



Teaching Using RAFT Strategy and Its Effect on the Acquisition of Science Processes among Students of the Second Grade of Secondary School in Physics

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Abstract: This study investigates the impact of teaching using the RAFT strategy on the acquisition of science processes among second-grade secondary school students in physics. Al-Warkaa Secondary School for Boys in Baghdad was selected as the study site, with a sample comprising 60 students divided equally into experimental and control groups. Prior to the experiment, the researcher ensured the equivalence of the groups in terms of chronological age, IQ, previous knowledge, and science operations acquisition test scores. A validated and reliable test of science processes was administered to both groups, and statistical analysis, including the t-test, was conducted to assess the results. The findings indicate that the RAFT strategy significantly enhances the acquisition of science processes among students in the experimental group compared to the control group in the context of physics. The study offers recommendations and proposals based on the results.

Keywords: RAFT strategy, science processes, secondary school education, teaching methodology, experimental study

1. Introduction

The era of technological development and the knowledge explosion is the most prominent feature of our current era in various fields of scientific and practical life, including the fields of education and teaching methods, as it has developed radically. Many modern methods, models and strategies have emerged in the field of teaching physics, which help students to enrich their information and acquire science processes. The most prominent problems that have emerged in teaching physics is the inertia of the subject matter, as well as the adoption of most Physics teachers of the traditional method of teaching them, which depends on memorization and indoctrination and its common use in our schools. which does not contribute to the development of the mental skills of learners, but rather focuses on the preservation and retrieval of information, which led to the poor achievement of students in physics and reluctance to study it. This was reinforced by the researcher's observation of the methods of teaching Physics teachers in secondary schools and their use of regular teaching methods, as well as through seminars held for teachers of the subject from time to time, in addition to the researcher's experience as a physics teacher in secondary schools for more than 25 years, he found that the majority of students find it difficult to absorb the subject because of the usual teaching methods used, and this is confirmed by the results of some studies, such as Al-Qaisi [1] and Maha [2], which led to the interest of the researcher to adopt modern strategies in teaching, including the RAFT strategy

Therefore, the following question is raised in this research:

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Did teaching with the RAFT strategy affect the acquisition of science processes among students of the second intermediate grade in physics?

1.1. Research significance

Teaching science is an urgent need and necessity to face the breadth of scientific knowledge, its tendency and its effect on technological progress, and the development of societies. This requires educators to deal with education as a process that is not limited by time or place and to continue with man as a need and necessity that facilitates his adaptation to environmental developments so that its interest is to teach the student how to learn and how to think as very important future connotations, which required changing the view towards teaching science as means and methods of transferring the content of books to learners as a basic goal for learning science in general and physics in particular to a comprehensive integrated view that means their mental, emotional and skill development and the integration of personality in its various aspects, and teaching them how to think? Rather, how do they memorize courses and books by heart without understanding and employing them in life [3].

Modern education has given great importance to teaching methods, and has considered them the cornerstone of the educational process, because of their great importance in achieving the objectives and translating the objectives that the curriculum seeks to achieve, and they have a clear effect on students' attitudes and attitudes towards the subject matter and towards their teachers, and the teacher's success or failure in his work depends on them. The teaching method is the means that achieves the desired effect in the learner with what the teacher does in the classroom, so it leads to learning. It is of great importance not only because it is the basis of the basics of science, but because it provides the student with a means by which he can keep pace with the growth in knowledge, simplify teaching tasks and help to store similar information in an effective way and receive our needs to address each part of knowledge as a separate part [4].

Physics is one of the experimental sciences that adopt natural phenomena as a subject, experiment and measurement as a means. It is one of the most natural sciences that affect human life and society. There is no scientific and technical revolution, information developments and achievements in the fields of life such as medicine, atomic and peaceful nuclear radiation, communications, business management with computer programs and satellites, astronomy and others, except for physics.

