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The Effectiveness of Instrumental Enrichment on Developing Primary Language School Pupils' Reasoning Skills and Achievement in Science

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Abstract

The present study investigated the effectiveness of instrumental enrichment on developing primary language school pupils' reasoning skills and achievement in science in the first semester of the academic year (2021–2022). A quasi-experimental design was adopted. The researcher used a reasoning skills test and an achievement test as research instruments. The study sample consisted of 60 participants from fifth grade. The sample was selected from the distinguished Sherbien Official Language School and divided randomly into two groups: the experimental group (n = 30) and the control group (n = 30). The experiment lasted for six weeks, after which research instruments were applied. The results revealed that instrumental enrichment had a positive effect on students' reasoning skills and achievement. Results also revealed that there is a statistically significant difference at ($\alpha \leq 0.05$) level between the mean score of the experimental group and the mean score of the control group in favor of the experimental group in both reasoning skills achievement in science.

Keywords: Instrumental Enrichment, Reasoning Skills.

1. Introduction:

Science education today has great challenges for science teachers, not only about how to teach but also how to do it in a more innovation-relevant way so that students can considerably develop their scientific skills and attitudes (Martin, Prieto & Jimenez, 2016). The use of experimental steps in inquiry methods including cognitive and metacognitive activity should be used in science teaching to improve the reasoning process, as the effectiveness of the student's science teaching process has an impact on science comprehension (Artayasa, Susilo, Lestari, & Indriwati, 2018).

The Malaysian Curriculum Development Centre has emphasized the importance of acquiring reasoning ability and using its skills in an inductive or deductive way as it can potentially assist students to think outside the box (Curriculum Development Centre, 2005). Most traditional education settings place importance on content learning in fostering student reasoning abilities.

Furthermore, most studies indicated that scientific reasoning strongly correlates with cognitive abilities as effective science reasoning involves logic, justification, rational thinking, and decision making (Lei Bao et. al, 2009).

Students' reasoning skills are defined as the procedures through which they rethink and recreate their hypotheses about the world through experimentation and induction, resulting in logical comprehension. It is the foundation for students' acquisition of logical knowledge concurring with the procedures they use to identify, assess, revisit, and transmit it (Andersen & Garcia-Mila, 2017).

As a mental process that comprises operating and using the information to solve issues, make decisions, and attain goals, reasoning abilities emerge as a complex construct that has been recognized as an essential aspect of scientific education (Uswatun,2020).

Students, on the other hand, continue to struggle hard with reasoning application. These difficulties are caused by insufficient learning strategies, resulting in a level of reasoning that is still low, poor, and disintegrated (Suhandi, Nugraha & Muslim, 2017).

This is due to the three science-related disciplines: chemistry, biology, and physics. These disciplines are inherently different in terms of a scientific concept, context, and knowledge. (Zulkipli, Yusof, Ibrahim & Dalim, 2020) pointed out that the different disciplines in science will have varied effects on pupils, particularly in the manner they collect and organize data, this would affect the way students process information in carrying out their scientific reasoning.

Thus, it is necessary to choose the appropriate strategies or programs to develop thinking skills in general and reasoning skills in particular on the one hand and to treat deficiencies and weaknesses faced by students when studying science on the other hand, and this is what this study aims to do.

Researchers are emphasizing the importance of reasoning skills in science more and more these days. (Opitz, Heene & Fischer, 2017). Many studies have reported that the traditional method used in science teaching has led to a low level of achievement, due to its reliance on memorization and receiving a lot of information without understanding; It also does not focus on higher mental skills and is limited to knowing facts and concepts without the learners' understanding of them (Lee& She, 2010). Many studies indicate a deficiency in reasoning thinking skills, such as the study (Stammen etal., 2018), and this deficiency has a negative impact on the

achievement level of learners, as the results indicate a direct correlation between reasoning skills and academic achievement.

