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Effect of using fryer strategy on the achievement and systemic thinking of intermediate second-class students in the chemistry subject

Najwa Abdulmunem Jasim Alnoori
Chemistry Teaching Methods, College of Education for pure Science, Ibn Al-Haitham University of Baghdad, Iraq
Email: najwa.a.j@ihcoedu.uobaghdad.edu.iq

Wasan Qasim Neamah
Chemistry Teaching Methods, College of Education for pure Science, Ibn Al-Haitham University of Baghdad, Iraq
Email: Wasan.k.n@ihcoedu.uobaghdad.edu.iq

***Abstract*---**The objective of this research is to identify the effect of Using Fryer strategy on achievement and systemic thinking in the subject of chemistry of second class intermediate school students. The sample of research consisted of 59 students in one intermediate school in Baghdad/Iraq, split into two groups; experimental and control. The scientific material of the study is related to Chapters II and III of the Science Book for the second Intermediate School for the Year (2019-2020). The scientific test is composed of 25 test items whilst the second instrument for research related to systematic thinking test consisted of 12 items. The results of the research showed that the use of Fryer's chemistry-teaching strategy has increased achievement and the trend of systemic thinking of the students.

***Keywords*---**Effect, Fryer Strategy, Systemic Thinking, Outcomes.

Research Problem

The most important thing that the teacher and learner face today is in this age when knowledge is exploding dramatically and continuously, which requires increasing the role of the learner by relying seriously on his or her efforts to raise his or her level of acquisition (Al-Tamimi, 2010:126), creativity and thinking became the most important necessary to cope with developments and to make decisions that could solve any of the problems facing students and develop their ability to understand and overcome the attitudes and problems facing them

(Benoit, 2004). By pursuing various modern strategies in education, it provides us with diverse and advanced knowledge that trains students in thinking, with diverse skills that develop mental capacity and train students in creativity (Beyer, 2003) and with patterns of learning that are concerned with discovery that develop the skills of thinking of students and at higher levels so that they can explore, create and acquire multiple levels of thought (lameness and chauvinism): The basis of the progress of the third millennium generation is to teach them intellectual habits that will enable them to find solutions to the problems they face and express their independent ideas. Here is the problem of searching for answers to the following questions:
What's the impact of Fryer's strategy on the collection of chemistry and systemic thinking for middle - second graders?

Importance of The Research

The importance of this study comes from the application of modern teaching methods as the cornerstone through which the educational process's objectives are achieved. Whenever the teaching method is appropriate, the intended objectives are achieved in making the learner proactive, effective and planned, and not passive, and the only role of receiving knowledge and information is to respond when receiving the exciter (Qatami and Qatami, 2000, p. 36; Wittrock, 1990: p356). The Fryer Strategy is considered to be one of the most important learning-by-discovery strategies: first, the concept analysis, second, and third, the measurement of its acquisition, and aims at developing the ability of the learner to uncover his or her previous experience and link it to new subjects (Ambuseidi and Hussidi, 2016). The research is therefore important as:

1- Research and its recommendations benefit chemistry secondary teachers from changing traditional teaching methods.
2- Research benefits those interested in the in-service training of teachers in the Ministry of Education.

Aims of This Research

The current search aims to verify:

1- The impact of Fryer's strategy on the achievement of grade II students is intermediate in chemistry.
2- The impact of Fryer's strategy on the systematic thinking of grade II students is intermediate in chemistry.

To verify the aims of the research, the following questions were formulated:

1- What are the statistically significant differences at the level of 0.05 between the average grade of students to test achievement in chemistry between the experimental group and the officer in the remote test?
2- What are the statistically significant differences at the (0.05) level between the average grade of students to test for systemic thinking in chemistry between the experimental group and the officer in the remote test?

