014). The application school, as well as the classes within it, were selected randomly based on the simple method. The sample consisted of n = 141 11th-grade girl students from Al- Nahda school in Salalah city at Oman. Participants in the experimental group (N = 70, mean age is 16.6 years) received a treatment based upon Reigeluth's model, and participants in the control group (N = 71, mean age is 16.5 years) received an alternative treatment. The research experiment was applied in the second semester during the academic year 2020/2021.

5.3. Materials and Tools

5.3.1. The Student's Book

The author prepared the Sequences and Series unit included in the content of the Student's Book in Mathematics for eleventh grade students in Oman according to the Reigeluth's Model, based on the aforementioned five steps. To verify the applicability of the content of Student's Book, its suitability to the Reigeluth's Model, and the levels of both the students' cognitive achievement and mathematical literacy self-efficacy, it was presented to six experts specializing in mathematics education curricula. The content of the book was modified and finalized based on their suggestions, by redesigning some activities and adding others.

5.3.2. The Teacher's Manual

The author prepared a manual for secondary school mathematics teachers in a way that explains teaching the sequences and series unit for eleventh grade students using the Reigeluth's Model. The manual consisted of several components: unit objectives, areas of learning, levels of mathematical literacy self-efficacy, educational activities, teaching steps, and evaluation methods. To check the manual's applicability, relevance to the Reigeluth's Model, and the levels of both the students' cognitive achievement and mathematical literacy self-efficacy, it was presented to six experts specializing in mathematics education curricula. The mathematics teacher manual was modified and finalized based on their suggestions.

5.3.3. Cognitive Achievement Test

The author prepared a standardized test to measure the cognitive achievement in mathematics of the eleventh grade students in the sequence and series unit included in the mathematics book to be taught in Oman. This test consisted of (27) questions distributed as follows: (21) multiple-choice questions and (6) problem-solving questions. The author provided the test to six experts in curriculum and mathematics education. Some of the test questions were reformulated, and two of them were deleted based on expert suggestions, so that the test consisted of (25) questions, (20) multiple-choice questions and (5) problem-solving questions, and the percentage of agreement among experts reached (87%). The author applied the test as a pilot study on (33) students in the eleventh grade at Al-Saada Secondary School, then calculated the reliability coefficient for the test using the Guttmann equation, which was found at (0.90). five questions were omitted from the test as a result of the reliability procedure, so the final version of the test consisted of (20) questions, including (15) multiple-choice questions and (5) problem-solving questions. One mark was given to the student's correct answer and zero mark to his wrong answer in the multiple choice questions. As for the student's score in problem-solving questions, it was (0-2) marks according to the accuracy of the student's answer. Therefore, the maximum score for the test was (25) while the minimum score was (0), provided that the test time was (40) minutes.

5.3.4. Mathematical Literacy Self-Efficacy Scale

To determine the levels of mathematical literacy self-efficacy of eleventh grade students in Oman, the "Scale of Mathematics Literacy Self-efficacy for Secondary Schools" Baypınar and Tarım (2019) was used. This scale consists of (30) items, (24) of which are positive and (6) of them are negative items and it has (4) sub-dimensions. The scale was arranged in a (5-point) Likert format. Negative items were scored inversely. The lowest score a student can obtain in the scale is (30) and the highest score is (150). Baypınar and Tarım (2019) found the internal consistency coefficient for the whole scale they developed (0.92), (0.90) for the first dimension, (0.75) for the second dimension, (0.81) for the third dimension, and (0.78) for the fourth dimension. In the data collected within the scope of the current research, The Cronbach's alpha internal consistency reliability coefficients of the secondary school mathematical literacy self-efficacy scale determined (0.90) for the whole scale, (0.91) determined for the first dimension, (0.92) determined for the second dimension, (0.85) determined for the third dimension, and (0.84) determined for the fourth dimension. According to the data obtained, it can be said that the scale is valid and reliable for this research.

