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The Impact of a Proposed Science Informal Curriculum on Students' Achievement and Attitudes During the Covid-19

Abstract

This study aimed to identify the impact of a proposed science curriculum based on informal learning on the academic achievement of ninth-grade students and their attitudes towards science majors in Al-Qunfuthah Governorate during the COVID-19 pandemic, and thus answer the following questions: What activities represent informal education in science that can be included in the science curriculum? Is there a statistically significant difference in the attitudes towards scientific disciplines for ninth-grade students due to the proposed curriculum based on informal education? Is there a statistically significant difference in the educational attainment of ninth-grade students due to the proposed curriculum based on non-formal education? The researcher used the experimental method, where the study sample was randomly selected and numbered (29) students in the control group, and (29) students in the experimental group. The researcher designed the science curriculum to include activities based on informal education in science, and it was taught to students in the experimental group, while the control group will study the formal curriculum of science for the third intermediate grade. The researcher also prepared a measure of attitudes towards the sciences major, and a test to measure the students' academic achievement.

Keywords: Science Curriculum, Informal Education in Science, Academic Achievement, Attitudes Toward Science Major.

Introduction

As a result of the development of the educational process, the educational literature presents a proposal to classify the educational system, and it includes formal education, non-formal education, and informal education, and many studies have shown (Patrick, 2010). (Stocklmayer, Rennie, & Gilbert, 2010). The effectiveness of informal education activities in achieving the goals of science, spreading scientific culture, developing trends towards science and studying it in light of the globalization we are witnessing, although the definitions and differences are not completely clear between these classifications; These concepts can be highlighted as follows: Formal education: It is an organized educational system, governed by a set of rules, the curriculum is precisely defined, the objectives of all kinds are clear and well-formulated, the educational content, the educational environment, teaching methods, activities and means are clear. It is supervised by an official institution such as a school or university, in which students interact with teachers in the educational environment to achieve the desired goals, and requires students to attend a minimum level of classroom attendance, and an accuracy process is conducted to achieve the desired goals, as well as a comprehensive evaluation process for all elements of this educational system. In the absence of one or more of the elements of this education, we move towards non-formal education. As for non-formal education: The educational literature indicates that there is not yet a comprehensive and unified definition of non-formal education, and such a

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definition may not appear until after further studies and experiments. The educational literature can refer to it as alternative education systems, or open systems such as open universities, distance learning, or non-conventional studies. Here, we note that sometimes these terms are used as synonyms, and other times they do not find agreement on their meanings (Stocklmayer, Rennie, & Gilbert, 2010).

In this education, although it is supervised by an educational institution, it can happen without strict follow-up by the educational institution, and it is with the will and the wish of the individual, and it can be implicit in some official programs, where learning takes place that has nothing to do with the program or planned and programmed goals. It differs from formal education, in the great flexibility available in its components, which focuses on the student, his interests and needs. We can move from formal education to non-formal. In the absence of one or more of the elements of this formal education. For example, if we lose the element of contiguous communication (directly face to face) between the teacher and the student, we are moving towards non-formal education, as well as if the communication between the teacher and student is reduced, or if activities are carried out outside the educational institution, or if the curriculum is very flexible and able to adapt to the needs of students and their interests, in which time or grades are not a determining factor, but rather the student's achievement of the educational task is the determining factor in his progress. If the focus is on the student in learning, and if flexible goals and procedures are formulated for the student to choose what suits him, then we will move towards non-formal education. As for informal education: it is far from formal education, and closer to non-formal education. The Organization for Economic Co-operation and Development (OECD) defined it as that learning that occurs through daily activities in and outside the institution, and it occurs in an unstructured, unorganized or without pre-objective manner and is not tied to a specific time (Patrick, 2010, Alakrash & Razak, 2020).

In this type of education, there is no formal educational institution that supervises it. Also, this education does not include the necessary educational elements in informal education, such as objectives and traditional curriculum. This education targets students and the public in general, their needs, and interests, and does not impose any obligations or control over their activities. This education is not concerned with awarding degrees or certificates. Examples of this education include: visiting museums or science fairs, reading books or magazines related to science and technology, watching scientific television programs, participating in clubs and scientific competitions, or attending scientific lectures and conferences. Among the institutions and programs that support this learning: science museums, environmental centres, natural history museums, interactive science fairs, zoos and aquariums, media that support science, the Internet and its scientific contents, communication programs, programs and electronic games, scientific festivals, scientific centres and clubs, and civil society organizations. volunteering, organizers of scientific trips and expeditions, observation centres and planetariums, virtual scientific laboratories, and others. There are also some opinions that do not differentiate between informal learning and some other types, such as experiential learning, incidental learning, learning from life, tacit learning, learning during Work (Work Place Learning), as some educators consider it synonymous with informal learning, and it is - from their point of view - every education outside the scope of formality, follow-up and monitoring (Hager, 2012).

There is also a consensus in the science teaching literature that attitudes towards science and the acquisition of scientific knowledge are among the most important goals of science education (Zaytoun, 2014). Perhaps the provision of science with informal educational activities in integrated curriculum linking formal and informal teaching affects students' attitudes and pushes them towards the study of these scientific disciplines in the secondary stages; This will affect the students' choice of scientific majors that are consistent with their scientific trends, which will contribute to their excellence in their university studies and the achievement of the desired goals.

