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## **ANALYSIS OF THE MODELING APPLICATIONS' TRENDS IN THE EDUCATIONAL PROCESS FOR 2020–2023**

***Ghazi Hussein Taan Albayati***

*Presidency of Sunni Endowment, Religious Teaching and Islamic Studies  
Directorate, Baghdad, Iraq, dr.ghazi@taleemdeny.edu.iq*

**Abstract.** This study aims to investigate the trends of applying modeling processes in the educational process at the Arab and foreign levels for the period (2020–2023). The study followed the descriptive approach by presenting the modeling concept and the research areas covered in different languages and identifying the most important models used in the educational process based on the global database available on: (Google Scholar, elibrary.ru, Scopus). The study included (319), Arab and foreign studies that dealt with the restriction and numerical, qualitative, and methodological classification from 2020 to 2023. The study has identified the most important trends in which modeling was used as a research method. The study has also highlighted the models used in the educational process. We hope that the analysis of the trends will help to identify the areas and departments where modeling has been used to solve educational and scientific problems. The study has shown several results that could evaluate this study and help researchers in applying modeling as a research method.

**Keywords:** *Modeling, Modeling Methods, Modeling procedure, 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, all with the same goal, modeling events can help develop plans and strategies to solve complicated problems. Computer programs have helped to improve the ability of predictive machine applications to perform tasks related to complex systems and to access problem-relevant big data. Modeling processes are widely used as cognitive and objective procedures in education, and the role of educational modeling increases directly with the technological development that accompanies the educational process and facilitates the transmission of information to students [1].

It is necessary to analyze the experiments on the use of modeling in the educational process to solve theoretical and practical problems that can be used as a means of cognitive awareness since the model and its different forms are

considered theoretical transmitters of knowledge. Therefore, large amounts of data can be collected and processed through a framework that relies on this data to extract information [2].

Many studies have specifically addressed trending issues related to process modeling, especially in certain fields such as geography, sports, and other disciplines. We list some of the factors that have 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." The aim of this study was to investigate hybrid modeling techniques, methods for identifying the systems 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 big data and machine learning phenomena [3].

The study by Hegazy (2023) is titled "Recent Trends in Constructional Locative Modeling Research during the Period (2012–2022)". This study contains a reference overview of modern trends in the field of locative and constructional modeling from foreign and Arab sources. The study follows several methodological procedures, including the analysis of modeling concepts and the evolution of their study over time, as well as the leading foreign and Arab research areas. (181) Studies were included in the study [4].

The study by Trunfio (2020) is entitled "Recent Trends in Modeling and Simulation Using Machine Learning." The aim of this study was to identify modern trends and ideas for modeling and simulation systems based on advanced technologies. The study followed a descriptive-analytical method in processing the data. The study shows the diversity of trends in the field of machine learning [5].

The study by Tkacheva (2017) is entitled "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, and 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, leading to acceptable solutions and more powerful and clear artificial intelligence that can help researchers [6].

Based on previous research in conjunction with the review and review of the aforementioned research literature, within the limits of the theoretical and literary framework, the theoretical and methodological framework of the current study can be determined, which focuses on the application of the modeling method in educational studies and research at the Arab and foreign levels. Be it in education or in 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 aspects used in the procedure – a descriptive study involving the modeling of trends and conducting a qualitative analysis. While the current study represents a comprehensive and overarching vision of research on modeling as a research method, it differs from this in terms of the sample and target population.

### **Scientific Novelty**

The novelty of this study lies in the fact that for the first time, the trends of 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 use of modeling in various fields of the educational process. Given the increasing use of modeling processes to solve educational problems, this study classifies the main types of modeling covered by research and studies, as well as the fields and specializations of this research, whether scientific, humanitarian, or socio-economic.

### **Study problem**

In recent years, researchers have noted the increasing use of modeling methods in many fields, including education and the natural sciences. Therefore, the tasks of analysis, planning, and prediction are referred to as modeling processes, through which educational problems can be modeled and possible solutions can be found. There are two generally recognized methods. Qualitative and quantitative modeling can be used if the researcher cannot obtain quantitative data. Quantitative modeling methods should be used if the research topic has statistical data. The modeling process makes it possible to predict the future state of an object based on its past data. Many studies have shown the role of modeling in solving complex problems, e.g., [7–9].

Given the growing interest in research that uses modeling approaches in various human and scientific disciplines, I did not find similar studies on the application of modeling trends in the educational process at the Arab and foreign levels, which prompted the researcher to attempt to identify the application trends of modeling methods in the period 2020–2023, especially in the education sector. The main questions to be answered can be formulated as follows: **What are the trends in the application of modeling in the educational process?**

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

- In which areas is modeling applied in studies?
- What types of modeling are covered in these studies?
- What methodology is used in the modeling study?