Research Terms

Impact: Outcome of changes in learning as a Result of an Intentional Learning Process (Shahata et al, 2003, p. 2).
The Fryer Strategy: It is a term of steps that a teacher offers at the beginning of a lesson by presenting the concept and its distinctive characteristics to reach the definition of the concept and to know what students have acquired of the concept by providing examples of the concept through a limited format. (Almomni, Mustafa: 552:201).
Systemic thinking: is one of thinking modes uses higher-end thinking skills by analyzing knowledge, understanding the relationship between parts, and working to reconstruct and coordinate parts without losing their meaning when students are exposed to an integrated, logically linked and structured attitude, that is to say, holistic treatment of all parts by human nature that are concerned with each and every part after processing them. (Kotenikov , 2006:1).
Outcomes: The cumulative rate of achievement of students indicates their outcome at the educational level and their understanding of information and knowledge in terms of quantity and quality (Nasrallah, 2010:321).

Theoretical Background

One of the most important revolutions of interest in education is that which emphasizes the role of students in the discovery of information, in the way they think and in the development of their ability to engage in extrapolative thinking. The Fryer Strategy is one of the most important models that works to refine students' information about concepts in terms of traits and traits and its role in shortening the time for understanding the concept.(Yolen and Covelle 1998) and is divided into three stages to acquire the concept:

Concept analysis: is a term that refers to the characteristics, adjectives and negative and positive examples contained in both the main and sub-concepts.
Learning the concept: Fryer refers to a set of processes contained in the concept in terms of attributes, the conceptual knowledge base and the relationship between the main and subsidiary concepts and the concept itself.
Knowledge of the extent to which the concept has been acquired: There are some concepts that Fryer has defined through which students' mastery of the concept, procedures and criteria of the application is judged.
Actions to use the Strategy within its three phases

1. Pre-teaching by identifying the scientific substance (chemical compounds and chemical reactions):
   - Feedback on the subject to define concepts.
   - Sorting out the chemical concepts of the prescribed substance of the Science Book for Grade II Medium.
   - Preparation of daily study plans for the application of teaching steps in accordance with the Fryer strategy.
2. Steps during teaching:
   - Distribution of a model outline and clarification of the idea to apply Fryer's strategy.
   - Doing a brainstorming way for students to define concepts.
   - Students follow up on the concept and phrases in the design.

- The last version of the definition and writing of concepts has been developed in the assigned place of the model.

Fryer graph:
Four blocks in the middle of which there is a different entry in which the name of the concept is placed as follows:

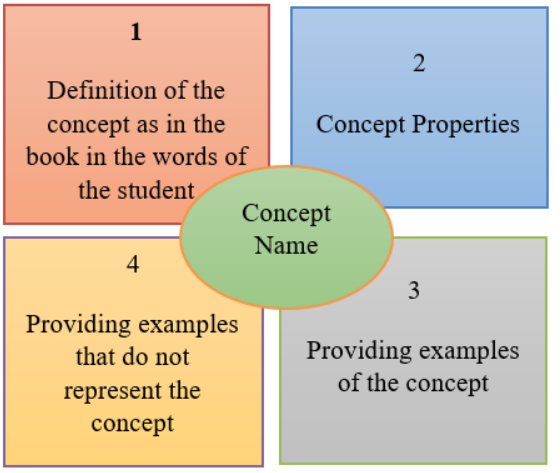

Figure 1. Fryer's strategy graph (National Behaviour Support Service, 2005; Meliana, 2014; Sullivan, 2014; Wanjiru & Connor, 2015).

Advantages of Using Fryer's Strategy

1. It relies on self-learning and active learning, and can be used to correct the concepts students learn.
2. He was pleased to provide a summary of what he had learned about the concept through the notation of the observation, the analysis, the conclusion, the discussion and the information himself.
3. How to give examples that represent the concept and the counter.
4. It develops the capacity for scientific and innovative thinking.
5. Developing student problem solving skills.
6. He helps the teacher by guiding the students to summarize what they came to through the Fryer's diagram.
7. Developing critical thinking and retrieving and organizing past information.

Systemic Thinking

This includes thinking about the number of high-level skills students turn to when faced with a problem, where it relies on a thorough analysis and perception of the situation and works to create similarities between the parts and structure them in a number of ways and flexibly that are restructured as they are supposed to be. (Al-Saeed, 2005:491).

Systemic Thinking Properties

1. Looking at the situation thoroughly and stay away from the simplicity of the solution.
2. Looking at the system as a whole and the relationships between its parts.
3. Urging students to decide whether to solve the problem.