This led some researchers and specialists in the educational fields to conduct research and studies and try different methods and strategies that would contribute to reaching good educational results in science. In this regard, (Strang& Shayer,1993) indicate that many programs aim to train learners on thinking skills, such as the instrumental enrichment Program, which studies have proven it's effective in developing thinking skills.

The Instrumental Enrichment Program is based on the idea that the mental capacities of learners with delayed cognitive performance are not fixed properties, but may be changed and modified through targeted educational programs aimed at producing cognitive structural changes. (Feuerstein, Feuerstein, Falik & Rand, 2006), as this cognitive program, according to (Otilia ,2014) has been shown to be effective in overcoming deficiencies in learning.

If the basis of the instrumental enrichment is the concept of cognitive modification - as constructive changes - that occur to the student through an intentional intervention, then its purpose is to give students concepts and master skills and mental processes that are needed to modify their cognitive structure and improve their cognitive performance (Elbanna (In Arabic), 2000, p.6).

Through the above, the researcher found that it is necessary to use learning strategies and programs that depend heavily on the learner to make him the focus of the educational process and be active and effective, so does teaching with using the Instrumental Enrichment have an impact on the development of reasoning skills and achievement in science? This is what the current study seeks as a primary goal of the research.

2. Statement of the problem:

The problem of the research explored through answering the following main question:

What is the effectiveness of instrumental enrichment on developing primary language school pupils' reasoning skills and achievement in science?

This main question was subdivided into the following sub-questions:

1. What is the effectiveness of instrumental enrichment on developing primary language school pupils' reasoning skills in science?

2. What is the effectiveness of instrumental enrichment on developing primary language school pupils' achievement in science?

3. Research Objectives:

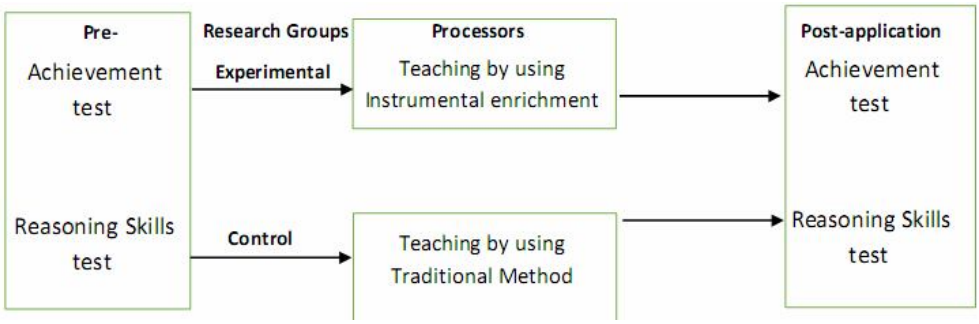
The present research aimed at achieving the following:

1. To identify is the effectiveness of instrumental enrichment on developing primary language school pupils' reasoning skills in science.
2. To identify the effectiveness of instrumental enrichment on developing primary language school pupils' achievement in science.

4. Significance of Research:

1. Responding to recent trends that have called for attention to strategies for instrumental enrichment in the development of reasoning Skills.
2. Attracting the attention of science teachers to get rid of traditional methods and use instrumental enrichment to improve teaching process.
3. Providing science teachers with procedural steps for instrumental enrichment that contribute to the development of reasoning skills and achievement.
4. Providing opportunities for researchers to use instrumental enrichment in different approaches and many different learning stages.
5. The current study may help researchers to conduct further research with different research design to develop other skills.

5. Research Design:



6. Research variables:

6.1. The independent variable (teaching methods):

a- Instrumental Enrichment.

b- Traditional method.

6.2. The dependent variables are:

a- Achievement.

b- Reasoning Skills.

7. Research Instruments:

- An achievement test in science (Prepared by the researcher).
- A Reasoning skills test in science (Prepared by the researcher).

8. Research materials:

- Teacher's guide (Prepared by the researcher according to Instrumental Enrichment).
- Pupil's activity book (Prepared by the researcher according to Instrumental Enrichment).

