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ANALYSIS OF THE MODELING APPLICATION'S TRENDS IN THE EDUCATIONAL PROCESS FOR THE PERIOD 2020 – 2023

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ABSTRACT

The idea of the current study is summarized in the reference review procedure of the trends of modeling process application in the educational process at the Arabic and foreign levels for the period (2020 - 2023). The study has followed the descriptive approach by presenting the modeling concept and the research fields that have addressed in various languages, in addition to identifying the most important models used in the educational process, based on the global database which are available on: (Google scholar, elibrary.ru, Scopus, …etc.).

The study included (319), Arabic and foreign studies that was dealt with restriction and numerical, qualitative and methodological classification during the time period from 2020 to 2023. The study has revealed the most important trends that used modeling as a research method. The study also showed the models set that used in the educational process. It is hoped that analyzing of trends will contribute to identify the fields and departments in which modeling has been used to solve educational and scientific problems. The study has showed a set of results that evaluate this study, which could help researchers in the field of applying the modeling process as a research method.

Keywords: Modeling, Modeling Methods, Educational Modeling, Educational Process.

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INTRODUCTION

The modeling process plays a vital role in solving modern educational problems through predictions in strategic planning and management processes as well as in various scientific fields. The modeling process is considered one of the most precise methods of ensuring the plan. Although a variety of research methods have been developed and all pursuing the same goal, modelling events can help to develop plans and strategies for solving complicated problems, and computer programs have helped to increase the ability that predictive machine applications will perform tasks related to complex systems and access to the large data which are relevant to the problem.

Modeling processes are widely used as cognitive and objective procedure in education, and the role of educational modeling increases directly with the technical development that accompany the educational process and facilitate for providing the information to students. (Bobkov, 2021) ،(Bebikhov et al., 6, 2019)

It is necessary to analyze the experiments of using modeling in the educational process as a means of solving theoretical and practical problems, which can be used as a means of cognitive awareness, as the model and its various forms are considered a theoretical transmitter of knowledge. Therefore, large amounts of data can be collected and processed through a framework that relies on that data to extract information (Soboleva et al., 2022)

Many studies have specifically addressed trend issues related to modeling processes, especially in specific fields such as geography, sports, and other disciplines. We list some of the factors that benefited from these studies to identify the results obtained, the tools used in data collection, and the methods used to conduct these studies:

The study by Sansana (2021) is titled “Recent Trends in Hybrid Modeling for Industry 4.0”. This study has aimed to review hybrid modeling techniques, methods for identifying the systems that relevant to digitalization, and criteria for evaluating models. The research method was descriptive and analytical. The research uncovers new methods and techniques that combine practical knowledge with phenomena in large data and machine learning) .Sansana et al., 2021(

Hegazy’s study (2023) is titled “Recent Trends in Constructional locative Modeling Research during the Period (2012 – 2022). This study includes a reference

survey of modern trends in the field of locative and constructional modeling from foreign and Arab sources. The study follows a several methodological processes including analysis of modeling concepts and develop its study over time, and major foreign and Arab research areas. The study included (181) studies. (Hegazy, 2023)

The study by Trunfio (2020) is titled "Recent Trends in Modeling and Simulation Using Machine Learning". This study had aimed to identify modern trends and ideas, which related to modeling and simulation systems based on advanced technologies. The study has followed a descriptive analytical method in processing the data. The study points to the diversity of trends in machine learning. (Trunfio, 2020)

The study by Tkacheva (2017) is titled "Time Series Modeling Trend Analysis". The purpose of this study is to analyze modeling trends based on time series using a software system prepared for this purpose, while the study uses an algorithmic analytical approach. The research finds new ways to integrate practical knowledge and phenomena into big data and machine learning frameworks, resulting in acceptable solutions and more powerful and clearer artificial intelligence that can help researchers. (Tkacheva, 2017)

Based on previous research, combined with the review and review of the above research literature, within the boundaries of the theoretical and literary framework, it can be used to determine the theoretical and methodological framework of the current study, which focused on applying the modeling method in educational studies and research at the Arab and foreign levels. Whether in education or science. Therefore, we can point out that the current study is similar to the studies of (Takjiva, 2017), (Trunfio, 2020), (Hejazi, 2023) and (Sansana, 2021) in the methods and those aspects used in the procedure. A descriptive study involving modeling trends. and conduct qualitative analysis. While the current study presents a comprehensive and overarching vision of research on modeling as a research method, it differs from it in terms of sample and target group.

Scientific Novelty

The novelty of this study lies in the fact that, for the first time, trends the modeling in the educational process at the Arab and international levels are analyzed through a quantitative and numerical analysis of data between 2020 and 2023 , given the increasing number of using the modeling in various fields of the educational process. In view of the increasing use of modeling processes to solve educational problems, this study classifies the main types of modeling covered by research and studies, in addition to the fields and specializations of that research, whether scientific, humanitarian, social economic... etc.

