

The effect of the (cause and effect) strategy on the achievement of chemistry for first–grade intermediate students

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Abstract

This study aims to examine the role that cause and effect play in first graders' chemistry learning and performance.

Our study argues that the standard procedures for the chemistry improvement test show no statistically significant difference at the level of group significance (0.05).

The two researchers relied on a controlled experiment to accomplish their study objectives. They awarded the control and experimental groups medals based on a number of factors, including chronological age in months, IQ test, prior information test, prior accomplishment test, and attitude towards self-learning measure.

The research instrument consisted of an achievement test of (40) multiple-choice items (with four possible responses each), with the psychometric characteristics calculated. The data were statistically analyzed and processed. The study found that there is a statistically significant difference at the level of significance (0.05) between the average scores of the experimental group students who studied according to the cause and effect stratagem and the control group students who studied according to the traditional approach.

Keywords: cause and effect strategy, chemistry achievement.

Introduction

Today, the world is witnessing a rapid movement of a scientific progress, technological development, and openness to the outside world in various fields of science coping with a huge amount of information(Qeshta, 2008). Education is responsible for educating the learners and developing them in a comprehensive and integrated development so that they are beneficial to themselves and to their society(Ali, 2019).

Thus, educators paid attention to teaching methods and strategies as they worked on developing them to be in line with successive experiences(Maikhan, 2020).

Practical education aims to change the behavior of the learners to acquire scientific knowledge and develop the attitudes of the learners that make them capable of self-reliance(A. M. Zaytoun, 2005). Therefore, attention was drawn to strategies that develop learning processes and train them in different activities for learning(Muhammad & Jalil, 2020). So, the researchers chose a cause-and-effect strategy that may contribute to raising the achievement of the first average in chemistry which focuses on the principle of learning by doing and encouraging deep learning. This strategy that may help the learner understand the educational material better, and is expected to be able to explain and clarify it(Awwad, Al-ShibliIntisar, & Abd, 2012).

One of the contemporary active learning methodologies is the cause-and-effect approach. This approach is built on getting pupils used to connecting the cause and the effect and offering solutions that encourage students' original thought(Saidi & Hosaniyeh, 2016).

It shows the importance of the (cause and effect) strategy in increasing learners' achievement and understanding of what they have learned from various topics, and increases their ability to rely on themselves in finding answers to the reasons on the subject(Attia, 2014).

With its multiple subdisciplines, huge scope, and intrinsic relevance to human existence and social systems, chemistry encompasses various academic pursuits. This highlights the need to ensure that the transition between elementary and secondary schooling (where this science is often taught) is smooth, with a special focus on ensuring that students understand how the material relates to their everyday lives. The study looked at several methods and concluded that the cause-and-effect approach is one of the more recent active learning ways that might help students get better results. Hence, the researcher posed this issue as the problem they needed to investigate through the following question:

How can teaching first-year intermediate students chemistry using a cause-and-effect approach affect their performance and motivation for independent study?

The significance of the study may be summed up as follows, based on the aforementioned:

1- One, the globe and the discipline of chemistry both need to keep progressing in science and technology.

2- The intermediate stage is the middle base on which the educational system is built, due to what the primary stage has achieved in terms of basic knowledge, the end of the childhood stage and the beginning of the bully stage. It also links the primary stage and the preparatory stage, which is a sensitive age stage for the growth of students.

The employment of a cause-and-effect teaching approach affects first-grade pupils' chemistry success.

The search is determined as follows:

1- First-year intermediate school students in Baghdad's Karkh II schools (run by the Education Directorate).

2- The first academic semester of the year (2022-2023).

3- Sections 2 and 3 of the First Intermediate Science Textbook, Fifth Edition, which has been deemed suitable for use in the classroom in the year 2021 AD, make up the bulk of the scientific content.

Background

The Latin root (Sturere) of the term building or structure, which refers to the method of construction of a particular building, is the source of the word constructivism. It is commensurate with how learners learn. Also, the teaching methods require compatibility with how to learn with a variety of strategies and can often be followed in the classroom, and that the only way for teachers to learn is how to teach in a constructivist way.