4. Urging students to appreciate and respect the opinion of others.
5. It works to make sense of the relationships between the parts of the situation that he seeks to resolve (Sterling, 2004:78).

Systemic Thinking Dimensions

There are four dimensions that need to be known from the point of view (Al-Kamel, 2004):

1. Think about building thoughtful and balanced models.
2. Biometric thinking is chronologically sequential.
3. Thinking in a way that illustrates mutual relations.
4. Systematic handling. (Al-Kamel, 2004:65).

Systemic Thinking Skills

Most researchers agree that thinking requires higher skills to analyse a problem or situation, where there are four basic skills and twelve sub-skills as shown in (Table 1).

Table 1.

No.	Main Skill	Sub-Skill
1	Relationship perception	
2	System analysis	Creating a subsystem out of the core system.
3	System formulation	1- building a system based of concepts. 2- Generalizing the system. 3- Writing the report.
4	System adjustment	1- Judging the integrity of the relationship between parts. 2- System development. 3- The holistic view of the situation.

The Importance of Systematic Thinking in Education

1. Helps students to find solutions to complex problems by seeing the whole problem, not just its parts, and solving problems that result from repeated and wrong attempts.
2. Helps students to focus holistically and provide them with skills that can be derived from systems in a critical and subsidiary manner.
3. The ability of students to see the future and the whole of any subject without losing their molecules, as well as their ability to analyze, structure, and create, thereby obtaining a successful educational system. (Ismail, 2012:30)
4. Students are able to broaden their perspectives and make sound decisions when dealing with the problems they face realistically and effectively.
5. Students can keep the information in mind by linking it to the comprehensive system (Siyam, 2017:31).

Methods for Measuring Systemic Thinking

1. Enables students to develop a structured scheme through which the relationships between concepts and the completion of the missing in the scheme are defined by the students.

2. Students are provided with a structured scheme that includes key concepts, writing sub-concepts and creating a relationship between them by students after writing them in the scheme.
3. Giving examples to students and then asking them to build a new system along the lines of the past (Al-Kubaisi, 2010:77-82).

Research Methodology

Research Sample

The research sample was deliberately selected from the second-grade intermediate students of one of the first Al-Karkh Education Directory Baghdad/Republic of Iraq middle schools for the academic year (2019-2020), consisting of 59 students of two divisions (A) experimental and (B) control, distributed according to the number of groups, the arithmetic mean and the standard deviation of student grades to test chemistry in the first semester before the experiment according to table (2).

Table 2.

Group	Number	Arithmetic Average	Standard Deviation
Experimental (A)	29	14.12	2.34
Control (B)	30	14.85	1.63

Parity was compared and confirmed in both groups through the T test of independent samples and did not indicate a statistically significant apparent difference between averages according to table (3) below.

Table 3.

Group	Number	(T) value	Denomination Level
Experimental (A)	29	1.45	0.131
Control (B)	30		

The two research tools

The scientific material is defined as (Chapter II and III) of the Science Book for Grade II. The two research tools were prepared by the researchers, consisting of the test of science and composed of (25) a paragraph. The test is of multiple choice, filling the blank, and includes questions about the definition, distinction and application of concepts, as well as the distinction between the qualities of concepts. The initial picture of the test was confirmed by being presented to competent arbitrators and expressing their opinion in order to ascertain the veracity of the test, and was modified according to their opinions. Whereas the second research tool was a systemic thinking test, which included (12) questions distributed whereby skills for systemic thinking would be defined, then their relationship with other systems, then a skill and the re-installation of system components, and internal coherence would be confirmed by table (4).

Table 4.

Skill	Correlation Coefficient	Denomination Level
System analysis	0.817	Significant at 0.1
Relationship perception inside the system	0.901	Significant at 0.1
Subject full view without missing its parts	0.866	Significant at 0.1
System installation from its components	0.910	Significant at 0.1

From the table above, the correlation coefficients of each domain to the total degree are statistically function at 0.01 and indicate the internal consistency of the test.