And due to the Covid-19 pandemic, the Ministry of Education in the Kingdom of Saudi Arabia announced the suspension of studies in all schools and universities on March 9, 2020, and the approval of distance education. These platforms have been approved for teaching in schools: https://vschool.sa and https://ien.edu.sa (Ministry of Education, 2020). This study comes to present a practical proposal that links and integrates formal and informal science activities and the applications of science in life during the COVID-19 pandemic. It supports the trend towards linking science with society, the environment, technology and life; This proposal may contribute to supporting guidance towards the integration of science activities inside and outside the school, thus it may contribute to the dissemination of scientific culture among students, increase their acquisition of scientific knowledge, and may give them positive tendencies and attitudes towards science and improve their educational attainment, which makes them have the passion and desire to study. Scientific disciplines. Hence, this study came to reveal the impact of a proposed science curriculum based on informal learning on the academic achievement of ninth-grade students and their attitudes towards scientific disciplines.

Literature Review

Previous studies were divided into two parts: studies related to the topic of informal learning activities and are available globally due to the importance of this topic; However, Saudi studies in this aspect were few, and the second section: studies related to teaching science during the Covid-19 pandemic, and they were few. In fact, Saudi studies on the use of e-learning during epidemics in general and in the sciences, in particular, are scarce. This means many challenges, but at the same time highlights the importance of studying science education through e-learning during epidemics. Examples of these studies include:

AL Najjar (2021), which aimed to identify the most important obstacles that affect the teaching of science in Saudi universities and the proposed solutions during COVID-19. The results showed that the order of obstacles from the students' point of view was, respectively: university obstacles, students' obstacles, and the curriculum obstacles, and in the last place were the obstacles of the faculty members. We can say that there is no relationship between the cumulative average and the obstacles to e-learning and that both male and female students were homogeneous and agreed that there were obstacles of almost the same degree. There is also a direct relationship between the levels of study and some learning obstacles. It also suggested some solutions to these obstacles.

A study (Almaiah, Al-Khasawneh, & Althunibat, 2020) aimed to identify the challenges facing e-learning systems and the factors that support the use of the e-learning system in six universities from Saudi Arabia and Jordan and used the interview method with (30) students and (31) Experts in e-learning systems. The results presented some suggestions for the development of e-learning. Zaharah, Kirilova, & Windarty, (2020) aimed to study e-learning during COVID-19 in Indonesia, by looking at the results of literature studies, journals, and documents of print and electronic media. He showed government steps on how to use e-learning. A study (Layali, & Al-Shlowiy, 2020), which focused on students' perceptions of e-learning of English as a second language, through the study and analysis of eight studies on Google Scholar and ERIC. It showed some pros and some cons to e-learning. Similar studies: Al-Zahrani and Al-Thaqafi (Alzahrani & Althaqafi, 2020, Abu-Ayfah, 2020).

A study (Hamdi, 2016), which is a theoretical study, aimed at highlighting the role and importance of informal learning - which takes place without planning, structuring or follow-up by the administration - on enhancing individuals' employability through its contribution to the development of their competencies in its various components (knowledge, Skill, values, motives, traits, self-concept). Where the study found its role in targeting the components of competence, especially motives and values. If these latter two are strengthened, they will positively affect the rest of the other components such as knowledge, skill and some types traits; The study also concluded that the institution, represented by its senior management and human resources management, has the responsibility to provide the appropriate climate and atmosphere for the learning process to occur, and to support it by framing and providing various mechanisms and equipment to enhance that learning.

A study (Dawson, 2014), where this theoretical study aimed to investigate the extent to which justice and equity are achieved for informal education activities compared to formal education. Where thousands visit scientific centres, zoos and science festivals. The study presented many experiments and research that concerned the activities of informal education. This study showed that most researchers agreed that informal education activities had a positive impact on science subjects, so it is possible to benefit from these activities in formal education, where more justice will be achieved in science learning for all.

A study (Kim & Dopico, 2016) investigated the effectiveness of some informal activities on students' learning of science. The study took the activity of school visits to science museums in some middle schools in America, and tried to integrate these visits with formal education, and showed These activities are effective in improving students' science learning and have shown the effectiveness of these activities in helping students to think, communicate, and solve problems. It recommended that informal education and life-learning activities should be used in formal education.

Norqvist & Leffler (2017) and this study aimed to reveal the extent to which the sample members understand formal and informal learning. This study was in the form of a case study, in which a group of young people underwent a learning program offered by the European Union. Individual interviews and focus groups were used as tools for collecting data from sample members. The study showed that there are multiple and different interpretations of learning and the activities that achieve it. It also showed the benefit of informal education activities such as visiting museums, exhibitions and festivals, and also showed that it is difficult to divide learning into formal and informal, so these activities should be combined in a flexible way, bridge the gap between formal and informal learning activities, and facilitate the process of movement between them, like this in the interest of the learners. Study ((Watermeyer, 2013). This study aimed to identify the effectiveness of science teacher preparation programs in changing their philosophies towards learning and teaching to provide fair opportunities for all students in learning science. This study was in the form of a case study and was conducted in America. The education of science teachers has had no effect on teachers' philosophies towards learning and teaching. It also showed that involving science teachers in informal, community-serving education activities modifies their views of science education and encourages problem-based science teaching. A study (Stocklmayer & others, 2010), a theoretical study, aimed at clarifying the roles of formal and informal institutions in providing effectiveness in science education. The study presented many articles and research related to formal and informal science education. In the first section, the study presented the current state of science education in Australia and in the world in general, and the criticisms directed at formal education in achieving the goals of science education as it should be. In the second section of the study, informal institutions that provide science learning are described. And reached to clarify the differences between these systems of education. The study also called for the necessity of integration between formal and informal institutions to achieve more effective science education, and this achieves justice and opportunities for all students to possess a scientific culture and sound scientific learning. She also demanded that formal school science education respond to the changing social context due to a large number of students, the lack of resources, and the high costs of education and that it responds to many studies and research that call for bridging the gap between formal and informal education and building science curriculum in a flexible way that enables young people to participate positively in Science issues. It is noted from the previous studies that: Some studies tried to suggest activities related to informal education, such as visiting museums and science fairs, and others. Some of these studies were conducted during the COVID-19 pandemic, and they tried to identify some of the e-learning problems and propose solutions to them. Most of these studies used the descriptive, analytical, or theoretical approach. Most of the previous studies agreed on the importance of integrating formal and informal learning activities and working to bridge the gap between them. Which will lead to improvement and development in science learning. These studies recommended the necessity of showing the integration between formal and informal learning in science curriculum and teaching methods. Since there are few Saudi studies in this field, this study came as a continuation of previous studies in which educational literature demanded the necessity of integrating formal and informal science education activities and activating this during the Covid-19 pandemic. Accordingly, the current study comes to investigate the impact of a proposed science curriculum based on informal learning on the academic achievement of ninth students and their attitudes towards scientific disciplines.