I. H. Zaytoun and Al-Majali (2022) mentioned that constructivism is epistemology (the science of knowledge) and it is considered one of the educational theories that provide a full explanation of the nature of knowledge. It shows how students learn and build their new concepts and knowledge by linking and interacting between their previous knowledge, ideas and beliefs with the activities that they perform(I. H. Zaytoun & Al-Majali, 2022)

In the educational process, constructivism centers on the learner(Salman & Daoud, 2020). Therefore, the strategies of constructivist theory enable the student to practice many scientific activities(Al-Kubaisi, 2016).

The following null hypothesis was developed to test the study's assumptions and ensure its success:

1- There is no substantial distinction between the mean scores of students in the experimental group using the cause-and-effect strategy and the average scores of students in the control group who

study using the conventional approach to learning chemistry at the 0.05 level significance.

What gives credence to the tested design is the subject's capacity to accomplish the desired results or impressions per approach (Youssef, Ahmed, & Ali, 2019).

From a methodological standpoint, the students' average performance improves when first graders are taught chemistry using the cause-and-effect technique.

Literature review

Cause and effect strategy is used by educators when instructing. Students tend to understand the material quickly, so the teacher encourages the students to understand the discussion with the special cause or effect. They are only results from a reason (Alak, 2021)

Scientifically, it is defined by the author as one active learning strategy that emphasizes familiarity with making that connection between input and output. In this way, the student becomes a critic, researcher, innovator, and self-reliant in understanding the scientific material and providing them with positive attitudes among students and developing creative thinking to cause and effect.

It shows the level of skill the learner acquires from studying a specific subject or educational unit (Al-Lami & al-Rawi, 2022).

The students in the first intermediate have learned about chemistry by the end of the research period. This learning is determined by the results of an achievement test that the researcher created especially for that purpose.

Cause and effect strategy

It is one of the active learning techniques is it. This approach aims to get students used to connecting the cause to the effect and to provide creative thinking-enhancing remedies (Saidi & Hosaniyeh, 2016).

The importance of cause-and-effect strategy:

1. It contributes to increasing students' achievement and understanding of the various subjects they have studied.
2. It promotes the positive interdependence of the students.
3. The information is entrenched in the mind of the learner by linking relationships with concepts (Al-Masoudi, 13: 2022)

These are the steps of this strategy:

1. Students read the passage.

2. The teacher presents the organizational chart shown in the figure, which consists of four column Consists of appearance, cause, effect, prevention.
3. After reading, the student writes and summarizes the most important ideas from their memory.
4. His work is evaluated by going back to reading the text again.
5. It can be implemented individually or through small groups, and here roles must be defined effectively by using any previous active learning strategy.

Methodology:

Due to its suitability for putting hypotheses to the test and leading to the revelation of previously unknown facts, experimental research was the method for the two researchers. Examining hypotheses is facilitated by this method, and we can also address the problem cause and effect (Al-Munaizal & Yousef, 2010).

An experimental design with partial controls was employed to compare the two similar groups (experimental and control) post-test. Given that there will be one independent variable (a cause-and-effect method) and one dependent variable, this design makes sense (academic achievement) as in table 1

Table 1 The approved experimental design for the two research groups

No.	the group	the independent variable	The dependent variable
1	Experimental	Cause and effect strategy	1. Acquisition of chemistry 2. The trend towards self-learning
2	control	Teaching in the usual way	

Research Population

The first stage must determine the original community so that the researcher can choose the sample for his research (Al-Zobaei, Al-Kinani, & Abdul-Hassan, 1981).

Students in grades 6 and up from government middle and secondary schools for males in the Baghdad and Karkh region are part of the research community for the current school year (2022-2023).

Fourth: The Samples of the research

Middle school students from the House of Prophecy in the Al-Hussein area, affiliated with the Second Directorate of Education of Baghdad / Karkh II, served as the sample for this study. The experiment was designed to applied to this age group (60).

Fifth: Control Procedures

The following internal variables were monitored and recognized as having the potential to influence the experiment's outcomes:

1- The s study's experimental and control groups are similar

Although the two groups (experimental and control) were selected at random to avoid erroneous findings through internal safety verification, the researchers established variable parity that may impact the safety of the experiment before carrying it out.