9. Research Sample:

The sample of the research consisted of (60) participants from fifth grade, and divided randomly into two groups: the experimental group (n = 30) and the control group (n = 30).

10. Research Procedures:

The research carried out in the following steps:

1. Reviewing previous studies related to the subject of the study to form the theoretical framework.
2. Preparing the selected unit (Energy) according to instrumental enrichment.
3. Preparation research materials (teacher's guide and activity book) according to instrumental enrichment.
4. Preparing the instrumental enrichment instruments (reasoning skills test and achievement test) according to instrumental enrichment.
5. Providing research materials and instruments to a group of juries to verify their validity and make adjustments according to their opinion.
6. Selecting the main sample for the research from fifth grade primary pupils (which consists of two groups), one of which learned by the traditional method and the other group by instrumental enrichment.
7. Administering the pre and posttests of (reasoning skills test and achievement test) on both groups.
8. Processing the collected data statistically using appropriate statistical methods.
9. Presenting a set of recommendations and proposals in light of the results.

11. Literature Review:

11.1. Reasoning Skills:

One of the fundamental tasks in education research is to understand what influences student learning (National Research Council, 2000). Through many studies, it was found that several key factors that are postulated to exert significant influences on student learning among them: are student reasoning skills and epistemological sophistication levels (Moore & Rubbo, 2012)

The concept of reasoning is defined as the goal-driven process of drawing conclusions which informs problem-solving and decision-making efforts (Leighton & Sternberg, 2004). Sternberg & Sternberg (2012) explained that in reasoning "we move from what is already known to infer a new conclusion or to evaluate a proposed conclusion" (p. 507).

- **Types of Reasoning Skills:**

Reasoning skills can be classified according to (Kwon, Lawson, Chung & Shin Kim, 2000) into three skills as follows:

Deductive reasoning:

According to Michal & Ruhama (2010), deductive reasoning is "the process of inferring conclusions from known information (premises) based on formal logic rules, where conclusions are necessarily derived from the given information and there is no need to validate them by experiments"(p.1131).

In another meaning, deductive reasoning is the process of drawing a conclusion based on premises that are generally assumed to be true, that is," moving from general to the particular"{top-down reasoning}. If something is assumed to be true and another thing relates to the first assumption, then the original truth must also hold for the second thing.

The process of deductive reasoning starts with premises and attempts to reach a logically secure conclusion or a series of conclusions from prior beliefs, observations, or suppositions that are not explicit in the initial premises(Wang, Zhang, Zou, Wu & Wang , 2020).

Inductive reasoning:

Inductive reasoning is considered one of the most important component skills of almost all transversal skills such as problem-solving and general intelligence (Molnár, Greiff, & Csapó, 2013), it constitutes a driving force of cognitive development (Perret, 2015). It plays a central role in learning processes, such as knowledge acquisition and application

(Molnár et al., 2013) and is a good indicator of learning potential. Inductive reasoning plays a part in a wide range of daily cognitive activities, including categorical generalization, analogical reasoning, causal reasoning, or probabilistic judgment, scientists often consider it as a higher thinking skill (Perret, 2015).

It is also defined that covers the processes of moving from the specific to the general (direction), generalizing, and deriving broad rules based on single experiences and observations (Sandberg & McCullough, 2010).

Through the above, Inductive reasoning in some ways it's the opposite of deductive reasoning, as it involves reasoning from a specific case or cases to derive a general rule, it is a method of logical thinking that combines observations with experiential information to conclude, {down-top reasoning}.

Conclusion Reasoning:

It is reaching certain results based on facts and sufficient appropriate evidence, that is, the conclusion occurs when the student can link his observations and information about a phenomenon, with his previous information about it, and then issue a specific judgment that explains these observations.