### **Aims of the study**

– to take stock of scientific and humanities research (doctoral theses, studies in journals, conferences, or peer-reviewed journals) in Arab and foreign fields.

– Analyze the trends of modeling applications in educational processes to show the usefulness of the models developed based on these trends.

– Inventory the types of models used in the Arab world and in foreign research.

### **Importance of the study**

The importance of this study is to introduce researchers and interested parties to the trends in applicable modeling methods in educational research and

to use them in future studies. The aim is to identify the most important types of trends that have emerged according to these models and to show the differences between published research in the Arab world and worldwide. Many studies have confirmed the importance of analyzing trends, for example, [10, 11].

### **Limits of the study**

The boundaries of the material study are limited to research and studies published in peer-reviewed journals, conferences and periodicals, Arabic and foreign websites, and academic platforms. The spatial boundaries are limited to journals, conferences, and periodicals at two levels: the Arab and international worlds. The temporal boundaries are limited to the period 2020–2023.

### **Terms of the study**

**Modeling – Terminologically:** Petukhov defines it as a method of studying physical phenomena, engineering designs, and systems and predicting their behavior [12].

**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, positively or negatively, an individual’s beliefs, interests, and Values” [13].

**Procedurally:** This is the process of conducting a quantitative and qualitative analysis of the data included in the current study, based on 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 [14].

Kalinovskaya pointed out that in modern education, many types of educational process models are widely used in teaching educational subjects. These classroom teaching models are based on various cognitive and practical educational activities involving varying degrees of subjectivity. The subjectivity of students in the process of learning the education major includes [15]:

1. **Experimental model:** The knowledge and necessary skills for experiments are formed based on the student’s experience and organized in courses [16].

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 [17].

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 to connect theoretical knowledge with school reality [18].

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 [19].

**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 [20].

**6. Reflective mode:** Discover the contradiction between the nature of theoretical knowledge and the subjectivity of teaching activities and promote teachers' self-development [21].

**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 [22].

**8. Social (anthropological) model:** It focuses on the applied nature of educational knowledge and embodies the characteristics of the scientific method of educational thinking [23].

**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 [21].

**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 [24].

Each of these models can be used in different combinations in the educational process of future teachers in distance education and also for presentations to explain, explore, and clarify the educational topic under study. It is also used as a research method or as a helpful tool for analyzing and illustrating research topics. In order to determine the direction of application of the modeling process in the educational process, it is necessary to identify the elements of the educational environment (educational systems and management) that can be modeled to solve emerging problems. Whether personal, social, administrative, or geographical [25].

**11. Educational System Model:** Rodatko defines an educational system as a series of components. This model can be divided into four types: comprehensive, practical, logical, and open [26].

Dahin defined it as a group of elements that are logically consistent and interrelated in the educational system, such as the goals and content of education, the design of educational technology, the technology used in managing the educational process, the curricula, and the programs [17].

Depending on the educational goals and methods, the educational model is divided into three levels: 'Basic Levels,' 'Intermediate Levels' and 'Complex Levels'. The basic level can be used, for example, in lesson plans, the intermediate level can be used in modeling natural phenomena, and the complex level can be used with simulation software [27].

### Advantages of applying modeling in education

There are many advantages to using modeling in education, such as [28]:

- It saves time, effort, and resources.
- Modeling allows you to predict various events and phenomena.
- It allows us to study complex systems for scientific and applied disciplines that 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 the study

Study Methodology: A descriptive approach was used in the data analysis, and quantitative and qualitative analyses were conducted to explore research themes and methods, including qualitative analysis of studies that used modeling as a research method.

### Society and sample of the study

The study represents research published in the Arab world and internationally from “2020–2023.”

### The procedure of the study

1. Conduct research in electronic libraries and international platforms that contain academic and educational articles.
2. Search for Arab and foreign websites, journals, and databases, as shown in Table 1.
3. Monitor and classify research methods related to the modeling process.
4. Classify studies at Arab and foreign levels.

Table 1

*Shows Arab and foreign centers, journals, and platforms*

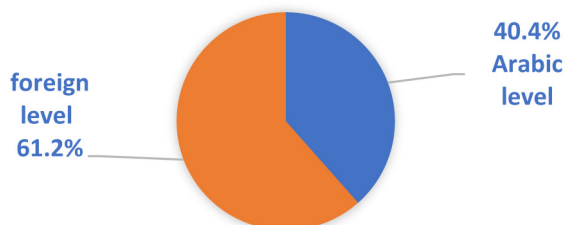
Arabic websites & journals	Foreign websites & journals
Center of Rafad for Research	ResearchGate
Al-Sabt Center for Research & Publishing	E-library.ru
Arid Platforms	Scopus
ORCID	Scientific Electronic Library
Website of Iraqi academic scientific journals	CyberLeninka
	Willy
	E-Learning and Digital Media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

From Table 2 we can see the researched (319) studies. It was divided into two parts, with the studies in the Arab countries reaching (129), with a percentage of (40.4%). This is a good indicator of the increasing use of modeling in Arab research and studies, compared to (190) studies abroad with a percentage of (61.2%). Among them were foreign countries (America, Eastern Europe). Thus, foreign studies have surpassed Arab studies in using the modeling method. Note: Figure 1.