Due to the rapid developments in the educational process, teachers had to try to encourage students in the class room through the use of modern strategies that promote active learning. Students always prefer strategies that allow their discussion and dialogue about the intended content and issues, as the use of these strategies should help students to be more interactive through the way they develop new skills that help them live and new innovations.

One of the modern strategies is the RAFT strategy, as it is one of the modern cognitive strategies, which is short for four words, namely, Role Play, Audience, Format, Topic, and while the learner must play the role of a person or something related to the topic of the lesson, and this requires him to analyze the information and compose some other topics, so that he can play the role of the personality involved in the topic by assuming the role, and is characterized by the learner's positivity, providing interaction with the text, and providing the specific task of writing, and encouraging learners to analyze content when they represent different roles directed to different audiences, and the strategy motivates learners and allows them to choose, interact, and involve them in this topic in a personal way, but it needs a learner with mental abilities trained on it [5].

Science processes are ways of thinking and solving problems, and the use of ideas are processes that describe patterns of thinking. They include specific mental skills that can be gained from scientific activities that are prepared in the learning situation. As

such, science processes play a key role in teaching science and in embodying the nature of science from looking for answers to human questions. These questions are based on his observations of the world around him, and therefore he uses observation, interpretation and inference to reach answers to these questions [6].

The importance of the research can be summarized as follows:

- 1) The application of modern strategies, including RAFT strategies, is consistent with the modern educational philosophy, which emphasizes making the student the focus of the educational process, so that he is effective and positive in various educational situations.
- 2) The importance of teaching physics in secondary schools, which helps students acquire physical information that explains cosmic and natural phenomena.

1.2. Research objectives and hypothesis

The current research aims to identify the teaching of the RAFT strategy and its effect on the acquisition of science processes among students of the second intermediate grade in Physics, and to achieve the goal of the research, it is necessary to verify the validity of the following null hypothesis:

There is no statistically significant difference at the level of (0.05) between the average scores of the experimental group students who study physics in the RAFT strategy and the average scores of the control group students who study the same subject in the usual way in the science acquisition test.

1.3. Research limitations

The current study is constrained by the following factors:

- 1) It involves second-grade middle school students enrolled at Al Warka Secondary School for Boys under the Directorate General of Education Baghdad / Rusafa I during the 2021-2022 academic year.
- 2) The research focuses specifically on the first semester of the academic year 2021-2022.
- 3) The subjects under examination correspond to the content covered in the first semester (movement), second semester (laws of movement), third semester (work, power, and energy), and fourth semester (simple machines) of the science textbook designated for second-grade intermediate students during the academic year 2021-2022.

1.4. Definition of terms

The current study is constrained by the following factors:

- 1) **Teaching** is defined by Ali [7] as

the set of intended educational procedures and activities available by the teacher, through which he interacts with the learners in order to facilitate the learning process and achieve the comprehensive and integrated growth of the teacher.

Therefore, in this research, **teaching** is defined as a set of procedures and activities within the classroom carried out by the teacher in order to facilitate the learning process and achieve the desired objectives.

- 2) **RAFT strategy** is defined by Al-Shammari [8] as being

... concerned with higher thinking skills and aims to integrate reading and writing in an interesting and fun way, carried out at any time before, during or after reading, as well as in pairs, small groups or even for all grade students.

Maaytah et al. [9] also defined **RAFT strategy** as

A strategy in which the integration of reading and writing is done, in an unconventional way, consisting of four steps: the role, the audience, the form of writing, and its subject.

Therefore, the study elects to define **RAFT strategy** as a set of organized and integrated steps taken by the researcher to impose the teaching of physics topics to be taught to the students of the experimental group with the aim of acquiring science processes.

3) **Scientific process**, as defined by Ali [7], is

(a) simple mental processes used in the stages of education where it is easy to acquire and learn and examples (classification, measurement, communication, inference, prediction, conclusion, formulation of hypotheses, interpretation of data and experimentation).