Study problem

In recent years, researchers have noticed the increasing use of modeling methods in many fields, including education and the natural sciences. Therefore, the tasks of analysis, planning and prediction are called modeling processes through which educational problems can be modeled and possible solutions found. There are two generally accepted methods. For modeling i.e. qualitative and quantitative modeling, if the researcher is unable to obtain quantitative data, then qualitative modeling can be used. If the research topic has statistical data, quantitative modeling methods should be used. The modeling process makes it possible to predict an object's future state based on its past data. Many studies have demonstrated the role of modeling in solving complex problems, e.g. (Kravets & Salnikova, 2020), (Diakonov, 2022), (Muhammad & Sayed, 2023).

Given the growing interest in research employing modeling approaches across various human and scientific disciplines, and I didn’t find any similar studies on the adoption of modeling trends in the educational process at the Arab and foreign levels, which prompted the researcher to try to identify the applicate trends of modeling methods during the period 2020-2023, especially in the education sector. Here Basically, can be formulated the questions are to answer the following questions: main question is: **What are the trends in the application of modeling in the educational process?**

To answer the main question, we should answer to the following sub-questions:

- What are the areas of applicate modeling in studies?
- What types of modeling do these studies cover?

- What is the methodology that followed in the modeling study?

Study aims:

- inventory scientific and humanities research (doctoral theses, journal studies, conferences or peer-reviewed journals) in Arab and foreign fields.
- analyze trends of applicate modeling in the educational processes to demonstrate benefit of the models that were created according on these trends.
- inventory the types of models used in Arab world and foreign research.

Importance of study

The importance of this study is to introduce researchers and interested parties the trends in applicate modeling methods of educational research and to use them in future studies, while identifying the main types of trends, that was created according to these models, and showing the Differences between published research in Arab world and worldwide. Many studies have confirmed the importance of analyzing trends, such as: (Al-Ajami et al, 2020),(Al-Said, 2011)

limits of study

The limits of the materials study are limited to research and studies that has published in peer-reviewed journals, conferences, and periodicals, through Arab and foreign websites and scientific platforms. The spatial boundaries are limited to journals, conferences and periodicals at two levels: the Arab world and the international one. The time limits are limited to the time period 2020 – 2023.

Terms of study

Modeling

Terminologically: Petukhov defines it as a method of studying physical phenomena, engineering designs, and systems and predicting their behavior.(Petukhov, 2015)

Procedurally*:* It is an advanced research method based on the storage and processing of large amounts of data and the realistic reproduction of the environments, phenomena and problems studied using computer programs.

Modeling trends

Terminologically*:* Ibn Manzur defines them idiomatically: they are "a system of emotions and reactions that reflect, in a positive or negative way, an individual's beliefs, interests, and Values".

Procedurally*:* This is the process of conducting a quantitative and qualitative analysis of the data included in the current study, on the basis of which the most commonly used aspects of modeling are identified.

The process of applying the model in education focuses on analyzing the variable into mini-sections through which the characteristics of the situation can be studied for each of the aspects surrounding the variable. (Strijbos et al., 2004)

Kalinovskaya pointed out that in modern education, there are many types of educational process models that are widely used in the teaching of educational subjects. These models in classroom teaching are based on a variety of cognitive and practical educational activities involving varying degrees of subjectivity.

The subjectivity of students in the process of learning the education major includes: (Kalinovskaya et al., 2010)

1. Experimental model: The knowledge and necessary skills for experiments are formed based on students' personal experience and organized in the form of courses. (Dung & Minh, 2020)

2. Education model: This model includes the interaction between teachers and students and between students in the education process. Problems are discovered on the spot during teaching practice and solved theoretically. (Dung & Minh, 2020)

3. Practical mode: This mode involves active interaction between teachers and students, solving problems that arise in part-time work, and aims to alternate between educational, cognitive and practical activities in order to: connect theoretical knowledge with school reality. (Fotiadis et al., 2006)

4. Semi-professional model: This model consists of the modeling of professional and teaching activities within the framework of teaching practice and is related to

the formation of a personal stance related to the acquired knowledge and professional activities, with an organizational, reflective represent, communication, teaching and other important skills at the professional level. (Waldron, 2012)

5. Guidance model: It includes activities carried out by students in the educational process of pedagogy through discussion, which is a repeated position at the theoretical level to form a flexible scientific and educational way of thinking. (Grabaurov, 2021)

6. Reflective mode: Discover the contradiction between the nature of theoretical knowledge and the subjectivity of teaching activities, and promote teachers' self-development. (Arsyad et al., 2017)

7. Practical Personality Models: Here, basic information is presented to students verbally and visually in the form of models (diagrams, algorithms, matrices), where the student's task is determined by determining the meaning of the information within its own structure. (Almond, 1995)

8. Social (anthropological) model: It focuses on the applied nature of educational knowledge and embodies the characteristics of the scientific method of educational thinking. (Zaharlick, 1992)

9. Self-learning model: It depends on the use of self-education opportunities, when the student himself builds a path for his educational development and methods for studying units in educational specializations. (Arsyad et al., 2017)

10. Educational model: It is defined as the educational technology that embodies the teaching methods and organizational forms of education that constitute the educational basis of the educational model. (Таан, 2019)

Each of these models can be used in different combinations in the educational process of future teachers in the context of distance education, and also for presentation with the aim of explaining, researching and clarifying the educational topic

under study. It is also used as a research method. or as a useful tool for analyzing and illustrating research topics.