Chronological age in months:

To determine the difference in chronological age between the two groups in months, it is required to know the homogeneity of the variance between the two research groups. It is a condition for the use of variance homogeneity before using the t-test between the two groups, as the variance homogeneity means that each level of the independent variable affects each member of the sample in the same way. There is no clear differentiation in the sample's scores for the investigated variable(Al-Dulaimi, 2019).

The results of Levine's test for homogeneity of variance were compared in Table 2 to determine whether or not the variation between the experimental and control groups was consistent (1).

Table 2 Age in months Results of the Levene test to determine whether or not the experimental and control groups' score distributions are similar

No.	the group	the number	SMA	Levin's value of homogeneity	
1-	Experimental	30	147.90	Calculated percentage	tabular percentage
2-	Control	30	147.60	0.223	4.00

Table 2 shows that the experimental and control groups are comparable in age since, at the 0.05 level of significance, the calculated percentile value (0.223) is lower than the tabular percentile value (4.00). The (t-test) for the two independent equal samples determine the significance of the differences between the mean ages of the students in the experimental and control groups. The calculated

t-value was (0.311), which is lower than the tabular t-value (2), at the level of significance (0.05), and with a degree of freedom (58). This shows that the two groups are equal in the chronological age variable in months.

Table 3 Comparison of two samples using the t-test for the continuous variable "age"

Experimental group	sample number	SMA	standard deviation	degrees of freedom	T value		Statistical significance
					calculated	Tabular	
Experimental	30	147.90	3.575	58	0.311	2	non function statistically
Control	30	147.60	3.882				

2- Duration:

The duration of the experiment in the first semester, which was equal for the experimental and control groups, was from Wednesday, 10/26/2022, to Thursday, 1/12/2023.

3-Distribution of classes:

A total of one 45-minute science (chemistry) session each week was agreed upon by the two researchers and the administration for the first intermediate grade. These classes would take place once a week on Wednesdays.

4- Scientific material:

Specifically, the second and third chapters of the Science Book, fifth edition, will be covered in the 2021 AD / 1443 AH science class that will be presented to the experimental and control groups.

5- Experiment's Place

The test was conducted on the (control and experimental) groups in (House of Prophecy Intermediate School for Boys), due to the availability of capabilities and specifications for teaching the two groups (experimental and control). The two research groups were not affected by the place, and the surrounding conditions were equal for both groups.

6- Experimental extinction (abandonment during the experiment):

It is what the students of the sample of the research are subjected to during the period of applying the experiment in terms of accidents, such as a number of students dropping out, leaving them, or being absent from work. This will lead to an impact on the dependent variables and then lead to different results (Abbas, Nofal, Al-Absi, & Odeh, 2009).

During the period of the experiment, the two groups were not exposed to dropouts, interruption of work, or student transfer from one branch to another, except for the few individual absences, which are considered normal conditions.

7-The John Henry Factor:

The participants in the research behaved differently from their normal behavior, and they realized within the study sample. The negative or positive effects of the experiment and that the control group did not make them feel that they were in competition with the experimental group(Christensen, 2007)

In order to get rid of this factor, the researcher taught the control group the usual subject, science (chemistry), so that the control group did not feel that they were in a competitive position with the experimental group.

Fifth: Checking the external integrity of the experimental design:

Work has been done to control external safety as follows:

The experimental and control groups were not exposed to more than one experiment during the experiment period.

The researcher was concerned with maintaining the experiment's secrecy and reached an arrangement with the school administration and the subject instructor. Thus, the experimental and control groups of pupils would remain unaware of their participation in the study.

1- The students of the experimental group (the experimental group and the control group) were not exposed to any accidents.

2- The two researchers chose the division, which represented the research sample, which is Division (D-E) at random, to be Division "D" for the experimental group and Division "E" for the control group.

3- At the conclusion of the study period, the achievement exam was administered to the experimental and control groups as a study tool.

4- Maturity-related procedures for the student population sampled is represented by the mental, biological, or psychological changes that may occur to students during the experiment's application period.

Due to the experiment short duration and age similarity of the two groups, and equal any mental - biological - psychological growth), of the groups, the groups are not affected by the factors.