(Ding, Wei & Liu, 2016) refers that the reliance of reasoning thinking on the skills of deduction and induction only leads to general rules and unrelated facts, but if it links these general rules by finding a relationship between them and trying to deduce other relationships, this would show results they were hidden before and the reasoning become productive.

The deduction skill enables the student to apply a general rule or a general principle, meaning that it is a mental process during which moving from general to the particular, takes a symbolic or abstract linguistic form for concluding, while the induction skill is used to discover a general rule from special cases. It is a process during which the moving takes place from particular to the general, as it aims to reach definite conclusions or generalizations that go beyond the limits of the available evidence, where information is collected and find interrelationships between them until results are reached according to this information that we have obtained, thus, the conclusion is an inductive product.

There are many studies have dealt with reasoning skills due to its importance such as Setambah (2018) This study showed the lack of

reasoning skills has been recognized as one of the contributing factors to the declined achievement in the Trends in Mathematics and Science Studies (TIMSS) and Programme for International Student Assessment (PISA) assessments in Malaysia.

Uswatun (2020) This study aimed to examine the impact of Science, Technology, Engineering, and Mathematics (STEM) instruction on strengthening the reasoning skills of Indonesian high school students.

Ilhan & Aslaner (2020) In the study, the correlations between visual mathematics literacy perceptions, reasoning skills on geometrical shapes and geometrical performances of pre-service mathematics teachers were investigated.

11.2. Instrumental Enrichment:

The Instrumental Enrichment was prepared by Feuerstein in 1979 to improve cognitive performance and reach higher levels of thinking, through acquiring cognitive skills and modifying the cognitive structure. And this led to its adoption in various educational areas.

Instrumental enrichment is designed as a direct and focused attack on those mental processes in need of strengthening. The method teaches students the process of learning "how to learn". According to Feuerstein, who was behind the method, “Intelligence is not a static structure, but an open system that continues to develop throughout life”. The instrumental enrichment program aims to change the cognitive structures of the brain and transform the student’s passive and dependent cognitive style into that of an active, autonomous, and independent learner.

- **Instrumental Enrichment Theoretical Frameworks:**

Mediated Learning Experiences:

Mediated learning experience (MLE) is defined as a high-quality interaction between a learner and a mediator, in which the mediator intervenes in the learner's learning by putting himself/ herself between the learner and the stimulus (task) and the learner's response (Falik & Feuerstein, 2005). In the sense that MLE refers to the process in which stimuli experienced in the environment are transformed by a mediating agent, whether a parent, teacher, sibling or other person in the learner's life. MLE processes also represent a special quality of interaction between a mediator and a learner (Feuerstein et al, 2002; Feuerstein et al, 2006; Tzurie, 2013).

Feuerstein's theory of Mediated learning experience (MLE) builds on Piaget's constructivist theory. Whilst it gives importance to the child's interaction with the environment, also highlights the importance of a mediator who scaffolds the learning process for the child. (Ong, 2016). Feuerstein proposes that there are two modalities of learning, a direct approach and a mediated approach (Tzuriel, 2013). The difference between the two types of learning is that the former is incidental while the latter is intentional.

Cognitive Map:

The cognitive map is defined by Feuerstein et al. (1988) as "a tool by which to locate specific problem areas and to produce changes in corresponding dimensions, it allows the analysis of the individual's cognitive behavior" (p.269). The cognitive map describes the mental act in terms of seven parameters that permit us to analyze and interpret a subject's performance, these parameters are:

- The content.
- The modality or language in which the mental act is expressed.
- The mental act.
- The cognitive operations required by the mental act.
- Level of complexity.
- Level of abstraction.
- The level of efficiency.

Structural Cognitive Modifiability:

Feuerstein's main theory, Structural Cognitive Modifiability, in which Feuerstein posits that the human brain is an open system, having plasticity that renders it malleable and capable of growth and structural change throughout our lifetime, and intelligence is dynamic and modifiable, also parents and teachers have an important role in the cognitive development of the individual (Feuerstein, Tannenbaum, & Klein, 1991).