To determine the direction of the application of the modeling process in the educational process, it is necessary to identify the elements of the educational environment, represented by (educational systems and management), that can be modeled to solve emerging problems. Whether personal, social, administrative or geographical. (Zherebkina & Lapshina, 2014)

11. Educational System Model: Rodatko defines an educational system as a set of components. This model can be categorized into four types: comprehensive, practical, logical, and open. (Lodatko, 2023)

For Dahin, he defined it as a group of elements that are logically consistent in the educational system, and these are connected to each other, such as (Aims and content of education, design of educational technology, technology used in managing the educational process, curricula, and programs). (Zverev, 2015)

According to educational aims and methods, the education model is divided into three levels: There are "Easy Levels", "Intermediate Levels" and "Complex Levels". For example, may be used in the lesson plan, the intermediate level may be used in modeling natural phenomena, and the integrative level may be used with simulation software. (Solodova & Antonov, 2005)

Advantages of applying modeling in the education

There are many advantages to using modeling in education, such as: (Soorapanth et al., 2023)

- It saves time, effort, and resources.
- Modeling allows you to predict various events and phenomena.
- Allows us to studying complex systems, for scientific and applied disciplines, which cannot be studied in reality.
- Improving resource management, through various methods.
- In scientific (applied) research, negatives can be evaluated to reduce errors, and appropriate actions can be taken for them.
- Modeling also supports environmental protection by assessing the impact of activities on the environment.

Methodology and Procedures of study

Methodology of study: the Descriptive approach was used in data analysis, as well as quantitative and qualitative analyzes used to examine research themes, and methods used in research, including qualitative analysis of studies that dealt modeling as research methods.

Society and sample of study.

The study represents research that published in the Arab world and internationally for the period from "2020-2023".

Procedures of study

1. Conduct research in electronic libraries and international platforms containing academic and educational articles.
2. Search Arabic and foreign websites, journals and databases, As in Table No. (1).
3. Monitoring and classification of research methods related to the modeling process.
4. Classification of studies at the Arab and foreign levels.

Table No. (1) shows Arab and foreign centers, journals, and platforms.

Arabic websites & journals	Foreign websites & journals
Center of Rafad for Research	ResearchGate
Al-Sabt Center for Research & Publishing.	E-library.ru
Arid Platforms	Scopus
ORCID	Scientific Electronic Library
Website of Iraqi academic scientific journals.	CyberLeninka
	Willy
	E-Learning and Digital Media
	Educational Digital Platforms

Table No. (2) shows the distribution of studies according to place of publication

Level	**Frequency**	**Percent**
Arabic	129	4,40%
Foreign	190	6.59%
Total	319	100%

From Table No. (2) we researched (319) studies. It was divided into two parts, where the studies in the Arab countries reached (129) studies, with a percentage

of (40.4%). It is a good indicator that shows the growing application of modeling in Arab research and studies, compared to (190) studies in foreign countries. with a percentage of (61.2%). It included foreign countries (the Americas, Eastern Europe, etc.). Therefore, foreign studies outperformed Arab studies in applying the modeling method. Note Figure No. (1).

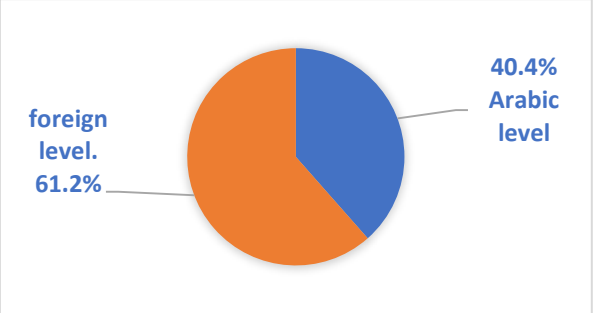


Figure (1). Shows the percentage of research according to the language of publication.

The most important Axes that covered with modeling method

The study included four important axes, each axis divided into several sub-fields or sections:

First axis: Field of Engineering Sciences

Table No. (3) Shows data of studies in the first axis for field of Engineering Sciences.

N	Engineering department	Types of modeling	Methodology	Publication year				Arabic Country		Foreign Country		Total
				2020	2021	2022	2023	F	%	F	%	
1	Civilian	1-Numerical	Analyze	2	1	-	3	2	7.1 %	4	14.3 %	6
		2-Computerization	Analyze	1	-	2	3	1	3.6 %	5	17.9 %	6
2	Electrical	3-Computerization	descriptive	-	1	2	-	-	-	3	10.7 %	3