Alwan [10] also defined **scientific process** as

educational habits acquired by the student during his learning or they are specific mental abilities used by scientists and individuals.

Therefore, this study defines **scientific process** as mental processes practiced by students of the second intermediate grade while learning the topics of physics (content under research), including observation, classification, measurement, inference, prediction, communication and interpretation, measured by the degree to which they obtain in the test of science processes adopted by the researcher for the purposes of the current research

2. Theoretical Framework

2.1. RAFT Strategy:

The RAFT strategy, as described by Maaytah et al. [9], is an acronym representing four key elements:

- 1) **R:** Stands for "Role," denoting the function or perspective adopted by the writer, student, or teacher.
- 2) **A:** Represents "Audience," indicating the intended recipients of the written material, which could include teachers, students, parents, etc.
- 3) **F:** Signifies "Format," specifying the particular style or mode of writing, such as narrative, poetry, speech, or message.
- 4) **T:** Stands for "Topic," referring to the subject matter of the writing, conceptualized by the author's imagination.

Table 1. Strategy description

Strategy Description	Objective of the Strategy	Strategy Implementation Time
The strategy consists of four sections: T Subject F Formula A Audience R Role	This strategy is one of the most important strategies that are concerned with thinking and linking reading and writing	This strategy is used during class or at the end of class or as homework

2.2. RAFT strategy steps

Steps for implementing the strategy are as follows:

- 1) The teacher introduces the concept of the strategy to the students, detailing the following components:
 - Author: The various roles assumed by the writer during the writing process.
 - Audience: The intended recipients or target group of the message.
 - Format: The mode or style of presentation, which could include narrative, book, advice, love letters, etc.
 - Subject of writing: The content or theme of the written piece.
- 2) The teacher provides students with copies of the strategy outline and encourages them to brainstorm ideas for the topic, format, audience, and writer's role.
- 3) Students commence writing based on their brainstorming, after which the teacher reviews their compositions and selects some to be read aloud to the class [11].

2.3. Acquisition of scientific processes

Educators emphasize the importance of students acquiring scientific processes as a primary objective of science education. This acquisition should be integrated into teaching methodologies, fostering research skills, scientific thinking, and the ability to conduct experiments. Students require these cognitive skills to effectively engage with scientific concepts and information. Mastery of these processes enables learners to represent and manipulate information mentally, advancing beyond basic understanding [12].

2.4. Scientific processes

Interest in scientific operations emerged in the early 1950s, leading curricula to focus on two main aspects: scientific knowledge and scientific operations. The American Association for the Advancement of Science (AAAS) emphasized the importance of teaching students these operations alongside scientific content. Scientific operations play a vital role in science education, serving as tools for students in their investigative endeavors. By adopting these processes, science curricula aim to cultivate students' mastery of rational knowledge [13,14].

2.5. Classification of Scientific Processes:

Umbu Saidi and Al-Balushi [6] classified scientific processes into two categories:

- 1) Basic Scientific Processes:
 - Observation: Observation involves the systematic collection of information through the senses to explore the causes and laws of phenomena or events. It yields qualitative data [15].
 - Classification: Learners group objects or materials based on common characteristics such as color, size, weight, or density. This process involves identifying and categorizing features and discerning similarities or differences.
 - Measurement: Measurement entails selecting appropriate instruments to quantify properties such as dimensions, distances, volumes, masses, heat, or velocity using standard units [12].