Years ago, the Kingdom of Saudi Arabia began a comprehensive process of developing the teaching/learning process. The Ministry of Education modified and developed school curriculum, including science curriculum, and these curricula were approved and taught at the beginning of the academic year 1432 AH. It is known that at the end of the intermediate stage (the ninth), the student begins a more specialized study in the secondary stage, where he chooses what suits his abilities and inclinations, such as scientific or literary specialization and others. To complete his studies at the university in a specialization consistent with his studies at the secondary level. There is also a consensus in the science teaching literature that attitudes towards science and the acquisition of scientific knowledge are among the most important goals of science education. Did the new and developed science curriculum with all its components achieve this goal? Did the results of our students in science and in international tests show an advanced level? How consistent are our students' specializations with their abilities and trends? Do we have clear strategies to guide our students towards studying scientific disciplines? And before that, did we do activities in support of the official curriculum that increases their positive attitudes towards science? And increase their possession of scientific culture? Can we raise our students' possession of scientific knowledge and gain their positive attitudes towards science and study scientific disciplines at the university? To achieve the excellence we aspire to, through activities based on informal science education. Hence, this study came to know the impact of a proposed science curriculum based on informal learning on the academic achievement of ninth graders and their attitudes towards scientific disciplines.

Research Questions

The current study aims to investigate the impact of a proposed science curriculum based on informal learning on the academic achievement of ninth-grade students and their attitudes towards scientific disciplines and their application during the COVID-19 pandemic.

Specifically, the current study attempts to answer the following questions:

1) What is the impact of a proposed science curriculum based on informal learning on attitudes towards science majors for ninth-grade students during the COVID-19 pandemic? The question can be rephrased as follows: Is there a statistically significant difference in the trends towards scientific disciplines for ninth-grade students due to the proposed curriculum based on informal learning?
2) What is the impact of a proposed science curriculum based on informal learning on ninth-grade academic achievement during the COVID-19 pandemic? The question can be reformulated as follows: Is there a statistically significant difference in the educational attainment of ninth-grade students due to the proposed curriculum based on informal learning?

Study Hypotheses

In light of the previous study questions, the researcher tries to test the following null hypotheses:

1. There are no statistically significant differences at the level of significance (0.05) between the arithmetic averages of the results of the sample members on the achievement test of the science curriculum for the control and experimental groups.
2. There are no statistically significant differences at the level of significance (0.05) between the arithmetic averages of the responses of the sample members on the scale of attitude towards science for the control and experimental groups.

Methodology

The researcher will use the experimental method, which includes an experimental group and a control group with a pre and post-test to examine the impact of the proposed curriculum on the sample's attitudes towards science and their educational attainment.

Participants and Sampling

The study population consisted of ninth-grade students in the schools of Al-Qunfuthah Governorate in the Makkah Al-Mukarramah region in Saudi Arabia in the academic year 1440/1441 AH. The ninth graders were selected; Because of the importance of the middle stage in the formation of personality and trends, and because they are the most mature in the middle stage, and because after this stage the student must choose his specialization in the secondary stage and after that in the university as a scientific or literary specialization or others. The second semester was chosen because it is closer than the first semester of the secondary stage, and the impact of the proposed activities based on informal education may have a greater impact on students' attitudes to choose scientific disciplines at the secondary level and then university, meaning that the impact of variables may be more clear in this chapter. This class was taught remotely during the Corona pandemic - after its development, modification and addition of activities that are consistent with informal science education and can be applied remotely - to the sample members in the experimental group. The study sample was randomly selected from among the study population. In the experimental research, it is taken into account that the number of the sample members is more than 15 individuals for each group (Odeh, & Malkawi, 2002), and therefore the sample members were selected (58) students, divided into two divisions, namely: 1 - the experimental group numbering (29) students, It was taught according to the curriculum based on informal education. 2 - The control group, numbering (29) students, was taught according to the official curriculum.

Research Instruments

To achieve the objectives of the study, the researcher prepared the following tools:

Achievement test: To construct the achievement test, the researcher followed the following steps:

Determining the objective of the test: The test aims to measure what the sample members have achieved of the desired objectives of the curriculum in the cognitive domain according to Bloom's levels (remembering, understanding, application, analysis, synthesis, and evaluation). Preparing the specification table: The researcher built the specification table in light of the desired cognitive goals, and according to the relative weight of the importance of the topics. Test questions formulation: Multiple choice questions were used; This is because it is characterized by objectivity, comprehensiveness, honesty, consistency, and ease of correction. Test construction: The questions were built-in in light of the specification table, and according to Bloom's levels. Test instructions: Test instructions are written at the beginning of the questions, such as information about the student, and instructions on how to answer the questions. Calculating the time required for the test: The appropriate time for the test was calculated by calculating the average time of the first five students who completed the answer, and the last five students who completed the answer. Scoring and Marking Method: One mark is assigned to each of the test questions. A test debug key has also been set up to facilitate the debugging process. Verify the psychometric properties of the scale as follows:

The researcher has designed the achievement test of science for the grade (9), he applied it on a pilot sample of students of grade 9 with sample (30) (this sample was excluded from the main sample of the study), in order to achieve the psychometrical properties of it before applying it in its final edition on the main sample.