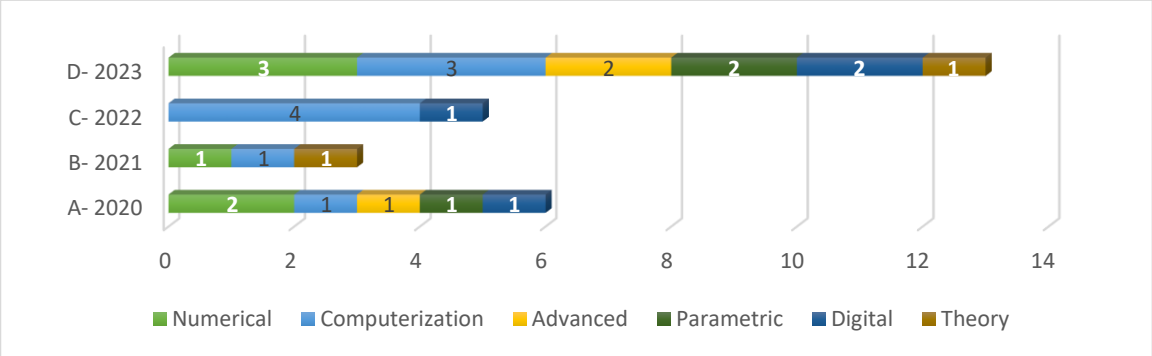
3	Architectural	4- Advanced	descriptive	-	1	1	2	2	7.1 %	2	7.1 %	4
		5- Parametric	Analyze	1	-	-	2	1	3.6 %	2	7.1 %	3
4	Computers	6- Digital	descriptive	1	-	1	2	2	7.1 %	2	7.1 %	4
5	Manufacture	7- Theory	Analyze	-	1	-	1	1	3.6 %	1	3.6 %	2
Total \ total percentage		**28**	**8.7%**	1.6 %	1.3 %	1.9 %	1.4 %	9	32.1 %	19	67.9 %	100 %

From the table (3), we notice that the results of the data that were analyzed, showed the interest of the researchers to applied the modeling's to their research. The proportion of studies that dealt with modeling's in the field engineering sciences was (28) studies, while the percentage was (8.7%) of the total for the current sample, it included five important sections: civil, electrical, architectural, computers, manufacture. the results are similar to “Mahmoud's” and “Zarubin” studies in terms of the used modeling in engineering. (Mahmoud, et al., 2020), (Zarubin, 2003)

The number of foreign studies was (19) studies, with (67.9%) percent, verses studies in Arab countries were (9), with (32.1%) percent. The study of “Bibikhov” and “Fan” within the geometry axis also pointed to the role of the modeling in the conduct of engineering research. (Fan et al., 2016), (Bebikhov et al., 2019)

Figure No. (2) Path of research in field of engineering during (2020 - 2023)

The research method used in the field of engineering varied between (analytical, descriptive). Regarding the place of study, we note the superiority of studies and research in foreign countries over studies conducted in Arab countries in this area. From Figure (2), we notice an increase in studies that used modeling in the engineering sciences during the year (2023) at a rate of (4.1%), followed by the year (2022) in second place at a rate of (1.9%) in terms of the number of studies monitored by the researcher. While the modeling used in studies regarding this axis



were divided into (6) categories: (numerical, computer, advanced, parametric, numerical, and theoretical). Numerical modeling Including (6) studies, and computer modeling obtained (9) studies, this axis has the highest percentage of studies, indicating scientific interest at Arab and foreign levels in the using of modeling's in engineering and various sectors.

Second axis: the field of natural and applied sciences

Table No. (4) Shows data of studies in second axis for field of natural and applied sciences.

N	Depat. natural & applied sciences	Types of modeling	Methodology	Publication year				Arabic Country		Foreign Country		Total
				2020	2021	2022	2023	F	%	F	%	
6	Biological	1-Sports	Analyze	2	1	1	4	2	2.8 %	6	8.3 %	10
7	Sports	2-Electronic	Experimentation	-	-	1	1	1	1.4 %	1	1.4 %	2
8	Physics	3- Numerical	Experimentation	-	1	3	4	3	4.2 %	5	9.6 %	7
		4-Physical numerical	Experimentation	-	3	1	2	4	5.6 %	2	2.8 %	6
		5-Physical	Experimentation	2	1	-	1	2	2.8 %	2	2.8 %	5

9	math emat ics	6- Physi- cal and sports	Experi- mentation	3	1	1	3	4	5.6 %	4	5.6 %	11
		7- Sports	descriptiv e	2	1	4	3	2	2.8 %	8	11.1 %	12
		8- Math- ematic	descriptiv e	1	-	4	2	7	9.7 %	-	-	14
1 0	Che mis- try	9- Mo- lecular	Analyze	-	2	-	1	2	2.8 %	1	1.4 %	5
		10- Ther- mal	Analyze	2	3	3	-	3	4.2 %	4	5.6 %	10
		11- Sports	Analyze	3	2	4	-	2	2.8 %	7	9.7 %	2
Total \ total percent age		**72**	22,6%	5,6 %	5,9 %	2.8 %	8,5 %	3 2	44,4 %	4 0	55,6 %	100 %

From extrapolation Table (4), we see diversity fields in which modeling is applied in the educational process, the studies amounted to (72) studies, involving modeling that was applied in fields of natural sciences and applied sciences, accounting for (22.6%) of the total number of current research samples, as includes (5) fields: (biology, mathematics, physics, mathematics, chemistry).

Regarding the location of the studies, there were a total of (32) studies conducted in Arab countries, which represented a percentage (44.4%) of the total number of studies (72) counted in this axis, in comparison, the number of foreign studies was (40), accounting for (55.6%).