- Inference: Inference involves drawing conclusions based on evidence and facts, linking observations with existing information to issue judgments or generalizations [12].
 - Prediction: Prediction demonstrates the learner's ability to forecast future events based on observations and gathered information [16].
 - Using Numbers: This process involves accurately employing mathematical numbers in scientific measurements and data analysis, including the use of symbols and numerical relationships between scientific concepts [17].
 - Using Space-Time Relationships: This mental process encompasses understanding spatial or temporal relationships between scientific concepts, including observing and dealing with phenomena based on their forms, observation time, proximity, or distance [18].
- 2) Integrated Science Processes:
- Interpreting Data: Learners interpret and classify information and data based on their observations and scientific knowledge [12].
 - Defining Operationally: This skill involves describing observed phenomena based on actions and experiences [19].
 - Controlling Variables: Learners isolate variables that influence a phenomenon to study their effects systematically, aiding in understanding cause-effect relationships [20].
 - Formulating Hypotheses: Learners propose testable solutions or interpretations of relationships between variables or research questions [12].
 - Experimenting: Learners design controlled experiments to study system responses under specific conditions, a fundamental aspect of scientific inquiry [21].

3. Literature Review

Al-Fartousi [22] conducted a study to investigate the impact of the RAFT strategy on the development of creative expression among fifth-grade literary students. Utilizing a partially controlled experimental design, the researcher divided participants into experimental and control groups. The sample comprised 64 fifth-grade literary students, evenly distributed between the two groups. The experimental group was taught using the RAFT strategy, while the control group received traditional instruction. Statistical analysis, including T-tests, chi-square, and Pearson correlation coefficient, was conducted using SPSS. Results indicated that students in the experimental group, instructed with the RAFT strategy, outperformed those in the control group. The study concluded with recommendations for further research.

In another study by Maha [2], conducted in Iraq, the impact of the RAFT strategy on the achievement of fifth-grade biological science students in chemistry was assessed. Employing an experimental design with post-achievement tests, the researcher selected two groups, experimental and control, from secondary school students. The sample consisted of 52 students, and both groups were matched on variables such as chronological age, previous achievement in chemistry, IQ, and parental achievement. Statistical analysis was performed using SPSS. Results revealed a positive effect of the RAFT strategy on the achievement of fifth-grade biological science students, with the experimental group showing greater improvement. The study concluded with recommendations for future research.

Regarding studies on science processes, Al-Qaisi [1] conducted a study to investigate the effect of problem-centered learning on the acquisition of physical concepts and science processes among second-grade middle school students in Iraq. Employing an experimental design with experimental and control groups, the researcher assessed 60 female students. The experimental group received instruction using problem-centered learning, while the control group received traditional instruction. Statistical analysis, including T-tests and Pearson correlation coefficient, was conducted. Results indicated

that the experimental group outperformed the control group in both physical concept acquisition and science process acquisition. The study provided recommendations for future research.

Finally, Al-Amri [23] conducted a study in Iraq to evaluate the effect of teaching the Hands-on strategy on the achievement of second-grade students in science and science operations. Employing an experimental design with experimental and control groups, the researcher assessed 50 students from the second intermediate grade. Statistical analysis, including t-tests and standard deviation, was conducted. Results indicated that the experimental group, instructed using the Hands-on strategy, outperformed the control group in both achievement tests and science operations. The study concluded with recommendations for further research.

Previous research has extensively examined the RAFT strategy as an independent variable within educational contexts. These studies have sought to investigate its influence on various aspects of learning, particularly in terms of acquisition and comprehension, alongside other pertinent variables. The primary focus of researchers has been on secondary education settings, where the effectiveness and applicability of the RAFT strategy have been explored in depth.

Furthermore, the scope of inquiry has encompassed a diverse range of subjects, spanning across disciplines such as science, physics, and biology. By examining multiple subjects, researchers have aimed to assess the generalizability and effectiveness of the RAFT strategy across different academic domains. This approach allows for a comprehensive understanding of how the strategy may impact learning outcomes across various fields of study within the secondary education context.

Overall, the body of research on the RAFT strategy provides valuable insights into its potential benefits and effectiveness in enhancing learning outcomes, particularly in secondary education settings. These studies contribute to the ongoing discourse on innovative teaching methodologies and their implications for educational practice and policy.