The notion of structural cognitive modifiability, therefore, emphasizes the quality of the interaction between the mediator (the parent, caregiver or teacher) and the child to initiate structural and permanent change in the developing child.

According to Feuerstein (2008), structural cognitive modifiability is the ability "to create modalities of mental and cognitive functions not previously present in the individual's repertoire" (p. 6). Feuerstein et al. (1979) interpreted structural cognitive modifiability as the basis of

instrumental enrichment, which means bringing about structural changes to the individual through the intervention of an intended program aimed at improving the individual's response and interaction with the stimuli of the environment around him through a set of activities based on mediated learning experiences to increase the learner's experience and overcome the deficiencies that appear in the mental act process.

Feuerstein, Feuerstein & Falik (2009) indicate that these structural changes are not intended merely to acquire a piece of knowledge or certain skills; rather, it means the broad meaning that is related to the individual's behavior, interaction, and response to situations that change in his environment.

Learning Potential Assessment Device:

The LPAD is defined as " a method used to evaluate the propensity of the individual to become modified, to study the reasons for his low functioning to be able to remedy them and to pave the way for the development of more efficient levels of functioning" (Feuerstein et al,1988, p.197). The basic idea is that, to know what kind of intervention would work best, it would be more suitable to explore how an individual learns and relearns things and what effort it takes. Through learning situations in which it is possible to observe the learner's performance during the learning process and identify the weaknesses and strengths in his performance, the teacher_ as a mediator_ can identify the tools that can be used to modify and change the learner's cognitive structure (Feuerstein, 2003).

In addition, LPAD instruments and procedures include two conceptual frameworks which guide the observation and decision-making of the assessment: the deficient cognitive functions and the cognitive map. These constructs are the basis for the construction of the instruments and form the procedures of the assessment. Thus, the LPAD examiner must have a high degree of familiarity with them to conduct the assessment (Falik & Feuerstein, 2005).

According to Feuerstein et al. (2002), LPAD has a complex meaning: it contains elements of cognition, attention, working memory, higher cognitive and mental processes, metacognition, as well as elements of motivation, emotional attitude towards learning, interaction with the environment, and elements of learning efficiency.

Also, it concentrates on the mediator role who contributes to discovering the changes in the behavior of learners, in light of his understanding of the seven dimensions of the cognitive map, then makes

interpretations of the learners' answers to predict the learners' ability to learn (Lebeer, 2011).

Many studies have dealt with the effect of using instrumental enrichment such as (Ben-Hur& Feuerstein, 2011) argued that the importance of inserting instrumental enrichment programs in general education early to eliminate previous contradictions in children's cognitive abilities, prevent learning difficulties at a later time, eliminate achievement gaps, and prevent teaching and learning problems, also indicate the importance of instrumental enrichment in developing cognitive functions, such as helping the learner in learning and applying basic concepts, classifications, effective thinking processes, thinking habits, and enhancing self-confidence.

Sebestian (2020) suggested that the students who continued the instrumental enrichment program made good gains in the targeted goals, The results also indicated that pleasure and self-confidence mediate the relationship between effort and academic achievement.

(Alyassri & Kamil, 2020), The aim of the research is to know the use of the means of enrichment strategy and its effect on achievement and thinking skills in mathematics among first-graders middle school students. and results revealed that instrumental enrichment had a positive effect in favor of the grades of students of the experimental group.

12. Research Hypotheses:

In the light of the research problem and literature review, the researcher came up with the following hypothesis:

1. There is no statistically significant difference at ($\alpha \leq 0.05$) between the means of scores for the experimental group and the control group in the post application of the reasoning skills test.
2. There is no statistically significant difference at ($\alpha \leq 0.05$) between the means of scores for the experimental group and the control group in the post application of the achievement test.

13. Methodology:

In order to achieve the objectives of the study, the following steps were applied:

1. A quasi-experimental design was adopted.
2. Choosing the content: The “Energy” unit as was chosen as an experimentation unite.
3. Preparing teacher's guide.