Table 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%



**Fig. 1.** Percentage of research by language of publication

### **The most important axes covered by the modeling method**

The study covered four main axes, with each axis divided into several sub-fields or sections:

#### **First axis: Field of Engineering Sciences**

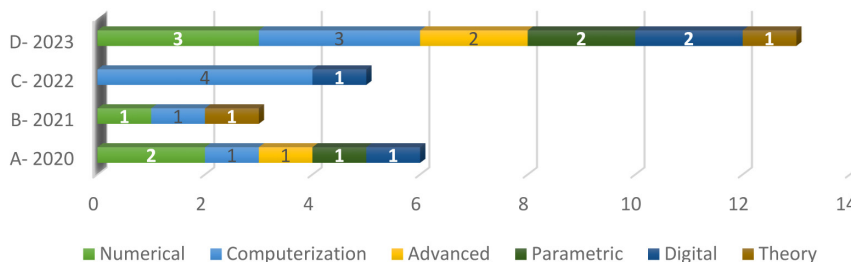
Table 3 shows that the analyzed data results demonstrate the researchers' interest in applying modeling in their research. The number of studies that dealt with modeling in the engineering field was (28), while the percentage for the current sample was (8.7%) of the total; it included five main fields: Civil, Electrical, Architectural, Computer, and Manufacturing. The results are similar to "Mahmoud" and "Zarubin" studies on using modeling in engineering [29, 30].

Table 3

*Data from studies in the first axis for the field of engineering*

N	Engineering departments	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%	

The number of foreign studies was (19), with (67.9%) percent, while the 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 modeling in conducting engineering research [31, 32].



**Fig. 2.** Path of research in the field of engineering sciences in the period (2020–2023)

The research methods used in the field of engineering vary between analytical and descriptive. As for the place of study, we find that studies and research abroad in this field are superior to studies conducted in Arab countries.

Figure 2 shows that the number of studies that used modeling in engineering increased by (4.1%) in the year (2023), followed by the year (2022), which ranks second with (1.9%) in terms of the number of studies observed by the researcher. At the same time, the modeling used in the studies on this axis was divided into (6) categories: (numerical, computer, advanced, parametric, numerical, and theoretical). Numerical modeling included (6) studies, and computer modeling received (9) studies. This axis has the highest percentage of studies, which indicates a scientific interest at the Arab and foreign levels in the use of modeling in engineering and various sectors.

### Second axis: the field of natural and applied sciences

The extrapolation in Table 4 shows the variety of areas in which modeling is applied in the educational process. The studies amount to (72) studies in which modeling has been applied in areas of natural and applied sciences, which represents (22.6%) of the total number of current research examples and includes (5) areas: (biology, mathematics, physics, mathematics, and chemistry).

As for the location of the studies, a total of (32) studies were conducted in Arab countries, which represents (44.4%) of the total number of studies (72) in this axis. In comparison, the number of foreign studies amounted to (40), representing (55.6%).

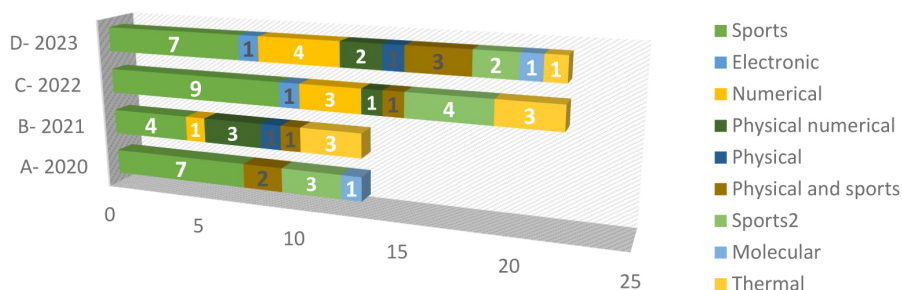
Figure 3 shows that the share of research with modeling in the natural and applied sciences reached (8.5%) in the year (2023). And in the year (2022) it was in second place with a growth rate of (8.2%). While the rate of the year (2021) is (5.9%) in terms of the total number of studies on this topic, the year (2020) is in last place with (5.6%). This shows us that modeling is increasingly used by researchers and interested parties in this field. There are (11) types of modeling for this axis: (mathematics, electronics, numerics, physical numerics, physics, and mathematics). “mathematical modeling” accounts for the largest

share of applications in scientific research. (27) Studies have been observed that are split between the natural sciences and the applied sciences (biology, mathematics, and chemistry). This suggests that researchers are more interested in it than in other fields (i.e., natural and applied sciences).