5- The physical classroom environment:

The researcher chooses the classroom, the teaching spots, the lighting, the chalkboard, and the study seats for both the experimental and control groups.

Sixth: Preparing research requirements

1- Choice a topic for your research:

Throughout the experiment, the researcher analyzed science content for both groups (experimental and control) based on the textbook Science (Chemistry) for the First Intermediate Grade, Fifth Edition.

2- Setting Behavioral Objectives:

When the Ministry of Education made a decision for the curriculum, the researcher created (140) behavioral objectives based on the two chapters of the first intermediate-grade chemistry textbook.

The researcher used (Bloom's) taxonomy of the cognitive domain, divided into six levels (memorization, assimilation, application, analysis, synthesis, and almanac), to formulate the behavioral objectives.

Table 4 Behavioral aims based on Bloom's six stages throughout two chapters

Level	Bloom's levels						Total
	Remembering	assimilation	applying	The analysis	Compositing	almanac	
Chapter 2	33	25	8	2	1	1	70
Chapter 3	39	24	3	3	1	0	70
Total	72	49	11	5	2	1	140

3- Preparing teaching plans:

The two researchers examined the first intermediate grade's second and third science (chemistry) chapters. They devised twelve lesson plans for the experimental and control groups based on covering the educational material and behavioral goals.

Seventh: Research Tools:

Methods and instruments used to collect data for analysis to support testing hypotheses and resolving a research problem constitute the research tool (Duwaidri, 2002). The steps involved in constructing the accomplishment exam are depicted below. What follows is a series of steps.

The aim of the test

The purpose of the test is to compare the performance of the two groups.

The academic subject:

The scientific material includes the second and third chapters of the science book for the first intermediate grade.

Formulate behavioral goals.

According to Bloom's taxonomy of the cognitive domain's six stages of functioning (memory, comprehension, application, analysis, synthesis, and evaluation), a total of one hundred and forty (140) behavioral objectives were developed.

Specification table:

curricular content and behavioral purposes are considered, the table of specifications is an important procedure in preparing achievement tests that are objective, comprehensive, and accurate. This is because the specifications table helps the researcher distribute test items uniformly across the curriculum among the academic subjects for all academic content Odeh (1998). Thus, the number of test items was (40) multiple choice subjective items.

Table 5 Table of specification

Total	Percentage of behavioral purposes						Relative importance	The number of lessons	Chapters
100%	correction	Compositing	Analysis	applying	assimilation	remembering			
	1%	1%	4%	8%	35%	51 %			
23	0~0.2	0~0.2	1~0.9	2~1.8	8~7.9	12~11.6	57%	8	1
17	0~0.1	0~0.1	1~0.6	1~1.3	6~6.0	9~8.7	43%	6	3
40	0	0	2	3	14	21	%100	14	Total

- Preparing test items:

The test items consisted of (40) multiple choice items.

- Test instructions:

A special exam instructions page has been prepared to be clear, understandable and easy for students. Achievement test correction Instructions:

- Correction (subjective paragraphs): Correct paragraph answers were worth one point, incorrect paragraph answers were worth zero, and answers for which more than one option were selected or which were left blank were not awarded any points.

Test Validity

-Virtual validity:

Apparent validity was demonstrated by presenting achievement test items and behavioral goals (in their initial form) on a group of arbitrators and specialists in the field of chemistry teaching methods.

The purpose of this is to learn what they think of the test's items in terms of their linguistic and scientific accuracy, as well as their suitability for the students at that level.

- Authenticity of the content:

This kind of validity was attained by breaking down the study materials into their constituent parts, articulating the behavioral purposes, establishing a table of specifications. It developed an achievement test that is suitable to the table of specifications and consistent with the targeted behavioral purposes.

- The exploratory applying of the achievement test: it includes two phases:

✓ The first survey applying:

The first survey is used to gauge how long students need to spend on each question, and it also checks for ambiguities in the test's paragraphs and directions. Examining the time, it takes students to complete each test item in relation to factors such as the clarity of the paragraphs and the absence of questions on how to answer.