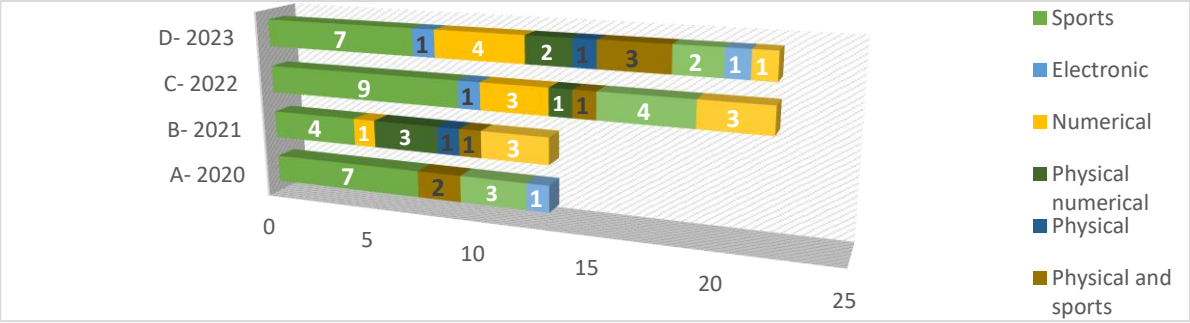


Figure No. (3) Research Path in field of natural science and applied science (2020 – 2023)

From Figure (3). We note that the proportion of research using modeling in the natural and applied sciences in (2023) was reached (8.5%). And in year (2022) it was came in second place with a growth rate of (8.2%). while the rate of year (2021) is (5.9%), in terms of the total number of studies on the topic, finally the year (2020) in the ranked at the bottom with (5.6%). This showed us that increasingly used modeling by researchers and people interested in the field. and there are (11) modeling types for this axis: (mathematics, electronics, numerical, physical numerical, physics, physics, mathematics). "Mathematical modeling" accounts for the highest proportion of applications in scientific research. (27) studies were monitored and distributed on the across the natural and applied sciences (biology, mathematics, and chemistry). This indicates us that the researchers are more interested in it than in other fields (i.e., natural and applied sciences).

Third axis: field of humanities and social sciences

N	Depat. humanities & social sciences	Types of modeling	Methodology	Publication year				Arabic Country		Foreign Country		Total
				2020	2021	2022	2023	F	%	F	%	
11	Agriculture	1- Spatial	Analyze	2	1	1	4	2	2.1 %	2	2.1 %	4

12	Economics	2- Electronic	Experimentation	-	-	1	1	1	1%	1	1%	2
13	Commerce	3- Numerical	Experimentation	-	1	3	4	3	3.1%	5	5.2%	8
		4-Physical numerical	Experimentation	-	3	1	2	1	1%	2	2.1%	3
14	Geography	5-Mechanism	descriptive	-	1	1	-	1	1%	1	1%	2
		6-Spatial	Analyze	1	1	1	-	3	3.1%	7	7.3%	10
		7-Sporting	Analyze	2	2	2	3	5	5.2%	9	8.4%	11
		8-Cartography	Analyze	2	-	1	3	3	3.1%	4	4.2%	7
		9-Cartography	Analyze	1	-	3	-	2	2.1%	2	2.1%	4
		10-Geospatial	Analyze	1	-	-	1	1	1%	1	1%	2
		11-Digital	descriptive	-	-	2	1	1	1%	2	2.1%	3
		12-Interactive	Semi-experimental	-	2	2	1	2	2.1%	3	3,1%	5
		13-Cartographic	Analyze	2	1	1	2	1	1%	3	3.1%	4
15	Sociology	14-Constructivism	Analyze	-	1	2	3	2	2.1%	4	4.2%	6

16	Psy-chol-ogy	15- Con-structiv-ism	Analyze	1	1	1	3	1	1%	2	2.1 %	3
		16- Psy-chology	Analyze	-	2	3	-	2	2.1 %	3	3.1 %	5
17	Sports	18- Sports	descriptive	2	3	3	4	5	5.2 %	6	6.3 %	11
18	Reli-gion	19- Sec-tarianism	Semi-ex-peri-mental	1	-	2	-	1	1%	2	2.1 %	3
Total \ total percentage		**96**	**36,9%**	4,7 %	6,1 %	9,4 %	10, 4%	**37**	44, 4%	**59**	55, 6%	100 %

Table No. (5) Shows data of studies in Third axis for field of humanities and social sciences

From Table (5) we can see that the field of humanities and social sciences is characterized by a more comprehensive application field of modeling in the educational process, its amounted in total to (96) studies, accounting for (36.9%), of the entire research sample. The axes include (8) main areas: (Agriculture, Economics, Commerce, Geography, Sociology, Psychology, Sports and Religion). A total of (37) studies were conducted in Arab countries, accounting for (44.4%) of the total number of studies in this axis, compared to foreign studies, which amounted to (96) studies in various fields. This corresponds to (59) studies, corresponding to a rate of (61.5%). Komissarov's findings highlight the effective role of modeling processes in the humanities. compared to foreign studies. (Komissarov, 2018)