Table 4

*Data from the studies in the second axis for the field of natural and applied sciences*

No	Dept. natural & applied sciences	Types of modeling	Methodolog y	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- Electro- nic	Experimen- tation	–	–	1	1	1	1.4	1	1.4	2
8	Physics	3- Nume- rical	Experimenta tion	–	1	3	4	3	4.2	5	9.6	7
		4- Physical numerical	Experimenta tion	–	3	1	2	4	5.6	2	2.8	6
		5- Physical	Experimenta tion	2	1	–	1	2	2.8	2	2.8	5
9	Mathematic s	6- Physical and sports	Experimenta tion	3	1	1	3	4	5.6	4	5.6	11
		7- Sports	descriptive	2	1	4	3	2	2.8	8	11.1	12
		8- Mathe- matic	descriptive	1	–	4	2	7	9.7	–	–	14
10	Chemistry	9- Mole- cular	Analyze	–	2	–	1	2	2.8	1	1.4	5
		10- Thermal	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 percentage		72	22,6%	5,6%	5,9%	2.8%	8,5%	32	44,4%	40	55,6%	100%



**Fig. 3.** Research path in the field of natural and applied sciences (2020–2023)

### Third axis: field of humanities and social sciences

From Table 5, we can see that the humanities and social sciences field is characterized by a greater degree of modeling in the educational process. There are (96) studies, corresponding to (36.9%) of the total research sample. The axes include (8) major areas: (agriculture, economics, commerce, geography, sociology, psychology, sports and religion). A total of (37) studies were conducted in Arab countries, representing (44.4%) of the total number of

studies in this axis, compared to foreign studies, which amounted to (96) studies in different fields. This corresponds to (59) studies, which is a ratio of (61.5%). Komissarov's findings highlight the effective role of modeling processes in the humanities compared to foreign studies [33].

Table 5

*Data on third axis studies in the humanities and social sciences*

No	Dept. 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
		14- Constructivism	Analyze	–	1	2	3	2	2.1	4	4.2	6
16	Psychology	15- Constructivism	Analyze	1	1	1	3	1	1	2	2.1	3
		16- Psychology	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	Religion	19- Sectarianism	Semi-experimental	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%

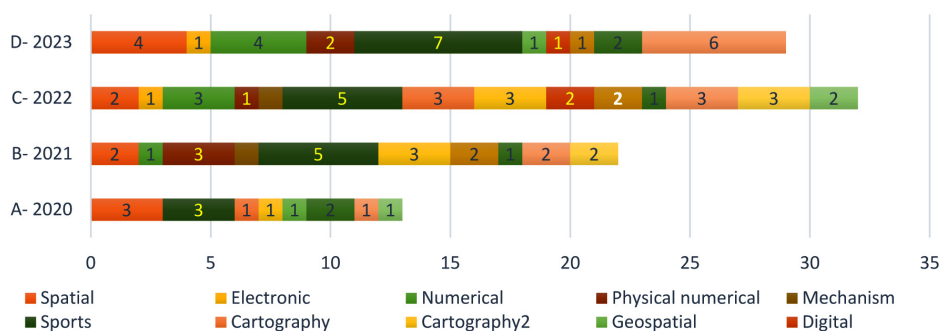


Fig. 4. Research path in the humanities and social sciences (2020–2023)

Figure 4 shows that the percentage of studies that used modeling in this axis has gradually increased, as the percentage of studies in the year (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) with (10.4%).

As for the types of modeling, they have also distinguished in this axis in (19) types, 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 sciences, as (21) studies on mathematical modeling and (12) studies on structural modeling were observed in the fields (geography and sports), and this shows the importance of mathematical and structural modeling in these two areas.

#### Fourth axis: 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. The 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, and Educational Technology). With the exception of the Department of Educational Research and Studies, which uses analytical methods, all studies on this topic follow experimental research methods.

Table 6

*Data from studies of the fourth axis for the area of education*

N	Dept. Education	Types of modeling	Methodology	Publication year				Arabic Country		Foreign Country		Total
				2020	2021	2022	2023	F	%	F	%	
19	Secondary Education,	1- Structural	Analyze	1	2	1	–	2	1.6	4	3.3	6
20	Research and Studies Department	2- Constructivism	Analyze	–	1	–	2	1	0.8	2	1.6	3
21	Kindergarten	3- Educational	Experimentation	–	2	1	–	1	0.8	2	1.6	3
22	Chemistry	4- Experimental	Experimentation	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

End of Table 6

N	Dept. Education	Types of modeling	Methodology	Publication year				Arabic Country		Foreign Country		Total
				2020	2021	2022	2023	F	%	F	%	
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%

The studies conducted in the Arab countries amount to (47) studies, i.e. (38.2%) of the total number of studies counted in this axis, which amount to (123) studies in different fields, compared to foreign studies, which amount to (76) studies, i.e. (61.8%). This shows this field's superiority in applying modeling through pedagogical research and studies. Denisenko's study confirms this effective role of modeling [34].