5.4. Data Analysis

In order to decide on the appropriate test in the analysis of the data, the normality of the distribution of the scores obtained from the whole scale and its sub-dimensions are examined. It is decided that the distribution is normal because the arithmetic mean-peak value-mean values of the scores obtained are close, and because normality tests (Kolmogrov-Smirnov and Shipiro Wilk) significance values are $p > 0.05$. Data were analyzed using means, standard deviations, t-tests, p-value, η2, and the effect sizes, based on the SPSS program, the version no.23. The author used t-tests to check whether there was a significant difference between the mean of the experimental and control groups in the pre and post applications. Statistical significance is the probability that the size of the treatment effect is not the result of chance, and the level of significance indicates the probability that the hypothesis being tested will be wrongly rejected, knowing that the traditional value of 5% was chosen. The eta square (η2) indicates the effect size of Marzano's Model on each of the cognitive achievement in mathematics and the self-efficacy of mathematical literacy in the participating sample.

6. RESULTS

6.1. Pre -Test

The author used the T-test to determine the equivalence between the experimental and control groups in the pre-application of each of the cognitive achievement test in mathematics and the mathematical literacy self-efficacy scale. Table 1 shown this.

Table 1. T-test results for the pre-application of the cognitive achievement test in mathematics and the mathematical literacy self-efficacy scale.

Variables Groups	Experimental Group			Control Group			*t-value*	*p-value*
	N	**Mean**	***SD***	***N***	**Mean**	***SD***		
Academic Achievement	70	5.04	2.88	71	4.22	2.61	1.54	0.126
Mathematical Literacy Self-Efficacy	70	30.65	5.41	71	30.06	5.61	1.57	0.121

Table 1 shows that the differences between the mean scores of the experimental and control groups were small and non-statistical in the two variables, which indicates that there are no significant differences between the experimental and control groups in the post application of the cognitive achievement test in mathematics, and the self-efficacy for mathematical literacy scale, so there was strong equivalence between the two groups. This means that we can mainly rely on comparing scores in post-tests of the experimental group and the control group.

6.2. Post-Test

The current research aimed to use Reigeluth's Model to development the cognitive achievement in mathematics and mathematical literacy self-efficacy for eleventh grade students in Oman, as well as to find out the relationship between these two dependent variables for these students. The current research relied on a quasi-experimental design (two experimental and control groups, pre-post application), and the central measure is the effectiveness of the Reigeluth's Model, which can be judged by determining the differences between the mean scores of the experimental group and the control group in the post application.

So, we want to check the following hypotheses: 1) Reigeluth's Model has a substantial effect on increasing mathematical achievement for Oman's eleventh grade students; 2) Reigeluth's Model has a substantial effect on developing mathematical literacy self-efficacy for Oman's eleventh grade students; 3) There is a direct relationship between the cognitive achievement in mathematics and mathematical literacy self-efficacy among Oman's eleventh grade students.

The author used the T-test to determine the significance differences between the experimental and control groups in the post-application of the cognitive achievement test in mathematics. Table 2 shown this.

Table 2. T-test results for the post-application of the cognitive achievement test in mathematics.

Variable Groups	Experimental Group			Control Group			t-value	p-value	2η
	N	Mean	SD	N	Mean	SD			
Academic Achievement	70	22.30	5.07	71	16.02	3.39	7.22	0.000	0.32

Table 2 shows that the average score of the experimental group (22.30) in the cognitive achievement in mathematics was much higher than the average score of the control group (16.02). The t value was (7.22) at the level of significance (p = 0.000), which indicates that there is statistically significant difference at (0.05) between the mean scores of the experimental group and the control group in the post-test application for the cognitive achievement in mathematics in favor of the experimental group. The value of the eta-square (2η) was high, as it was (0.32), which indicates that the size of the effect of the Reigeluth's Model on the development of cognitive achievement in mathematics was high for the sample students. Therefore, it can be said that the Reigeluth's Model led to the development of cognitive achievement in mathematics among the eleventh grade students participating in the study, and thus the first hypothesis is clearly supported.

Also, the author used the T-test to determine the significance differences between the experimental and control groups in the post-application of the mathematical literacy self-efficacy. Table 3 shows this:

Table 3. T-Test Results for the Post-Application of the Mathematical Literacy Self-Efficacy Scale.