The Difficulty Coefficients

The difficulty coefficient explained how much the question is easy to be solved (or how much it is difficult), it equals the percentage of students (in the pilot sample) who answered it correctly, it is Calculated for each question separately, regarding the following formula: difficulty = (x/n) *100.

such that: x is the number of correct answers; n is the total number of all students in the sample. The whole indicator of the test is calculated by finding the average of all difficulty coefficients of all questions. The following table shows the difficulty coefficients of questions of the test.

Table 1.

The Difficulty Coefficients of the Science Test

Question	**Number of correct answers (x)**	**Difficulty coefficients**
1	17	56.67
2	14	46.67
3	14	46.67
4	16	53.33
5	17	56.67
6	15	50.00
7	18	60.00
8	15	50.00
9	16	53.33
10	14	46.67
11	15	50.00
12	17	56.67
13	18	60.00
14	16	53.33
15	15	50.00

We see from the table that the values of difficulty coefficients ranged from (46.67) to (60.00), which means that these items are acceptable since the values ranged from (20) to (80) which is the appropriate range for difficulty coefficient, the average of all difficulty coefficients was (52.3) which is good. So regarding the first psychometrical property (Difficulty coefficient), all items of the test were acceptable.

The Discrimination Coefficients

The discriminant coefficient explains the efficiency of the question by recognizing the student who has a high ability and the student who has a low ability as the whole test score do. The discriminant coefficient was calculated by ordering the scores of all students in ascending order, then dividing the students into three groups regarding their scores on all questions (the test), then by Considering the highest group (30%) of the students and lowest group (30%) (in each group there are 10 students), then by subtracting the number of correct answers in the lowest group (y) from the correct answers in the lowest group (x) and dividing the result on the number of students in any group, then multiply the result by 100%, the good discriminant coefficient is greater than 20%, if it's value was negative is item must be deleted. as shown in the following table.

Table 2.

The Discriminant Coefficients of Items of the Test

Question	**x**	**y**	**Discriminant coefficient**
1	10	1	90%
2	8	0	80%
3	6	4	20%
4	10	0	100%
5	7	2	50%
6	7	4	30%
7	10	1	90%
8	9	0	90%
9	8	4	50%
10	8	0	80%
11	7	4	30%
12	10	0	100%
13	6	4	20%
14	8	4	50%
15	10	0	100%

We see from the table that all of the questions (items) of the test have a very good discriminant coefficient, since all of the values were greater than or equal to 20%, and no one has a negative value, also the range of values was from 20% to 100%m with a total average of all values (61.9) which indicates to good value that distinguishes between a student with High ability and students with low ability. Generally, we can say that the values of difficulty and discriminant Coefficients indicate that the achievement test has a good property and no need to modify any item of it.

The Reliability of the Test

Reliability is one of the important psychometrical properties that must available in the test, which means the consistency among the test items, it means that we will get approximated results if we apply the same instrument on semi sample of the study. The researcher computed the reliability of the achievement test by using the superman brown split-half (which is attached with the nature of the multiple-choice exam) as shone in the following table.

Table 3.

Split Half Method of Reliability of the Achievement Test

Reliability coefficient	Number of items	The value
Spearman Brown	15	0.850
Guttmann	15	0.850

We see from the table that the reliability coefficient values were greater than (0.70), which means that the achievement test was reliable, and we can get the same results after applying it on another semi sample of students.

The Validity of the Test

It means that how much the test is measuring what it was designed to measure. The researcher achieved the validity by the construct validity through Pearson correlation coefficient between the response on each item (question) and the total score (of all items of the test) of all students in the pilot sample, as shown in the following table.

Table 4.

Person Correlation Coefficients of the Construct Validity of the Achievement Test

Question	Person correlation coefficient (r)
1	.664**
2	.661**
3	.402*
4	.766**
5	.446*
6	.482**
7	.681**
8	.697**
9	.535**
10	.647**
11	.482**
12	.751**
13	.346*
14	.535**
15	.755**

**. Correlation is significant at the 0.01, *0.05 level (2-tailed).

We see from the table that all of the person correlation coefficients were significant at the level of significance (0.01) and (0.05), which means that the test validity was achieved, and it is measure what it was designed to measure it, which is the achievement of students.

The Effectiveness of the Alternatives

In the multiple-choice question (MC), the alternatives or the answers Are closed and there is one and only one correct choice, so there are Probabilities to select any choice of them. So, the choice (wrong one) must be attractive spirally to the student who has a low ability, and of course, in any question, there is one correct choice and other wrong choices. So, to calculate the effectiveness coefficient, we divided the students in the pilot sample into two groups (15 in each) after ordering their scores on the whole test in ascending order. The effectiveness of the alternatives is calculated by using the formula:

$$DA = (PU - PL) / ((1/2) * N)$$

D: the effectiveness coefficient, A: the alternative, Pl: number of students in the lower group who selected this choice, PU: number of students in the high group who selected this choice, N: number of students in two groups (N=30). The suitable and acceptable value of DA is negative or zero, but if we get a positive value, it means that the choice (alternative) is not good and need to be modified or deleted and replaced by another one. Here in the following table are the values of effectiveness coefficients of the alternatives of each question in the achievement test regarding the answers of the pilot sample of the students.

Table 5.