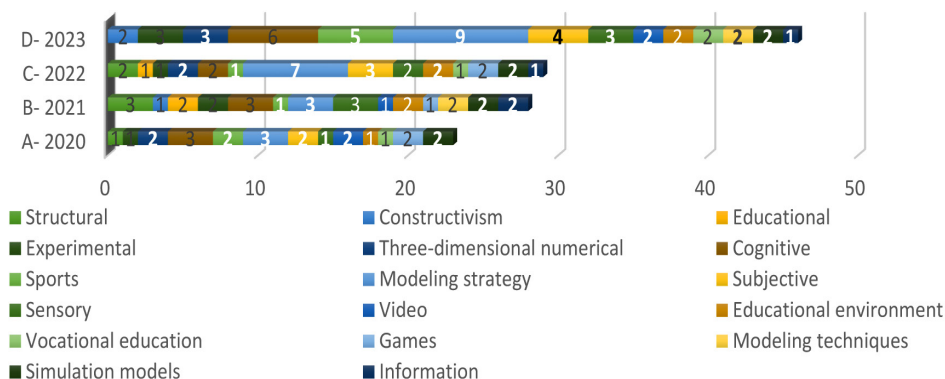


Fig. 5. Research Path in the field of Education Sciences (2020–2023)

Figure 5 shows the research path using modeling in education, which has grown exponentially as the percentage of research reached in 2020 (6.6%). This is followed by the year (2021) with a growth rate of (8.2%). Then the growth rate in the year (2022) is (9.4%). In the last year (2023), the growth rate is (14.4%). The modeling types in this axis are divided into (21) categories, namely: (structural, constructive, education, experimental, three-dimensional numerical, cognitive, mathematical, modeling strategy, subjective, sensory, video, educational environment, professional training, games, and modeling techniques, simulation modeling and information). The “Modeling strategies” accounted for the largest proportion of studies applied in education (22 studies), followed by “cognitive modeling” (15 studies).

### Research result

#### First: Topics and areas of modeling as a research method:

Table 7 shows the superiority of the education field over other fields in terms of research and the use of modeling in research, as the number of studies in this field reaches (123), which corresponds to (38.6%). This is a clear sign of the increasing use of modeling and a metric that should be considered when promoting the use of modeling in education in the future. The humanities and social sciences follow, with a slight difference. The number of studies is (96), and the corresponding proportion is (30.1%), followed by the natural and applied sciences. The number of studies in the natural and applied sciences is (72), while engineering is in last place with (28) study programs and a share of (8.8%). See Figure 6.

Table 7

*The total number of topics and areas related to modeling in the studies*

N	Axis	Fields	Topics of modeling	Arab level	Foreign level	Total of Studies	
						F	%
1	Engineering Sciences	5	7	9	19	28	8.8
2	Natural and Applied Sciences	5	11	32	40	72	22.6
3	Humanities and Social Sciences	8	19	37	59	96	30.1
4	Education	10	21	47	76	123	38.6

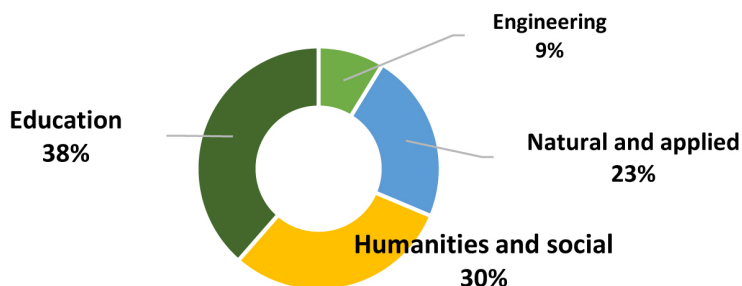


Fig. 6. The proportions of studies for fields of study

## Second: Methods used in research that apply modeling methods:

From the extrapolation of Table 8, we can see the diversity of the methodology of the studies that have addressed the topic of modeling in (4) types of research, namely: (experimental, quasi-experimental, analytical, and descriptive), and since most of the studies that have used modeling as a research method are studies in the field of education, compared to studies in 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 were close to each other (14.1–14.7), as indicators of an increasing interest of researchers in the field of education in the use of modeling.