Results Presentation and Interpretation

The first question: What are the statistically significant differences at the level of 0.05 between the average grade of students to test achievement in chemistry between the experimental group and the officer in the remote test?
To answer this question, we note Table 5 with statistically significant differences at the index level of (0.05) in findings, with reference to arithmetic averages, it is noted that these differences are in favor of the experimental group, and that the value is (T) is (7.32) at the denomination level (0.0000) and is smaller than the semantic level (0.05) at (88) degree of freedom, thus rejecting the zero hypothesis, and accepting the alternative hypothesis, which means that Fryer's strategy positively affects findings.

Table. 5. Arithmetic averages and standard deviations of the scores of the students of the two groups in the remote application of the crop test and the results of the test (t) for the significance of the differences between the averages

Group	Number	Arithmetic averages	standard deviations	(T) Test	Denomination Level	Degree of freedom
Experimental (A)	29	25.94	2.839	*7.32	0.000	88
Control (B)	30	20.63	2.187			

*Statistically significant at (T) value at a degree of freedom (88) (0.05 ≥α).

For the size of Fryer's results impact, the ETA (μ^2) value was (0.381) and the (d) value was (1.548). From the above, it is clear that the independent variable was high and for the experimental group as shown in table (6) below.

Table. 6. Values of (μ^2) and (d) and the impact size on results

Independent variable	Follow variable	(T) value	d_f	μ^2 value	d value	Impact size
Fryer's Strategy	Findings	*7.32	88	0.381	1.548	High

This result can be attributed to the fact that Fryer's strategy produced interest in science and work on duties as a result of active participation in the course and thus reflected in the results of the test.

Whereas the second question was: What are the statistically significant differences at the level of (0.05) between the average score of students to test for systemic thinking in chemistry between the experimental group and the control group in the remote test?

To answer this question, the arithmetic average and the standard deviation of the scores of the two groups' grades were extracted in the remote systemic thinking test in chemistry, followed by the extraction of a (T) value.

Table. 7. Arithmetic averages and standard deviations of the students' scores of the two groups in the remote application test and the results of the (t) test for the significance of the differences between the averages.

Group	Number	Arithmetic averages	standard deviations	(T) Test	Denomination Level
Experimental (A)	29	44.16	3.420	*9.04	0.000
Control (B)	30	35.07	4.409		

*Statistically significant at (T) value at a degree of freedom (88) (0.05 ≥α).

It can be seen from table 7 that statistically significant differences can be observed at indicative level (0.05) on remote systemic testing, with reference to arithmetic averages, it is noted that these differences are in favor of the experimental group, and that the value is (t) is (9.04) at the denomination level (0.0000) and is smaller than the semantic level (0.05) At 88, we reject the zero hypothesis, and accept the alternative hypothesis, which means that Fryer's strategy positively affects systemic thinking. For the size of Fryer's results impact, the ETA (μ^2) value was (0.501) and the (d) value was (2.008). From the above, it is clear that the independent variable was high and for the experimental group as shown in table (8) below:

Table. 8. Values of (μ^2) and (d) and the impact size on the systemic thinking

Independent variable	Follow variable	(T) value	d_f	μ^2 value	d value	Impact size
Fryer's Strategy	Findings	*9.04	88	0.501	2.008	High

Results and Discussion

The results showed that the experimental group outperformed the group in the Remote Achievement Test and the Remote Systemic Thinking Test. This may be because the Fryer Strategy teaching method helped to regulate the content of the subject and facilitated its acquisition of chemical concepts through its work with the Group. It is instrumental in implementing the Fryer Strategy steps in arranging and recruiting students' thinking in an orderly and logical manner. This provides sufficient opportunity to discuss information during the course of study and interaction to give understandable examples and chemical examples that do not belong to it. Also in doing that, students do not keep the concept in abstract form by applying the examples, or thinking about the most important features and summing up the information they have gathered in addition to putting in the strategy diagram, which is linked to the organizational thinking skills in terms of analyzing the main concept into subtractions, and then creating the relationship between them.

Recommendations and Proposals

1. It is essential that the Ministry of Education put into consideration and employ new teaching strategies and methods based on collective learning and the development of thinking patterns.
2. Studying Fryer's strategy and other variables such as motivation towards chemistry and studies on strategy for other materials.
3. Paying more attention to thinking skills at all levels through the development of chemistry curricula.
4. Conducting in-service training courses to recruit Fryer's teaching strategy.
5. Giving training courses to develop the measurement of organizational thinking skills.