4. Method

4.1. Research procedure

Experimental design, as described by Al-Asadi and Fares [24], refers to a structured plan detailing how an experiment is conducted. It entails organizing the conditions and variables surrounding the phenomenon under study in a deliberate manner, followed by observation of the outcomes. In line with the research objective, the researcher adopted an experimental design featuring two groups – an experimental group and a control group – with post-test assessments. This design was selected to effectively investigate the research aims and to validate two null hypotheses. By adhering to this design, the researcher could systematically evaluate the effects of the experimental intervention compared to a control condition. This approach ensured a methodical examination of the impact of the experimental treatment on the targeted variables.

Table 2. Experimental design adopted in this research

Group	Valence	The independent variable	The dependent variable
Experimental group	Chronological age in months	RAFT Strategy	Scientific process
Control group	Previous Collections Scientific process	Regular method	

4.1. Population and sampling

The research population comprises all second intermediate grade students attending

secondary schools under the Directorate General of Education in Baghdad/Rusafa I. From Al Wakra Secondary School for Boys, the researcher selected 105 students divided into three divisions: A, B, and C, consisting of 36, 35, and 34 students, respectively. This school was chosen for its willingness to cooperate with the researcher and the socio-economic homogeneity of its student population.

For the research sample, divisions A and B were randomly chosen, totaling 65 students. Division A represented the experimental group, while Division B served as the control group, comprising 36 and 35 students, respectively. After excluding failing students, the final sample consisted of 60 students, evenly distributed between the experimental and control groups, each comprising 30 students.

4.2. Control of extraneous variables

- 1) **Experiment:** The researcher personally instructed both the experimental and control groups.
- 2) **Maturity:** This variable had no bearing on the experiment's outcomes due to the short, specific, and uniform duration across both groups.
- 3) **Subject:** The researcher ensured parity in the lessons delivered to the experimental and control groups, covering the first four chapters (movement, laws of movement, work, and simple machines) from the science textbook for the second intermediate grade for the academic year 2021-2022.
- 4) **Weekly class schedule:** Physics was taught to both groups with four classes per week, two classes for each group distributed over two days as per the weekly schedule set by the school administration.
- 5) **School building:** The experiment was conducted in one school with similar classes in terms of distance, lighting, and ventilation, thereby minimizing any potential effects of this factor.

4.3. Research requirements

- 1) Setting objectives and formulating behavioral purposes.
- 2) Determining the scientific subject: The researcher identified the study subject for both research groups, encompassing chapters 1-4 of physics topics in the science book for the second intermediate grade for the academic year 2021-2022, covering motion (Chapter 1), laws of motion (Chapter 2), work, power, & energy (Chapter 3), and simple machines (Chapter 4).
- 3) Preparation of the teaching plan: Teaching plans for both research groups were developed based on the content of the first four chapters, resulting in 36 teaching plans overall, with 18 plans for the experimental group following the RAFT strategy and 18 plans for the control group using the traditional method.

4.4. Research instruments

The researcher utilized the Basic Science Operations Test developed by Al-Qaisi (2012) due to its applicability to middle school students in the second grade, specifically in the subject of physics within the Iraqi context, and its demonstrated high validity and reliability. To ensure the validity of the test items, the researcher sought input from specialists in teaching methods, educational, and psychological sciences, who confirmed the adequacy of the test items.

The test's clarity and administration were assessed through two pilot applications. Initially, it was administered to a sample of 30 students from Falcons Secondary School for Boys to evaluate the clarity of instructions and response time. Subsequently, the test was administered to a sample of 100 students from Abdul Karim Qasim Secondary School for Boys to ascertain its reliability.

The reliability of the test was determined using the Cronbach's alpha equation, indicating a coefficient of 0.86, which is considered good and acceptable. According to Duran [25], a reliability coefficient between 0.80 and 0.95 is indicative of high reliability.