Table 8

Distribution of studies by research methodology

Years	Methodology								Total
	Experimental		Quasi-experimental		Analytical		Descriptive		
	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
Total	125	39.2%	47	14.7%	102	32%	45	14.1%	319

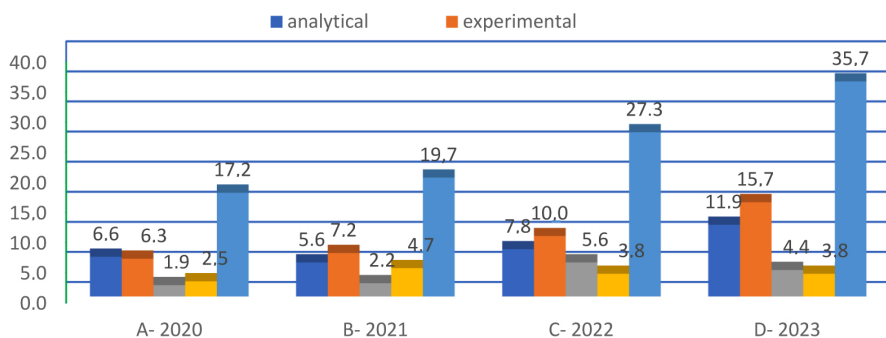


Fig. 7. Percentage distribution of studies by research methodology

As seen in Figure 7, the studies are distributed chronologically by the methods used to create the studies and by the studies that used modeling in their procedures. We also noted a change in the density of research on modeling topics over the last four years as the number of published research papers gradually increased so that in 2020, there were (55) studies that accounted 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. In 2022, the number of studies increased significantly compared to the previous year, with a number of (87) or a share of (27.3%). Finally, in 2023, the number of studies increased significantly (114), which corresponds to a share of (35.7%) of the total number of studies. This

shows that researchers are increasingly interested in using modeling as a research method in these areas. This significant increase sheds light on the research methods and the possibilities of using modeling in practice, especially in education. The current study results show that Arab and foreign researchers are increasingly interested in using modeling to solve specific problems in education and other disciplines. 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 current study's results help identify pathways for modeling's application in the broader scientific and educational fields. The results provide an overview of 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.

### Recommendations for further research

- Conduct further research and studies to observe modern trends in the use of modeling in educational processes.
- Apply the modeling process to a broader scope and time period to identify differences in the use of models in the past and present.
- Researchers and individuals interested in the topic of modeling can benefit from the results of the current study and apply modeling to other areas.
- The study is not limited to the researcher's experience and addresses the latest research findings and trends in the field of modeling applications for future study and research.

### References

1. Bobkov S.P. Approaches to modeling queuing systems. *News of Higher Educational Institutions. Series: Economics, Finance and Production Management*. 2021;3(49):130-134. URL: [http://main.isuct.ru/files/publ/PUBL\\_ALL/ivt/ivt2\\_18092008.pdf](http://main.isuct.ru/files/publ/PUBL_ALL/ivt/ivt2_18092008.pdf)
2. Soboleva E.V., Zhumakulov K.K., Umurkulov K.P., Ibragimov G.I., Kochneva L.V., Timofeeva M.O. Developing a personalized learning model based on interactive novels to improve the quality of mathematics education. *Eurasia Journal of Mathematics, Science and Technology Education*. 2022;2(18):em2078. URL: <https://www.ejmste.com/download/a-11590.pdf>
3. Sansana J., Joswiak M.N., Castillo I., Wang Z., Rendall R., Chiang L.H., Reis M.S. Recent trends on hybrid modeling for Industry 4.0. *Computers & Chemical Engineering*. 2021;(151):15 p.
4. Hegazy Abdel Fattah. Recent trends in urban spatial modeling studies during the period (2012–2022). *Journal of the Egyptian Scientific Academy*. 2023. DOI: 10.21608/JFNILE.2023.193223.1039 (in Arabic).
5. Trunfio G.A. Recent Trends in Modelling and Simulation with Machine Learning. *2020 28th Euro micro – International Conference on Parallel, Distributed and Network-Based Processing (PDP)*. March 2020:352-359. URL: <https://app.dimensions.ai/details/publication/pub.1127639154>
6. Tkacheva E.V. *Zadachi analiza i modelirovaniya tendentsiy vremennykh ryadov* [Tasks of analysis and modeling of time series trends]. Belgorod: Belgorod State National Research University Publ., 2017:1-75. (in Russian). URL: <https://core.ac.uk/download/pdf/326324283.pdf>