✓ Applying the test to the second survey sample:

In order to verify the validity of the test, the test was applied to a second survey sample consisting of (200) students from the first intermediate grade students. They were chosen from middle and high school students from the Second Karkh Education Directorate, in a simple random way. So the two researchers chose a statistical analysis

sample of (100) students from these two schools from each school. Then the two researchers corrected the students' answers, and the scores were arranged descending from the highest score to the lowest score according to the total score of the test (Al-Dulaimi, 2019).

Then, the statistical analyzes were performed as follows:

A- Item difficulty coefficient:

Since the test is one of the objective questions, the difficulty coefficient was calculated for the objective questions, according to its equation.

B- Discrimination coefficient for a paragraph:

According to its equation, the discrimination coefficient for the accomplishment test items was determined for the objective items.

C- the success rate of fake alternatives the effectiveness:

The incorrect choices were left in place since all of their effectiveness values were negative and that they attracted more members of the lower score group than the higher score group.

D- The stability of the test

The (QODER-20) technique was used for objective achievement assessments to the scores of the statistical analysis sample, consisting of (200) students. The items were graded on a scale from (0, 1), and the resulting stability coefficient was (0.89). According Al-Nabhan (2004), when the stability coefficient is more than (0.70), the test can be called stable.

Eighth: Statistical means

- 1- The t-test for two independent samples.
- 2- Equation of the item discrimination coefficient.
- 3- Equation of the difficulty coefficient of the items.
- 4- Using the erroneous choices as though they were equally effective in the items.
- 5- The Alpha-Cronbach equation
- 6- Cooper equation
- 7- One-way analysis of variance
- 8- Eta square equation

Results and discussion

We compared post-test results from the two groups on a chemical accomplishment exam. Mean differences between the experimental and control research groups on the accomplishment test were displayed using the t-test for two independent, equal samples, with the findings displayed in Table 1 (5).

Table 6 the t-test findings for two independent samples comparing the experimental and control groups on a chemical achievement test

Statistical significance at level 0.05	T value		degrees of freedom	standard deviation	SMA	number of students	Total	No.
	Tabular	favoritism						
Statistically function	2	9.744	58	1.925	35.533	30	empiricism	1
				7.978	20.933	30	control	2

Table (5) demonstrates that the experimental group performed better than the control group on the chemical achievement exam. In contrast to the experimental group, the control group did well academically. It follows that the alternative hypothesis, which states that "there is a statistically significant difference at the level of significance (0.05) between the average scores of students who study according to the cause-and-effect strategy and the average scores of students who study using the traditional approach," was accepted and the null hypothesis was rejected. The eta square test was employed, as is standard procedure for a chemistry achievement exam, to determine the effect size of the independent variable (cause and effect approach) on the dependent variable (achievement), and the results are summarized in Table (6).

Table 7 the squared eta and post-accomplishment variable effect for the two research groups

The size of the effect	Eta Squared	Eta	Follower	independent variable
Average	0.621	0.788	Academic achievement	Cause and effect strategy

Second: Results Interpretation:

1- Teaching according to the strategy of cause and effect was effective in the achievement of the students in chemistry, because of the students' transformation into information seekers, reinforced by self-learning in order to reach scientific information.

2- Teaching according to this strategy makes the student's role positive, creating an active interactive atmosphere, as well as increasing the feedback process, unlike the student's role in the traditional approach.

3- This strategy works on developing students' attitudes by finding answers to the questions posed.

Conclusions

Compared to the traditional approach, teaching chemistry using the (cause and effect) model significantly increases first-year intermediate students' success in the subject.

Recommendations:

The study recommends the following:

1- Emphasizing employing constructive education strategies, including the (cause and effect) strategy, which allows students to participate actively and positively during learning.

2- Encouraging male and female chemistry teachers to adopt the (cause and effect) strategy in teaching chemistry for the intermediate stage to prove its effectiveness in teaching the subject.

3- Using the method (cause and effect) that places students at the center of the learning process in order to accomplish the aims of active learning and improve their degree of attitude towards self-learning is a promising approach to chemistry education.

The two researchers recommended the subsequent investigations to supplement the study methodology:

1. Using the (cause and effect) methodology used in this study to examine the same topic from a different disciplinary perspective and/or later on a more advanced students of chemistry.

2. Using first graders' meta-cognitive development to be taught by the cause-and-effect technique.

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