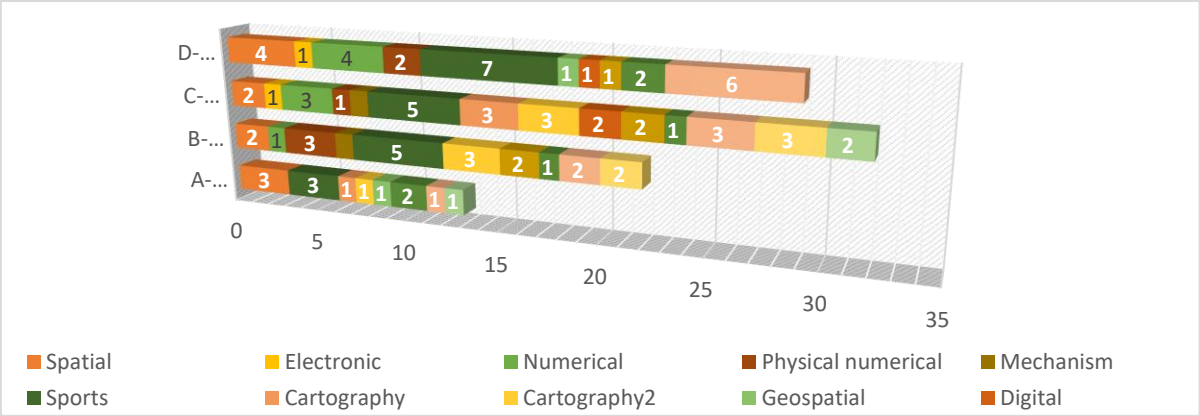


Figure No. (4) Research Path in field of humanities and social sciences (2020 – 2023)

From Figure (4) we notice the path of studies that used modeling in this axis has increased incrementally, as the percentage of studies in (2020) reached (4.7%), followed by the year (2021) with a percentage of (6.1%), then the year (2022), with a percentage of (9.4%) and finally the year (2023) by (10,4%).

As for types of modeling, they have also varied into (19) types in this axis, which are: (spatial, electronic, numerical, physical numerical, mechanical, mathematical, cartographic, cartographic, geospatial, digital, interactive, cartographic, structural, psychological, and doctrinal). "Mathematical and structural" modeling received high rates in terms of its application in human and social studies, as (21) studies were monitored for mathematical modeling and (12) studies for structural modeling were distributed in the fields of (geography and sports), and this shows the importance of mathematical and structural modeling. In these two areas.

Fourth axis: field of education

N	De-pat. Ed-uca-tion	Types of model ing	Methodo logy	Publication year				Arabic Country		Foreign Country		Total
				20 20	20 21	20 22	202 3	**F**	**%**	**F**	**%**	
1 9	Sec-ond-ary Ed-uca-tion,	1- Struc-tural	Analyze	1	2	1	-	2	1.6 %	4	3.3 %	6
2 0	Re-sear ch and stud ies De-part-men t	2- Con-struc-tivism	Analyze	-	1	-	2	1	0.8 %	2	1.6 %	3
2 1	Kin-der-gar-ten	3- Ed-uca-tional	Experi-menta-tion	-	2	1	-	1	0.8 %	2	1.6 %	3
2 2	Che mis-try	4- Ex-peri-menta l	Experi-menta-tion	1	2	1	3	2	1.6 %	5	4.1 %	7

23	Mathematics	5-Three-dimensional numerical	Experimentation	2	2	2	3	3	2.4%	4	3.3%	7
		6-Cognitive	Experimentation	1	2	1	4	3	2.4%	5	4.1%	8
		7-Sports	Experimentation	2	1	1	5	4	3.3	5	4.1%	9
24	Islamic teaching	8-Modeling strategy	Semi-experimental	-	2	1	1	1	0.8%	3	2.4%	4
		9-Cognitive	Experimentation	2	1	1	2	2	1.6%	4	3.3%	6
25	Sports methods	10-Modeling strategy	Experimentation	2	-	3	4	4	3.3%	5	4.1%	9
		11-Subjective	Experimentation	1	-	3	4	3	2.4%	4	3.3%	7

		12-Sensory	Semi-experimental	1	3	2	3	3	2.4%	3	2.4%	6
		13-Modeling strategy	Experimentation	1	1	3	4	4	3.3%	5	4.1%	9
26	Arabic language	14-Video	Semi-experimental	2	1	-	2	1	0.8%	4	3.3%	5
		15-Modeling strategy	Experimentation	-	1	1	2	2	1.6%	2	1.6%	4
27	English language	16-Educational environment	Experimentation	1	2	2	2	2	1.6%	3	2.4%	5
28	educational technology	17-Vocational education	Experimentation	1	-	1	2	1	0.8%	3	2.4%	4
		18-Games	Semi-experimental	2	1	2	-	2	1.6%	3	2.4%	5

		19-Modeling techniques	Semi-experimental	-	2	-	2	2	1.6 %	2	1.6 %	4
		20-Simulation models	Semi-experimental	2	2	2	2	3	2.4 %	5	4.1 %	8
		21-Information	Semi-experimental	-	2	1	1	1	0.8 %	3	2.4 %	4
Total \ total percentage		123	**38.6%**	6.6 %	8.2 %	9.4 %	14.4 %	47	38.2 %	76	61.8 %	100 %

Table No. (6) Shows data of studies in fourth axis for field of Education**.**

In Table (6) we note that the field of education is more comprehensive and diverse than other topics dealing with the application of modeling in educational processes, as the total number of studies reaches (123) studies. Proportion of the total study sample (38.6%). This axis includes (10) different areas, namely (Secondary Education, Research and studies Department, Kindergarten, Chemistry, Mathematics, Physical, Arabic language, English language, educational technology, etc.). With exception field (Department of Educational Research and Studies) that follow analytical methods, all research on this topic follows experimental research methods.