7. Kravets A.G., Salnikova N.A. Predictive modeling of technological development trends. *Proceedings of the St. Petersburg State Technological Institute (Technical University)*. 2020;(55):103-108. (in Russian). URL: <https://cyberleninka.ru/article/n/predskazatelnoe-modelirovanie>
8. Diakonov V. *VisSim+ Mathcad+ MATLAB. Vizual'noe matematicheskoye modelirovanie* [VisSim+ Mathcad+ MATLAB. Visual mathematical modeling]. Litres, 2010:385 p. (in Russian). URL: <https://mmf.bsu.by/ru/obrazovatelnye-resursy-magistratury/matematika/kompyuternoe-modelirovanie>
9. Muhammad Yusir Qasim Allah, Sayid Hamad Omar Muhammad. The most important trends and challenges of building information modeling to improve energy efficiency in building designs and the reality of local practice in the Kingdom of Saudi Arabia – the city of Riyadh as an example. *Journal of Architecture and Planning*. 2023;1(35) (in Arabic).
10. Al-Ajami Dhaidan Fahd Nahar, Bassiouni Abu Al-Nour Mahmoud. The components of parental education as perceived by children in light of modern trends. *Journal of Environmental Studies and Researches*. 2020;3(10):461-470 (in Arabic).
11. Al-Said Mahmoud Al-Said Iraqi. A proposed strategy for developing the practical education program at the Faculty of Education, Taif University, in light of some contemporary global trends. *Journal of Specific Education Research*. 2011;(22):183-235 (in Arabic).
12. Petukhov A.Yu. *Modelirovaniye sotsial'nykh i politicheskikh protsessov* [Modeling of social and political processes]. Nizhniy Novgorod: Nizhny Novgorod State University Publ., 2015. (in Russian). URL: <https://e.lanbook.com/book/153139>
13. Ibn Manzu Muhammad bin Makram. Lisan Al-Arab. *Hawza Literature*. 1985;15:1-508. URL: <https://www.noor-book.com/ciyh6j> (in Arabic).
14. Strijbos J.-W., Martens R.L., Jochems W.M.G., Broers N.J. The effect of functional roles on group efficiency: Using multilevel modeling and content analysis to investigate computer-supported collaboration in small groups. *Small Group Research*. 2004;2(35): 195-229.
15. Kalinovskaya T.G., Kosolapova S.A., Proshkin A.V. Research work of students as a factor in the development of creative activity. *International Journal of Applied and Fundamental Research*. 2010;(1):75-78. (in Russian). URL: <https://s.applied-research.ru/pdf/2010/01.pdf>
16. Zverev P.A. Modeling of the process of formation of motivation of creative activity of adolescents in the system of additional education. *Bulletin of Tomsk State University*, 2015;(395):211-216.
17. Dung T.M., & Minh P.K. Kolb's Experiential Learning Model: Teaching the Side-Side-Side Similarity Case of two Triangles. 2020. <https://www.scribd.com/document/434964987/EARCOME8ProceedingsVolume2-pdf>
18. Fotiadis D., Jastrzebska B., Philippsen A., Müller D.J., Palczewski K., Engel A. Structure of the rhodopsin dimer: a working model for G-protein-coupled receptors. *Current Opinion in Structural Biology*. 2006;16(2):252-259. URL: <https://www.academia.edu/download/44519736.pdf>
19. Waldron J. Conceptual frameworks, theoretical models and the role of YouTube: Investigating informal music learning and teaching in online music community. *Journal of Music, Technology & Education*. 2012;4(2-3):189-200. URL: [https://scholar.google.com/citations?view\\_op=view\\_citation&hl](https://scholar.google.com/citations?view_op=view_citation&hl)
20. Grabaurov V. *Menedzhment na transporte* [Transport management]. Litres, 2021:289 p. (in Russian).