Effectiveness Coefficients of Alternatives of Questions of Achievement Test

Q	A	PU	PL	DA	Correct choice	Q	A	PU	PL	DA	Correct choice
1	A	2	3	-0.07	C	**9**	B	1	3	-0.13	A
	B	1	4	-0.20			C	2	5	-0.20	
	D	1	2	-0.07			D	1	2	-0.07	
2	B	2	4	-0.13	A	**10**	A	2	4	-0.13	B
	C	1	3	-0.13			C	1	3	-0.13	
	D	1	2	-0.07			D	1	5	-0.27	
3	A	1	2	-0.07	C	**11**	B	2	3	-0.07	A
	B	2	4	-0.13			C	1	4	-0.20	
	D	1	5	-0.27			D	2	3	-0.07	
4	B	1	3	-0.13	A	**12**	A	1	3	-0.13	B
	C	2	3	-0.07			C	2	3	-0.07	
	D	2	3	-0.07			D	1	3	-0.13	
5	B	1	3	-0.13	A	**13**	B	1	2	-0.07	A
	C	2	3	-0.07			C	2	3	-0.07	
	D	1	3	-0.13			D	1	3	-0.13	
6	B	2	3	-0.07	A	**14**	A	1	4	-0.20	D
	C	2	4	-0.13			B	2	3	-0.07	
	D	1	3	-0.13			C	1	3	-0.13	
7	A	1	2	-0.07	B	**15**	A	2	4	-0.13	D
	C	1	3	-0.13			B	1	5	-0.27	
	D	0	5	-0.33			C	1	2	-0.07	
8	B	2	3	-0.07	A						
	C	2	5	-0.20							
	D	1	2	-0.07							

We see from the table that all of the values of the effectiveness of Alternatives of each question were negative, which means that all of them were effective.

The Science Attitude Scale: To build the Science Attitude Scale, the researcher followed the following steps: 1- Determining the objective of the scale: it measures the attitude of the sample members towards science and their tendency to study scientific disciplines before and after teaching the proposed science curriculum. 2- Determining the dimensions of the scale and its fields: There are many measures of attitude towards science in the educational literature (Zaytoun, 2014) and (Hillman & Others, 2016), which will help the researcher in determining the dimensions of the scale, and they can be initially identified in four dimensions: interests and scientific tendencies The difficulty of science, the social implications of science, the role of the science teacher, and the scale should be developed to show students' attitudes and inclination towards studying scientific disciplines. 3- Drafting the scale items: In the light of previous studies, the researcher has drawn up the scale items emanating from the four dimensions. 4- Estimating the scale scores: The scale items were graded five-fold according to the Likert scale pattern (strongly agree, agree, not sure, disagree, strongly disagree) and the scores are given (1,2,3,4,5) respectively. 5- Calculating the time required for the scale: The scale was applied to a survey sample, and the average time of the first five students and the last five students was calculated, and this is the appropriate response time on the scale. 6- Verify the psychometric properties of the scale as follows:

After reviewing the previous studies related to the subject of the study, and depending on his experience in teaching methods of teaching science, the researcher designed the instrument of attitudes of students towards science for grade 6, it consisted (21) Items, he used the fifth Likert scale: strongly agree (5), agree (4), natural (3), Disagree (2), and disagree (1). He applied it on the pilot sample of (30) students "the same pilot sample that used in the achievement test" to explore the validity and reliability of the scale, as follows.

The Scale Validity

The researcher achieved the scale validity using two methods:

After designing the scale, he distributed it to (5) specialists in teaching science to review its items and write their notes, the agreement coefficient was 80% on all items of the scale, after that he applied it to the students of the pilot sample.

He applied it on the students of the pilot sample, then he achieved the construct validity by finding the person correlation coefficients between the response on each item and the total average of all responses on all items as shown in the following table:

Table 6.

Person Correlation Coefficients of the Construct Validity of the Scale

Item	R	item	R
1	.952**	12	.814**
2	.977**	13	.868**
3	.928**	14	.936**
4	.873**	15	.948**
5	.806**	16	.921**
6	.954**	17	.753**
7	.707**	18	.662**
8	.960**	19	.626**
9	.943**	20	.547**
10	.950**	21	.543**
11	.811**		

(**.) Correlation is significant at the 0.01 level (2-tailed).

We see from the table that all values were significant at the level of significance (0.01), which means that the scale is valid and we can get the same results if we apply it on another semi sample of this pilot sample.

The Scale Reliability

The researcher achieved the scale reliability in two ways: After he designed the scale, he distributed it to (5) specialists of teaching science, he calculated the agreement coefficient (KABA coefficient) it was (80%), which is good value and means that the scale is reliable. After applying the scale on the pilot sample (30 students), he calculated the alpha Cronbach coefficient, as shown in the following table:

Table 7.

Alpha Cronbach Coefficient of Reliability of the Scale

Number of items	Alpha Cronbach coefficient
21	0.977

We see from the table that the value of alpha Cronbach was high, which means that the scale was reliable m and we can get the same results if we apply the scale on semi sample of a pilot sample.