Variables Groups	Max. Grade	Min. Grade	Experimental Group			Control Group			t-value	p-value	2η
			N	Mean	SD	N	Mean	SD			
Mathematical Ability	75	15	70	57.89	1.46	71	30.50	6.31	31.06	0.000	0.90
Personal Experience	30	6	70	27.56	2.47	71	21.78	3.72	11.89	0.000	0.46
Scientific Modeling	20	4	70	18.35	1.95	71	15.33	2.07	9.70	0.000	0.36
Social Context	25	5	70	23.69	1.44	71	19.44	3.90	9.83	0.000	0.35
Mathematical Literacy Self-Efficacy (Total)	150	30	70	127.49	5.24	71	87.05	7.10	36.45	0.000	0.91

According to Table 3, the average value for the total scale of the experimental group is (127.49) and the control group is (87.05). Considering the average value taken from the sub-dimensions of the scale, it is found that the average value of the first sub-dimension is (57.89) for the experimental group, and (30.50) the control group; the average value of the second sub-dimension is (27.56) for the experimental group, and (21.78) for the control group; the average value of the third sub-dimension is (18.35) for the experimental group, and (15.33) for the control group; and the average value of the fourth sub-dimension is (23.69) for the experimental group, and (19.44) for the control group. This means that the students of the experimental group outperformed the students of the control

group in all four dimensions of the mathematical literacy self-efficacy scale, and in the scale as a whole. The t-values vary from (t= 9.70) to (t= 36.45) with a significance level of (p =0.000), which indicates that there are statistically significant differences at (0.05) between the mean scores of the experimental group and the control group in post-test application for the mathematical literacy self-efficacy scale in favor of the experimental group whether for the dimensions individually or for the scale as a whole.

The values of eta square (2η) vary from (2η = 0.35) to (2η = 0.91), which indicates that the effect size of Reigeluth's Model on Mathematical Literacy Self-Efficacy development was high for the sample. It can be said that the Reigeluth's Model led to the development of the Mathematical Literacy Self-Efficacy for the participants of the study. So, the second hypothesis is clearly supported.

To know the nature and type of the relationship between the cognitive achievement in mathematics and mathematical literacy self-efficacy in the post-test, the Pearson correlation coefficient has been used, as shown in Table 4.

Table 4. Pearson Correlation Results between the Cognitive Achievement in Mathematics and Mathematical Literacy Self-Efficacy in the Post-Test.

Variables	Academic Achievement	Mathematical Literacy Self-Efficacy	P-Value
Academic Achievement	1	0.77	0.000
Mathematical Literacy Self-Efficacy	0.77	1	0.000

When examining the significant value in Table 4, it is stated that there is a strong and statistically significant positive correlation between the cognitive achievement in mathematics and self-efficacy of mathematical literacy in the post-test ($r = 0.77$, $p < 0.05$).

7. DISCUSSION

Reigeluth's Model stems from constructivist thought and cognitive psychology, as it is concerned with the thinking processes that occur in students' minds during their self-reliance on acquiring various knowledge. It contributes to linking the new knowledge that students acquire with their previous knowledge in an integrated and meaningful form. We tested whether the using of the Reigeluth's Model in teaching mathematics to Oman's eleventh grade students could be improved the Cognitive Achievement and mathematical self-efficacy of them.

The three hypotheses of the research were strongly confirmed, as we found that the experimental group that received special training using the Reigluth model scored significantly better than the control group on the post application of both the cognitive achievement test in mathematics and the mathematical literacy self-efficacy measure; and the effect was very large in both variables. We also found a strong direct and statistically significant relationship between the scores of the eleventh grade Omani students in the cognitive achievement test in mathematics and their scores in the mathematical literacy self-efficacy scale. The strong experimental design confirmed these conclusions.