The studies conducted in the Arab countries amounted to (47) studies, at a rate of (38.2%) relative to the total number of studies counted in this axis, which are numbered (123) studies in various fields, compared to foreign studies, which amounted to (76) studies, at a rate of (61.8%). This is a clear indication of the

superiority of this field in applying modeling through conducting educational research and studies. Denisenko's study confirmed this effective role of modeling. (Denisenko, 2023)

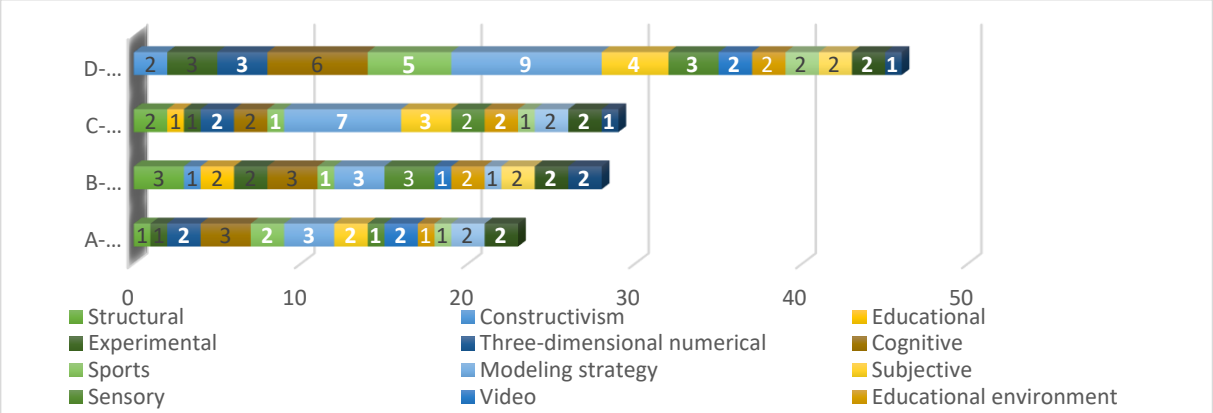


Figure No. (5) Research Path in field of Education sciences (2020 – 2023)

Figure (5) Shows the path of research that using modeling in education, which has grown exponentially when the percentage of research reached (6.6%) in 2020. This is followed by this year (2021) with a growth rate of (8.2%). Then the growth rate this year (2022) is (9.4%). In the last year (2023), the growth rate was (14.4%).

The modeling types in this axis are divided into (21) categories, namely: (structural, constructive, educational, experimental, three-dimensional numerical, cognitive, mathematical, modeling strategy, subjective, sensory, video, educational environment, professional training, gaming, and modeling techniques, simulation modeling and information). “Modeling strategies” accounted for the highest proportion of studies applied in the field of education (22 studies), followed by “cognitive modeling” (15 studies).

RESEARCH RESULT

First: Topics and fields of modeling as a research method:

Table (7) shows total number of topics and sections involved in modeling in studies.

N	Axis	Fields	Topics of mod-eling	Arab level	Foreign level	Total of Studies	
						F	%
1	Engineering sci-ences	5	7	9	19	28	8.8%
2	Natural and applied sciences	5	11	32	40	72	22.6%
3	Humanities and so-cial sciences	8	19	37	59	96	30.1%
4	Education	10	21	47	76	123	38.6%

Table (7) shows the superiority of the field of education over other fields in terms of research and use the modeling in research, as the number of studies in this field reaches (123), which is equivalent to (38.6%). This is a clear sign of the growing use of modeling, and it is a metric that should be considered when promoting the use of modeling in education futural. Followed is the field of humanities and social sciences, with a slight difference. The number of studies is (96), and the corresponding proportion is (30.1%), followed by the fields of natural sciences and applied sciences. The number of studies in natural and Applied Science is (72) studies, while the field of Engineering ranks last with (28) courses and a proportion of (8.8%). See Figure No. (6).

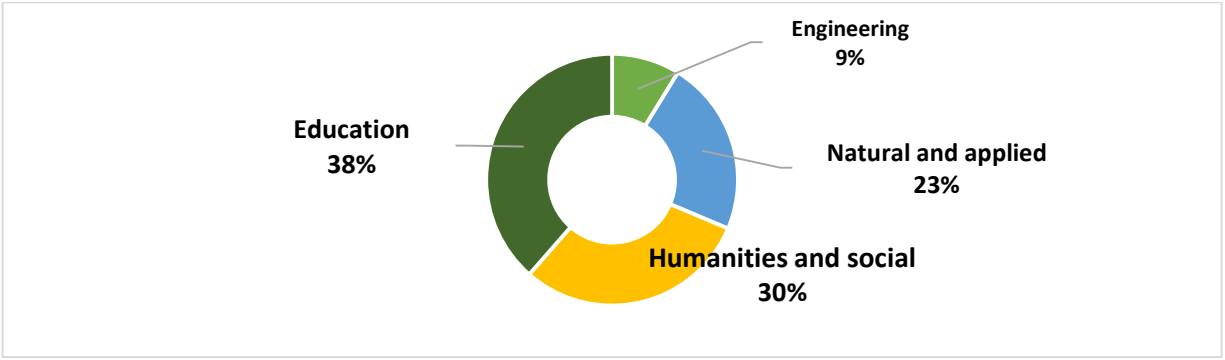


Figure No. (6) shows the proportions of studies for fields of study.