Methodology and Preparation of the Proposed Science Curriculum

1) The literature on informal science education was reviewed, such as Kim. et al, 2016; Stocklmayer. et al, 2010; Patrick, 2010) In the light of these studies and based on the questions of the study, activities that contribute to science education in an informal way and can be integrated into science curricula and taught via After through the approved education platforms during the Covid-19 pandemic, then the researcher discussed a group of specialists in science, curricula and methods of teaching science, and a set of activities that support non-formal science education and the institutions that sponsor this education were reached. 2) After preparing the study tools and verifying their validity and stability, the researcher coordinated with the science teacher who teaches the ninth-grade - after obtaining official approvals - and the students of Division (A) were considered the experimental group, and the students of Division (B) were the control group. 3) An attitude scale and an achievement test were distributed before the subject was taught. 4) The researcher provided the science teacher with the proposed new units that are consistent with the activities

based on informal learning - after their design and verification of their validity - and then trained on them. The teacher taught the experimental group the proposed new curriculum. 5) The attitude scale and achievement test were distributed after teaching the proposed curriculum, and then the results were obtained for analysis and interpretation. 6) The ninth-grade students were chosen - as mentioned previously - because of the importance of the intermediate stage in the formation of personality and attitudes, and because they are the most mature in the middle stage, and because after this stage the student must choose his specialization in the secondary stage and after university as a scientific, literary or other specialization. The second semester was chosen because it is closer to the first semester of the secondary stage, and the impact of the proposed activities based on informal education may have a greater impact on students' attitudes to choose scientific disciplines at the secondary stage and then university, meaning that the effect of the variables may be more clear in this the chapter. 7) The second-semester course includes several units, namely: The Unit of Life Foundations, and includes A chapter on activities and processes in the cell. Chapter: heredity. And the unit of motion and force, which includes: separation of motion and acceleration, separation of force and Newton's laws. And the unit of electromagnetism, which includes: separation of electricity, separation of magnetism. completely. The units include many topics in different branches of science that enable us to develop a variety of activities based on informal learning and can be taught through distance learning activities. The units also contain scientific topics that are important in forming positive attitudes towards science. The units include a variety of scientific knowledge material, as its objectives included Bloom's levels in the field of knowledge. The first unit - which is the life unit - was chosen from the units of the second semester of the science textbook for ninth-grade students, and the unit includes a chapter of activities and operations in the cell. Chapter: heredity. This unit was chosen as a sample of the second-semester units, to provide many activities that can be applied remotely, such as the virtual laboratory, educational videos, and the possibility of conducting scientific visits remotely.

The proposed activities were taught and distance learning platforms were used in the activity classes, after taking official approvals from the Education Department and the School Administration and preparing the administrative procedures related to the activity. The study was conducted at the beginning of the second semester of the year 1441 AH, and for a period of approximately one month. And this chapter was taught - after its development, modification and addition of activities that are consistent with informal science education and can be taught remotely - to the sample members in the experimental group. The curriculum is made up of the student's book, the activity book, and the teacher's guide. The researcher re-designed the curriculum according to activities based on informal education. After completing the preparation of the proposed science curriculum, the researcher presented it to a group of experts and specialists in curriculum, methods of science teaching, measurement and evaluation, to ensure its relevance and suitability to achieve informal education activities. The teacher's guide included the following elements: lesson introduction, lesson title, lesson procedural objectives, additional scientific activities based on informal education, directions on how to implement this material, general instructions, enrichment activities and exercises, answers to questions and exercises, and lesson plans. The plan for each lesson will consist of the following elements: the lesson title, lesson objectives, scientific material, suggested time, appropriate activities for the proposed material, and closing the lesson. After reviewing the previous studies, the researcher re-designed the science curriculum, including the student's book, the activity book, and the teacher's guide for the intended unit of study, taking the following considerations:

Linking each lesson in the unit to an educational activity outside the classroom - if possible -, and the necessary administrative approvals should be taken - and these activities should be purposeful and can be implemented easily. Linking the scientific material to the informal educational activities that are compatible with it. Directing the teacher in the teacher's guidebook to discuss these activities and how to prepare and implement these activities. Adding activities suggested by specialists that fit the subject matter of the study.

Virtual microscopes were used to view bacteria, fermentation process, and phagocytosis in white blood cells. The process of meiosis and mitosis.

- The virtual laboratories have been taken advantage of at https://www.praxilabs.com/ar/
- A remote visit to a bakery was coordinated, the video was explained, and the concept of fermentation was clarified.
- A remote video interview was conducted with an oncologist to learn about the concept of cancer cells.
- A virtual visit was made to the desalination plant using reverse osmosis, and the management was asked about the factory's work, and the concepts of

proliferation and osmosis were explained, and these links were also taken advantage of:
https://www.youtube.com/watch?v=tHzkRtzVmUM
https://www.youtube.com/watch?v=4RDA_B_dRQ0
https://www.youtube.com/watch?v=ron94T_5kmA
https://www.youtube.com/watch?v=pdwp6S1lrP0
Three-dimensional videos have been prepared for the following scientific concepts, which are part of the curriculum lessons:
Enzyme: These links have been used:
https://www.youtube.com/watch?v=yk14dOOvwMk
https://www.youtube.com/watch?v=BB_iH6QoMME
https://www.youtube.com/watch?v=FxjXrCyic6o
Photosynthesis: These links have been taken advantage of:
https://www.youtube.com/watch?v=2Re4PX1L5F4
https://www.youtube.com/watch?v=Z8KXglQe3_0
https://www.youtube.com/watch?v=pFaBpVoQD4E
Phagocytosis: These links have been taken advantage of:
https://www.youtube.com/watch?v=ack0RVGUH_E
https://www.youtube.com/watch?v=iAXQzxK8un4
https://www.youtube.com/watch?v=-dj-Nr6AwJ0
Cell division: These links have been taken advantage of:
https://www.youtube.com/watch?v=oF0x393JBL0
https://www.youtube.com/watch?v=UaK4BiPju04
https://www.youtube.com/watch?v=_xHykBGKUpA
A video interview was coordinated- with a farm owner to explain the cultivation of potatoes. These links were also made use of:
https://www.youtube.com/watch?v=PJGkDJFPpUo
https://www.youtube.com/watch?v=zJGc6z8-xYw
https://www.youtube.com/watch?v=hWp6oWBtLYo

These videos were edited from more- than one video available on the Internet, and the researcher, in cooperation with the professor of the subject, changed the audio and the explanation accompanying the video to be consistent with the prescribed material, and the researcher cut, deleted and added to the videos in order to achieve the desired goals.