4.5. Implementation of the experiment

The experiment commenced on October 10, 2021, with four sessions per week, each group receiving two sessions. Instruction was delivered to both groups according to the researcher's developed teaching plans, with the experimental group following the RAFT strategy and the control group using conventional methods.

The post-test for acquiring science processes was administered to both groups on December 15, 2021.

4.6. Statistical analysis

Statistical analysis involved the use of the T-test for two equal independent samples to compare the mean scores of students in the experimental and control groups. Additionally, the Cronbach's alpha equation was employed to calculate the reliability of basic science processes.

5. Results and Discussion

The researcher conducted the equivalence between the two research groups in a number of variables and the following table shows this.

Table 3 shows the arithmetic mean, standard deviation, and calculated and tabular T-value of the two research groups in the variables of chronological age in months and IQ, previous academic achievement, and the test of science operations.

Table 3. Arithmetic mean, standard deviation, and calculated and tabular T-value of the two research groups in the variables of chronological age in months and IQ, previous academic achievement, and the test of science operations.

Variable	Group	Number	Arithmetic mean	Standard Deviation	T value		Statistical significance at the level of 0.05
					Calculated	tabular	
Chronological age in months	Experimental	30	174.4	4.954	0.392	2.00	Not significant
	Control	30	174.9	4.91			
IQ	Experimental	30	31.3	6.063	0.809	2.00	Not significant
	Control	30	30/03	6.084			
Previous Academic Achievement	Experimental	30	67.36	12.783	0.573	2.00	Not significant
	Control	30	69.36	14.25			
Science Process Acquisition Test	Experimental	30	18.5	2.432	1.02	2.00	Not significant
	Control	30	17.9	2.103			

After applying the test to the two research groups and correcting the students' answers and using the T-test as a statistical method, the results were shown in Table (2)

Table 4. The arithmetic mean, standard deviation, variation, calculated and tabular T-value of the scores of the members of the two research groups in the test of acquiring the operations of dimensional science and the tabular value (theory)

Group	Sample Individual	Arithmetic mean	Standard Deviation	Variance	Degree of freedom	T value Calculated	tabular	Significance level at 0.05
Experimental Strategy RAFT	30	28.86	3.285	10.792	58	7.733	2.00	(Significant at 0.05 level)
Control the usual method	30	21.9	3.681	13.556				

It is clear from Table 2 that the experimental group that studied according to the RAFT strategy outperformed the control group that studied according to the usual method in the test of acquiring science processes.

This can be explained to the following reasons:

- 1) This strategy helped students to organize their ideas because it focuses on deep thinking, which made students the focus of the educational process, increasing their creative abilities to reach better and accurate outputs.
- 2) Teaching using a new strategy of suspending students and attracting their attention to the lesson, which led to a spirit of fun, enthusiasm and cooperation among them and thus increased their acquisition of science processes.

6. Conclusion

6.1. Conclusion

The findings of this study highlight the efficacy of the RAFT (Role, Audience, Format, Topic) strategy in enhancing science operations acquisition among the experimental group in comparison to the control group. It is evident that teaching with the RAFT strategy demands greater engagement, effort, and cognitive processing from students when compared to conventional learning methods. This suggests a promising avenue for improving learning outcomes and student engagement in science education.

6.2. Recommendations

Based on the results obtained, it is recommended to prioritize the training of physics teachers in secondary schools to effectively implement modern teaching methods, including the RAFT strategy. Additionally, efforts should be made to provide comprehensive libraries containing research on modern teaching methodologies, including the RAFT strategy, to enhance educators' knowledge and proficiency in utilizing contemporary teaching approaches.

6.3. Proposals

Future research endeavors should focus on investigating the impact of the RAFT strategy on other variables such as the development of positive thinking among students. Moreover, exploring the applicability of the RAFT strategy across various subjects and educational levels could provide valuable insights into its broader utility and effectiveness in diverse learning contexts.

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