21. Arsyad N., Rahman A., Ahmar A.S. Developing a self-learning model based on open-ended questions to increase the students' creativity in calculus. *Universitas Negeri Makassar, Global Journal of Engineering Education*. 2017;9(2):143-147. URL: <http://eprints.unm.ac.id/2691/1/08-Nurdin-A.pdf>
22. Almond R.G. *Graphical belief modeling*. London; New York: Chapman & Hall, 1995.
23. Zaharlick A. Ethnography in anthropology and its value for education. *Theory into Practice*. 1992;31(2):116-125.
24. Taan G.H. Modelirovaniye elektronnykh kursov obucheniya informatike v sisteme distantsionnogo obrazovaniya v Irake [Modeling of electronic computer science courses in the distance education system in Iraq]. *Izvestiya Saratovskogo Universiteta. Novaya seriya. Filosofiya. Psikhologiya. Pedagogica – News of Saratov University. New series. Philosophy series. Psychology. Pedagogy*. 2019;19(3):334-338 (in Russian). URL: [https://phpp.sgu.ru/sites/phpp.sgu.ru/files/2019/09/filosofiya\\_2019\\_3\\_334-338.pdf](https://phpp.sgu.ru/sites/phpp.sgu.ru/files/2019/09/filosofiya_2019_3_334-338.pdf)
25. Zhrebkina V.F., Lapshina L.M. *Pedagogicheskaya psikhologiya* [Pedagogical psychology]. Chelyabinsk: ChSPU Publ., 2014:315 p. (in Russian).
26. Lodatko E.A. Tipologiya pedagogicheskikh modeley [Typology of pedagogical models]. *Vector of Science of Togliatti State University. Series: Pedagogy, Psychology*. 2023;(1):126-128. URL: <https://www.vektornaukipedagogika.ru/jour/article/download/760/672> (in Russian).
27. Solodova E. A., Antonov Yu. P. Matematicheskoye modelirovaniye pedagogicheskikh system. *Matematika. Komp'yuter. Obrazovaniye: sbornik trudov XII Mezhdunarodnoy konferentsii* [Mathematical modeling of pedagogical systems. Mathematics. Computer. Education. Proceedings of the XXII International Conference]. Izhevsk, 2005;1:113-121 (in Russian).
28. Soorapanth S., Eldabi T., Young T. Towards a framework for evaluating the costs and benefits of simulation modelling in healthcare. *Journal of the Operational Research Society*. 2023;74(3):637-646.
29. Mahmoud Zainhum Muhammad. The effect of parametric modeling on the design of glass tiles for architecture. *Journal of Architecture, Arts and Humanities*. 2020;5(19): 235-254.
30. Zarubin V.S. *Matematicheskoe modelirovanie v tekhnike* [Mathematical modeling in technology]. Moscow: MSTU Publ., 2003:496 p. (in Russian).
31. Fan Y., Chen J., Shirkey G., John R., Wu S.R., Park H., Shao C. Applications of structural equation modeling (SEM) in ecological studies: an updated review. *Ecological Processes*. 2016;5(1):19 pp. DOI: 10.1186/s13717-016-0063-3
32. Bebikhov Yu.V. Semenov A.S., Semyonova M.N., Yakushev I.A. Analiz metodov modelirovaniya tekhnicheskikh sistem v srede MATLAB [Analysis of methods for modeling technical systems in the MATLAB environment]. *Modelirovaniye, optimizatsiya i informatsionnyye tekhnologii – Modeling, optimization and information technology*. 2019;7(3):1-24 (in Russian).
33. Komissarov I.I. Modeling in social and humanitarian cognition: ideal-typical constructions of Max Weber. *Manuscript*. 2018;6(92):84-88 (in Russian).
34. Denisenko M.A. Computer modeling in the educational process. *Computer Science: Problems, Methods, Technologies*. 2023:1267-1271.

**Information about author:**

**Ghazi Hussein Taan Albayati**, Doctor of Sciences, Candidate of Pedagogical Sciences, Presidency of Sunni Endowment, lecturer in Religious Teaching and Islamic Studies Directorate, Baghdad, Iraq, 10011.  
E-mail: dr.ghazi@taleemdeny.edu.iq

## АНАЛИЗ ТЕНДЕНЦИЙ ПРИМЕНЕНИЯ МОДЕЛИРОВАНИЯ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ НА ПЕРИОД 2020–2023 гг.

*Гhazi Хусейн Таан Албаяти*

*Главное Суннитского дарование, Управления религиозного преподавания  
и исламских исследований, Багдад, Ирак, dr.ghazi@taleemdeny.edu.iq*

**Аннотация.** Идеи данного исследования обобщены в процедуре справочного обзора тенденций применения процессов моделирования в арабском и зарубежном образовании за этот период (2020–2023 гг.). Исследование придерживалось описательного подхода и представило концепции моделирования и области исследований, рассматриваемые на разных языках, а также определило наиболее важные модели, используемые в образовательном процессе, на основе следующих глобальных баз данных: (Google Scholar), elibrary.ru, Scopus... и т.д.). Исследование включает в себя (319) арабских и зарубежных исследований, включающих ограничения и числовые, качественные и методологические классификации за период с 2020 по 2023 год. Исследование раскрывает важнейшие тенденции использования моделирования как метода исследования. В исследовании также представлен набор моделей, используемых в образовательном процессе. Есть надежда, что анализ тенденций поможет определить области и сектора, которые используют моделирование для решения образовательных и научных проблем. Исследование показывает ряд результатов, оценивающих это исследование, которые могут помочь исследователям в этой области принять процесс моделирования в качестве метода исследования.

**Ключевые слова:** *Моделирование, Методы моделирования, Процедура моделирования, образовательный процесс*

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### **Информация об авторе:**

**Гhazi Хусейн Таан Албаяти**, Доктор наук, кандидат педагогических наук, Главное Суннитского дарование, преподаватель в управления религиозного преподавания и исламских исследований, Багдад, Ирак, 10011.  
E-mail: dr.ghazi@taleemdeny.edu.iq

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