- It was taken into account that the video should be short (the duration of the videos ranged between 3-15 minutes), clear and attractive to students. These activities were presented and students were given the opportunity to interact with them simultaneously with the lessons in the coursebook. The students were given freedom when and how they wanted to watch them, as these videos were stored on the platforms, and they were followed up to verify their interaction with them. Adopting the distance learning and e-learning platforms approved during the Covid-19 pandemic, such as the Madrasati platform, Teams, Zoom, Webex, Duo, and employing the activities of the proposed curriculum through these platforms.

Results and Discussion

- ***The First Hypothesis***

There is no significant difference at the level of significance (0.05) between the students of control and experimental groups of means of achievement test of science.

Before achieving the hypothesis, the researcher checked the homogeneity of the two groups on the pre-test of achievement test of science as shone in the following table.

Table 8.

T-test of Independent Samples between the Control and Experimental Groups on the Pretest of Achievement Test of Science

Group	n	Mean	Sd	t-value	df	Sig
Control	30	34.2000	11.57405	-.468	57	.641
Experimental	29	36.1034	18.89321			

We see from the table that the significant value was (0.641) of the t-test which is greater than (0,05) so there is no significant difference between the mean score of achievement pretest of the control group and mean of experimental groups, which means that the two groups were homogeneous and if there will be any differences in the applying of the post-test, the reason will be for the used treatment (informal teaching using the u-tube method).

Also, the researcher checked the normality distribution of means of pretest scores of both control and experimental groups, in order to be sure of using the parametrical t-test for independent samples in the post-test. He used the histogram as shown in the following.

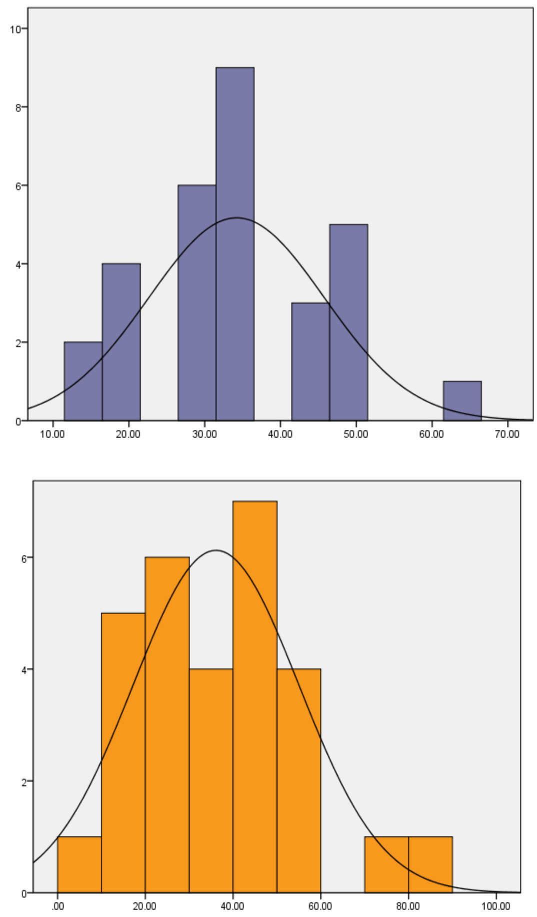

Figure 1.

The histogram of the distribution of mean scores of pretest of achievement for the control and experimental group

We see from the above two figures that the distribution of mean scores of both control and experimental groups are approximately normalized, so the appropriate test to achieve the hypothesis is the parametrical test: t-test for independent samples as follows.

After achieving of preconditions of using the t-test for independent samples, the researcher achieved the hypothesis, and explore the difference in means of scores of achievement test in post-test for both groups as in the following:

H0: There is no significant difference at the level of significance (0.05) between the students of control and experimental groups of means of posttest of achievement test of science

H1: There is a significant difference at the level of significance (0.05) between the students of control and experimental groups of means of posttest of achievement test of science to achieve the null hypothesis. The researcher used a t-test for independent samples as shown in the following table.

Table 9.

T-test of Independent Samples between the Control and Experimental Groups on the Posttest of Achievement Test of Science

Group	n	Mean	Sd	t-value	df	Sig
Control	30	49.93	18.330	-2.318	57	.024
Experimental	29	62.62	23.485			

We see from the table that the significant value was (0.024) of the t-test which is less than (0,05), so we reject H0, I.e., there is a significant difference between the mean score of achievement post-test of the control group and mean of experimental groups towards the experimental group, which means that the students in the experimental group who used the new method of informal teaching by YouTube have increased their achievement comparing the students who used the traditional method of teaching.

To explore the size effect of the new method of informal teaching on the achievement of students, the researcher computed it using the formula of Cohen D, as follows:

Cohen's d = (M2 - M1)/SD pooled

SD pooled = √ {(SD12 + SD22)/2} = sqrt{(18.330)^2 + (23.485)^2)/2}

= aqrt{ (335.98 + 551.55)/2}

= 21.07

Cohen's d = (62.62 - 49.93)/ 21.07 = 0.60

We conclude that the size effect of the new method of informal teaching had a large effect in improving the achievement of students in science.

- ***The Second Hypothesis***

There is no significant difference at the level of significance (0.05) between the students of control and experimental groups of means of attitudes towards science

Before achieving the hypothesis, the researcher checked the homogeneity of the two groups on the pre-applied scale of attitudes toward science as shone in the following table.

Table 10.