Second: Methods used in research applying modeling methods:

Table No. (8): Distribution of studies according to research methodology.

Methodology / Years	Experimentation		Semi-experimental		Analyze		descriptive		Totally
	F	%	F	%	F	%	F	%	
2020	20	6.3%	8	2.5%	21	6.6%	6	1.9%	55
2021	23	7.2%	15	4.7%	18	5.6%	7	2.2%	63
2022	32	10%	12	3.8%	25	7.8%	18	5.6%	87
2023	50	15.7	12	3.8%	38	11.9 %	14	4.4%	114
Totally	125	39.2%	47	14.7%	102	32%	45	14.1 %	319

From the extrapolation of Table No. (8), we notice the diversity of the methodology of the studies that adopted the topic of modeling into (4) types of research, which are: (experimental, quasi-experimental, analytical, and descriptive), and since most of the studies that adopted modeling as a research method are educational studies compared to studies Other scientific fields, despite their diversity. Experimental research and studies had the highest percentage (39.2%) compared to other studies, followed by studies with an analytical approach with a percentage of (32%), while studies with a descriptive and quasi-experimental approach had close percentages (14.1-14.7), as indicators indicate an increase in the interest of researchers in the educational field in applying modeling.

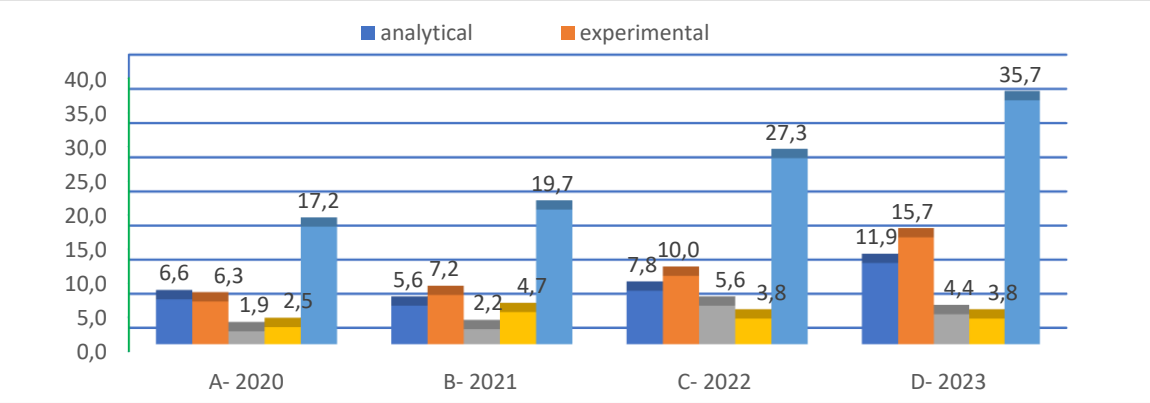


Figure No. (7): Percentages of studies according to research methodology.

As can be seen in Figure (7), the studies are distributed chronologically according to the methods used in preparing the studies and the researches that used modeling in their procedures.

We also noticed a change in the density of research involving modeling topics over the past four years, as the number of published research papers gradually increased, so that in 2020, there were (55) studies accounting for (17.2%) of the total number of studies in the sample. Subsequently, there was a slight increase in the number (63) or proportion (19.7%) of studies in 2019. For 2022, the number of studies has increased significantly compared to the previous year, with the number of studies (87) or the rate (27.3%). Finally, in 2023, the number of studies increased significantly (114), accounting for (35.7%) of the total number of studies. This shows that researchers are increasingly interested in the application of modeling as a research method in these fields. This significant growth sheds light on the research methods and paths for using modeling in practice, especially in the field of education.

The results of the current study indicate that Arab and foreign researchers are increasingly interested in applying models to solve specific educational problems and other disciplines problems. In particular, the role of modeling and its importance in science and human studies.

The current study highlights the weaknesses of using methods other than experimental, descriptive and analytical methods. The results of the current study help identify pathways for applying modeling in the broader scientific and educational fields.

The findings monitor the main methods used in research and the studies that use modeling in their procedures.

The results of this study can be generalized to the extent that this sample represents studies and research.

Research recommendations

- Conduct further researcher's and studies to monitor modern trends in the use of modeling in educational processes.
- Apply the modeling process to a wider domain and a wider time period to identify differences in past and present modeling use.

- Researchers and people interested in the topic of modeling can benefit from the results of the current study and apply modeling to other areas.
- Not limited to the researcher's experience and addresses the latest research and trends in the field of modeling applications for future studies and research.

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