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References

1. Abu Athra, Sanaa (2012). Oman: Dar Culture for Publication and Distribution, first edition.
2. Afana, Azzaw, and Nashwan, Ismail (25-28 July 2004). The impact of using some of the strategies beyond knowledge in teaching mathematics on the development of systemic thinking among basic eighth graders in Gaza. Egyptian Society for Practical Education. Research submitted to the Eighth Scientific Conference, Volume I, Ismailia.
3. Al-Kubisi, Abdul Wahid Hamid (2010): Systematic Thinking and its implementation in Learning and Education from the Holy Quran.
4. Al-Mumni, Qassi Shehada, and Mustafa Mahand Khazir Mahmood (2016). The impact of the use of Fryer and Whitley models in the acquisition of rhetorical concepts among the students of the tenth grade class in the Jordan, Faculty of Education, Al-Azhar University, No. 171, Part 3: December 2016.
5. Al-Saeed, Ridha Mesad (2005): Model of my multidimensional organization to regulate the content of the curricula.
6. Al-Tamimi, Tawad Jasim Muhammad: (2010) Common and up-to-date teaching methods, Dar Al-Wathaiq for Publishing and Distribution, Baghdad, 1.
7. Ambousidi, Abdul Allah and Hosina, Huda (2016). Active learning strategies: 80 Strategy with applied examples. Oman: Dar El-Maysarah for Publishing and Distribution House, First Edition.
8. Asriyati, P. E., Swarjana, I. K., Sastriani, N. L. A., & Krisnandari, A. A. I. W. (2021). The effect of electronic discharge planning with SBAR approach to optimize the implementation of patient discharge. International Journal of Health & Medical Sciences, 4(3), 280-287. https://doi.org/10.31295/ijhms.v4n3.1750
9. Benoit, Bob. (2004). Problem Based Learning, Retrieved February 6, 2005.
10. Beyer, Barry. (2003). Teaching Thinking Skills: A Handbook for Secondary School Teachers, Boston: AIlyn and Bacon.
11. Fifth Scientific Conference of the Systematic Entrance to Teaching and Dissemination, Guesthouse at Ein Shams University, Cairo, Egypt.
12. Kotelnikon, v.) 2006) : systemic thinking , focusing on the whole , not the parts of a complex system.
13. Qatami, Yusuf and Qatami, Naifa (2000): Class learning psychology. Amman, Dar Al-Shorouq for Publishing and Distribution House.
14. Sameen, Zaid and Sahi, Rasha (2011). The impact of implementing Fryer's model in physics on female pupils in second grader. Journal of Educational and Psychological Sciences. p 114-147. ‹(91).
15. Seyam, Baraa Abdul Aziz (2017): The employment of the D3 CABRI program in contribution to the development of systemic thinking skills in engineering among basic eighth graders in Gaza. Master in Curricula and Teaching Methods, Islamic University in Ghaza.
16. Shehata, Hassan et al. (2003): Lexicon of educational terminology. Egypt: The Egyptian-Lebanese House.
17. Sterling,s. (2004): systems thing. InD. Tilbury & D. workman (Eds), Engaging people in sustainability, commission on education and communication, IUCN, Gland, Switzerland and Cambridge, UK.

18. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. International Journal of Health Sciences, 6(1), i-v. https://doi.org/10.53730/ijhs.v6n1.5949
19. T1, Debono Printing, Publishing and Distribution, Amman, Jordan.
20. Wittrock, M. C. (1990). Generative Process of Comprehension .Educational Psychologist. 24(4), 345-376.
21. Yolen ،J. ،and B ،C.(1998). Armageddon summer. New York: Harcourt Children's Books
22. Yousif, Hala. (2015). The effectiveness of the mind map strategy in teaching history to develop some of the organizational thinking and decision-making skills of a high school student. Journal of the Society Education for Sociological Studies - Egypt. (71)220-273.

Supporting Information
Some examples show the diagram of Fryer's strategy regulated by pupils.