We did not get the previous results by chance, but as a result of several factors, including: 1) Organizing and teaching the content of the mathematics curriculum for eleventh grade students according to the Reigeluth's Model contributed to making this content compatible with the logical organization of knowledge in the minds of students, which led to the development of their cognitive achievement mathematical literacy and self-efficacy; 2) Reigeluth's Model enriched the mathematics content presented to students by providing many details of the new information, which made it meaningful to students, and helped to use it effectively in other educational processes and contexts; 3) The Reigeluth's Model provided several analogies for the content of the curriculum through examples and concepts from the realistic environment familiar to students, which contributed to their learning of new knowledge easily without errors in understanding; 4) Reigeluth's Model focused on linking new and old information with each other, which helped students understand the relationships between knowledge in an integrated framework, and effectively practice the dimensions of self-efficacy of mathematical literacy, such as: mathematical ability, personal

experience, scientific modeling, and social context; 5) Dividing the students of the experimental group into small groups that cooperated during the implementation of the activities created an active teaching and learning environment, which helped all students to understand and apply the information in new realistic situations; 6) Immediate feedback was provided to all students of the experimental group during the practice of all educational activities and learning practices, which greatly contributed to generating enthusiasm and motivation among these students to participate continuously and positively.

The results of the current research agreed with the results of many other researches, all of which confirmed the effectiveness of the Reigeluth's Model in developing many variables related to teaching and learning mathematics, such as: (Reigeluth, et, al., 2017; Rashwan, 2015; Cakiroglu, 2014; Alsayed, 2012; Omran, 2009; Foada, 2006).

The cognitive achievement in mathematics can be developed using other teaching models and strategies through teaching mathematics, such as: The six thinking hats strategy (Ahmed, 2016; Habib, 2013); A program based on the use of six thinking hats model (Al-Sa'idi, 2015); Educational games (Khalifa, 2010); Cooperative learning strategy (Abdel-Karim, 2010); And the Bybee's model (Abdel Moneim & Adam, 2008).

As well as the self-efficacy in mathematical literacy can be developed using other teaching models and strategies through teaching mathematics, such as: A training program based the framework of PISA (Al-Khider, 2020); An online training program (Ezz El-Din, 2020); An educational unit in mathematics according to the (PISA) program (Mohamed, 2019); And a proposed program in the light of the educational evaluation guide, the Info Graphic, and the Egyptian Knowledge Bank (Obaida, 2018).

The current research has at least two added scientific values. The first is that it relied on a quasi-experimental design based on empirical research, which was a robust research design that allowed for strong conclusions based on rigorous statistical analyses. The second added value is that the vast majority of the research conducted on the research variables was conducted in Western countries, but we present a study from a country that is culturally and historically different from those countries, which is the Sultanate of Oman, and we also relied on samples from one of its less developed regions far from the capital, it is the city of Salalah in the Dhofar region. We therefore present a unique way to validate the effectiveness of applying the Reigeluth's Model.

8. LIMITATIONS

The current research was determined by some limitations, including: 1) The sample size was not very large, as the number of students was 70 students in the experimental group, and 71 students in the control group, but this size is considered very suitable in experimental research to be able to draw strong conclusions. The impact in this research is very large; 2) The sample was from the city of Salalah in the Dhofar region located in the south of Oman, and it was good to obtain a second sample from the capital of Oman, but the sample was very representative of the eleventh grade students in the Dhofar region, because it was chosen randomly from one of the schools in the city of Salalah, it is a city with a different population composition that completely represents the entire Dhofar region. The teacher of the experimental and control groups was an Omani teacher, with extensive experience in teaching mathematics for up to seventeen years in teaching at the secondary stage.

9. RECOMMENDATIONS

Based on the results of this research, we recommend organizing and teaching the content of mathematics curricula at various levels of education according to the principles and philosophy of the Reigeluth's Model, and training mathematics teachers in these stages on how to develop mathematical knowledge achievement and self-efficacy in mathematical literacy among their students. More research should be done to determine the effect of using the Reigeluth's Model in teaching mathematics on many other variables such as mathematical thinking and mathematical prowess, as well as preparing a comparative study on the effect of using the Reigeluth's Model and other models on teaching mathematics in other educational stages.

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