T-test of Independent Samples between the Control and Experimental Groups on the Pre-applied Scale of Attitudes Toward Science

Group	n	Mean	Sd	t-value	df	Sig
Control	30	3.4635	.37431	-1.078	57	.286
Experimental	29	3.5649	.34707			

We see from the table that the significant value was (0.286) of the t-test which is greater than (0,05) so there is no significant difference between the mean score of attitude towards science in pre-applied of the new method of informal teaching of the science of control group and mean of the experimental group, which means that the two groups were homogeneous and if there will be any differences in the post applying of the scale of attitudes, the reason will be for the used treatment (informal teaching using the u-tube method).

Also, the researcher checked the normality distribution of means of pre-applied scores of both control and experimental groups, in order to be sure of using the parametrical t-test for independent samples in the post applied attitude scale. He used the histogram as shown in the following:

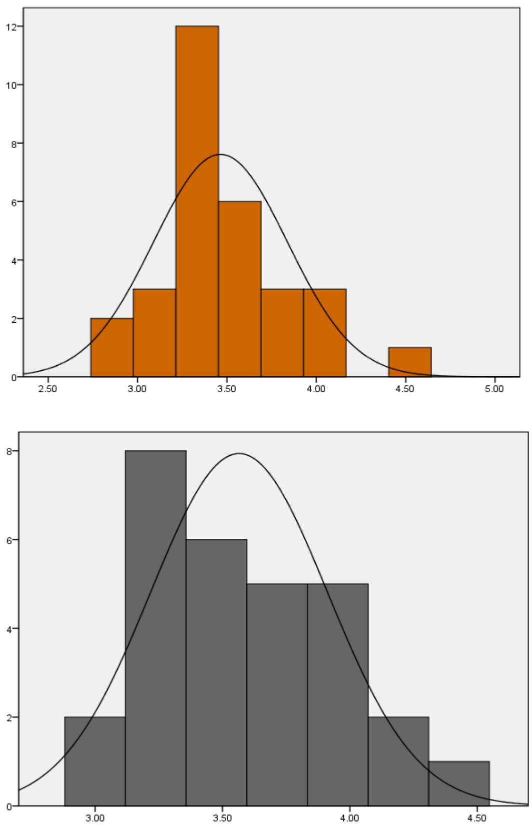

Figure 2.

The Histogram of the Distribution of Mean Scores of Pre-applied of the Scale of Attitudes Towards Science for the Control and Experimental Group

We see from the above two figures that the distribution of mean scores of both control and experimental groups are approximately normalized, so the appropriate test to achieve the hypothesis is the parametrical test: t-test for independent samples as follows.

After achieving of pre-conditions of using the t-test for independent samples, the researcher achieved the hypothesis, and explore the difference in means of scores of attitudes towards science in post applied for both groups as in the following.

H0: There is no significant difference at the level of significance (0.05) between the students of control and experimental groups of means of the post applied attitude scale towards science.

H1: There is a significant difference at the level of significance (0.05) between the students of control and experimental groups of means of the post applied of attitude scale towards science. To achieve the null hypothesis, the researcher used a t-test for independent samples as shown in the following table.

Table 11.

T-test of Independent Samples between the Control and Experimental Groups on the Post Applied of the Attitude Scale Towards Science

Group	n	Mean	sd	t-value	df	Sig
Control	30	3.4381	.45217	-2.299	57	.025
Experimental	29	3.7389	.54970			

We see from the table that the significant value was (0.025) of the t-test which is less than (0,05), so we reject H0, I.e. there is a significant difference between the mean score of the post applied of attitudes scale towards the science of control group and mean of experimental groups towards the experimental group, which means that the students in the experimental group who used the new method of informal teaching by youtube have increased their attitudes towards science comparing the students who used the traditional method of teaching.

To explore the size effect of the new method of informal teaching on the attitudes of students, the researcher computed it using the formula of Cohen D, as follows:

Cohen's d = (M2 - M1)∕SD pooled
SD pooled = √ {(SD12 + SD22)∕2} = sqrt{(0.452)^2 + (0.55)^2)/2}
= aqrt{(0.204 + 0.303)/2}
= 0.63
Cohen's d = (3.74 - 3.44)/ 0.63 = 0.48

We conclude that the size effect of the new method of informal teaching had a medium effect in improving the attitudes of students towards science.

It is worth saying here, that the results of this study are in agreement with many of the results of previous studies, as this study agreed with most of the previous studies on the importance of integrating formal and informal learning activities, and working to bridge the gap between them; Which will lead to improvement and development in science learning. These studies also recommended the need to work on the integration of formal and informal learning in science curriculum and teaching methods, as in the study (Hamdi, 2016; Dawson, 2014: 209; Kim & Dopico, 2016; Norqvist & Leffler, 2017; Watermeyer, 2013, Alakrash, 2021). Perhaps the following reasons seem reasonable to explain the results of this study: 1- The student learns science as it is in life in an integrated manner. Scientific activities should be taught in an integrated manner through the formal and informal system, as well as all formal and informal scientific activities that contribute to developing positive attitudes towards science (Zaytoun, 2014). Educational literature supports the trend towards linking science with society, the environment, technology and life, as this contributes to achieving the goals of science, and this is consistent with the call for integration between formal and informal science education activities, as this integration achieves scientific goals as best as possible (Kim & Dopico, 2016).

Recommendations

In light of the results of this study, which showed a positive relationship between the science curriculum based on informal learning and students' attitudes towards science, and their educational attainment, the study recommends the following: Inviting officials, decision-makers, and curriculum designers to adopt the activities of this curriculum in teaching science curriculum. Conducting studies similar to this study; To reach a clear vision about the integration of scientific activities, to achieve the desired scientific goals.

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