4. Preparing pupil's activities book.
5. Choosing the research sample from the distinguished Sherbien Official Language School (n = 60), which divided into two groups: an experimental group (n = 30) that was taught by using the instrumental enrichment, and the control group (n = 30) that was taught by using the traditional method.
6. Preparing research instruments (reasoning skills test and achievement test).
7. Appling the tests to a pilot random sample of (15) pupils in the fifth grade from outside the main study sample to calculate the degree of:
   - The stability value of the reasoning skills test using Kuder Richardsone Equation, and it was (0.689), which indicated that the test has an acceptable degree of stability in light of the current research purposes.
   - The correlation coefficients of the reasoning skills test, and they were all significant at the level of (0.05), (0.01).
   - The stability value of the achievement test using Kuder Richardsone Equation was (0.785), and using the half-segmentation was (0.768), which indicated that the test was characterized by an acceptable degree of stability in light of the current research purposes.
   - The correlation coefficients of the achievement test, and they were all significant at the level of (0.05), (0.01).
8. Administering the reasoning skills pretest and achievement pretest to the study groups.
9. Teaching the unit to the experimental group by using instrumental enrichment.
10. After teaching the assigned unit, the reasoning skills posttest and achievement posttest were administrated to the study groups.
11. processing the results of the study statistically.

14. Statistical Methods:

In order to verify the research hypotheses, the statistical package for social sciences (SPSS/PC$^+$)was used as follows:

1- "T" test for two independent groups.

2- The effect size (η^2) for measuring the effectiveness of using activities based on instrumental enrichment on developing reasoning skills and achievement in science to the experimental group.
3- Spearman Correlation Coefficient.
4- Kuder Richardsone Equation.

15. Results and Discussion:

15.1. Testing the First Hypothesis:

The first hypothesis states that" There is no statistically significant difference at ($\alpha \leq 0.05$) between the means of scores for the experimental group and the control group in the post application of the reasoning skills test".

To test this hypothesis, the researcher used the T-test to verify the hypothesis; as shown in table (1):

Table (1): The Mean, St. Deviation and T- values for post application of reasoning skills test

Reasoning Thinking Dimensions	Groups	N	Mean	St. Deviation	T	DF	Statistical significance
Induction	Experimental	30	12.2667	1.68018	5.306	58	Significant at 0.05
	Control	30	8.3000	3.73382			
Deduction	Experimental	30	12.3667	2.69717	9.685	58	Significant at 0.05
	Control	30	4.9667	3.20004			
Conclusion	Experimental	30	11.8333	2.24505	4.537	58	Significant at 0.05
	Control	30	8.5000	3.33994			
Total score	Experimental	30	36.4667	6.17968	7.330	58	Significant at 0.05
	Control	30	21.7667	9.08080			

Benverone correction for t-value (58, 0.0125) = 2.01

Looking through the results in a table (19) that all the values of "t" came in a statistically significant manner at the level ($0.05 \geq \alpha$), which meant that there were differences between the means of the two groups in favor of the experimental group. This demonstrated the superiority of the experimental group over the control group in both the dimensions of

reasoning skills and the post total degree. Therefore, the Zero hypothesis was rejected, and accepted the alternative hypothesis, which stated that:

"There is a statistically significant difference at ($\alpha \leq 0.05$) between the means of scores for the experimental group and the control group in the post application of the achievement test in favor of the experimental group". These means can be graphically represented as follows:

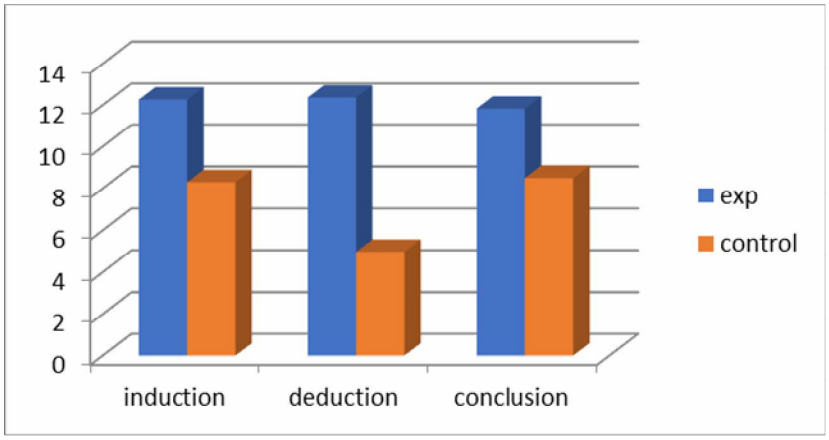


Figure (1): The means of experimental and control research groups in dimensions of reasoning skills

The effectiveness of the instrumental enrichment was determined on developing reasoning skills by using the "η^2" equation to quantify the effect based on T values, as shown in table (2):

Table (2): The value of "η^2" and the effect size of the instrumental enrichment Strategy on developing the reasoning skills

Reasoning Skills Dimensions	T	η^2	The Effect
Induction	5.31	0.33	High
Deduction	9.69	0.62	High
Conclusion	4.54	0.26	High
Total score	7.33	0.48	High

The results demonstrated in table (20) show that all the values of "h2 "were of a high effect ؛ while its values for the dimensions of reasoning skills that were included in the test ranged from 0.32-0.39. It also appeared that the effect of instrumental enrichment on developing reasoning skills as a whole amounted to 0.40. This meant that the contribution of the instrumental enrichment to the variance in reasoning skills was 40%, which

is a value that expressed a high effect size according to the graduation based on the values of "η^2" .

The data results reveal that the development on achievement could be influenced by the following factors:

1. Changing the method of teaching that relies on providing information-theoretically to pupils in order to memorize it only to a method based on instrumental enrichment activities that provides information that helps pupils understand it more than memorize it.
2. Through instrumental enrichment activities, complex or abstract concepts and ideas can be expressed in concrete ways that can make pupils encode and recall their knowledge easier.
3. The independent work of each student leads to enhance attention because it keeps pupils focused on the subject matter.
4. The diversity of educational methods used, as instrumental enrichment includes many activities that would make pupils active during the learning process.
5. The discussion between the teacher and pupils leads to increase motivation towards learning, generating inquiries, creating new ideas, increasing the interaction between students, and participation in the educational process.
6. Instrumental enrichment makes the pupil the center of the educational process and does not make him a passive recipient of information.
7. The role of the teacher as an effective mediator between the students and the activities they solve, as he guides the students and directs them to the basic steps that must be followed, which encourages the students to solve the activities and this leads to the survival of impact learning.

15.2. Testing the Second Hypothesis:

The second hypothesis states that" There is no statistically significant difference at ($\alpha \leq 0.05$) between the means of scores for the experimental group and the control group in the post application of the reasoning skills test".

To verify that hypothesis, the researcher used T-values as shown in table (3):

Table (3): The Mean, St. Deviation and T- values for post application of achievement test

Achievement dimensions	Groups	N	Mean	St. Deviation	T	Degree of freedom (df)	Sig
Knowledge	Experimental	30	14.4667	2.27025	6.138	58	Significant at 0.05
	Control	30	9.0667	4.25022			
Comprehension	Experimental	30	14.3333	2.45418	5.740	58	Significant at 0.05
	Control	30	9.3000	4.12854			
Application	Experimental	30	6.9333	1.17248	5.244	58	Significant at 0.05
	Control	30	4.6667	2.05667			
Total Score	Experimental	30	35.7333	5.33003	6.186	58	Significant at 0.05
	Control	30	23.0333	9.90118			

Benverone correction for t-value (58, 0.0125) = 2.01

The results in table (3) show that all "t" values came in a statistically significant manner at the level ($\leq 0.05\alpha$), which meant that there were differences between the two groups' mean scores in achievement in favor of the experimental group. This indicated that the experimental group outperformed the control group in both achievement dimensions and total score. The Zero hypothesis was therefore rejected and accepted the alternative hypothesis, which stated that:

"There is a statistically significant difference at ($\alpha \leq 0.05$) between the means of scores for the experimental group and the control group in the post application of the achievement test in favor of the experimental group".

These means can be graphically represented as follows:

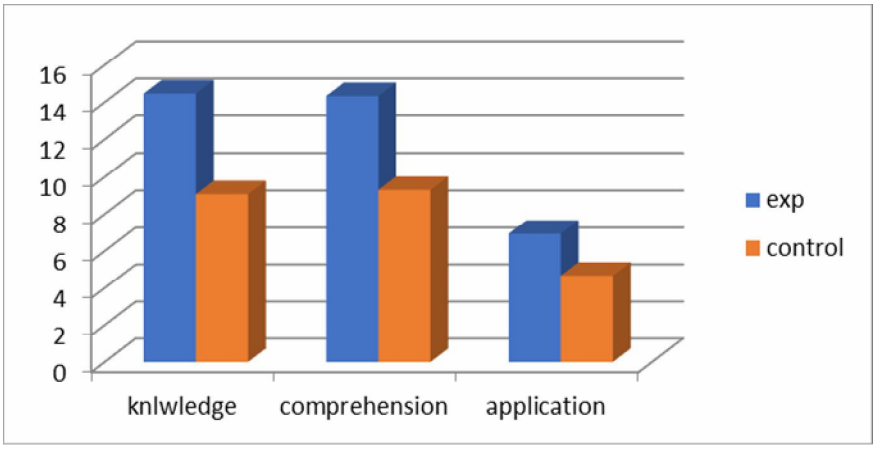


Figure (2): The mean scores of the two research groups (the experimental group and control group) at the achievement dimensions.

The effectiveness of the instrumental enrichment was determined on developing achievement by using the "η^2" equation to quantify the effect based on T values, as shown in table (4):

Table (4): The "η^2" value and the effect of instrumental enrichment on developing achievement.

Achievement dimensions	T	η^2	The effect size
Knowledge	6.14	0.39	High
Comprehension	5.74	0.36	High
Application	5.24	0.32	High
Total score	6.19	.40	High

It was clear from the previous table (4) that all values of "η^2" were high effect ؛ while its values for the achievement dimensions that were included in the test ranged from 0.32-0.39. It also appeared that the effect of instrumental enrichment on developing the achievement as a whole amounted to 0.40. This meant that the contribution of the instrumental enrichment to the variance in achievement was 40%, which is a value that expressed a high impact according to the graduation based on the values of "η^2" .

The data results reveal that the development on reasoning skills could be influenced by the following factors:

1. The instrumental enrichment activities represented in illustrations, syllogisms, classifications, comparisons, helped students to analyze,

distinguish, and conclude, which led to the development of reasoning skills.

2. The pupil's activity book, which was prepared by the researcher in the context of the unit's content, includes various activities based on the pupils' inferring of the generalizations and facts included in the unit by themselves.
3. The pupil's activity book also includes activities and exercises that provided the opportunity for him to present their ideas and benefit from the opinions of others, which contributed effectively on developing reasoning skills.
4. Discussion method, positive interaction between students and the teacher, and providing the opportunity to think about different learning situations during solving activities had a clear impact on developing reasoning skills.
5. Teaching according to instrumental enrichment, in which a number of activities are presented, which includes a set of exercises that require pupils to describe events, explain the phenomenon, infer scientific principles, analyze and classify things, the repeated use of these activities increased the pupil's ability to practice reasoning skills such as:
   - Activity based on syllogisms, pupils gain the ability to discriminate between valid and invalid conclusions and between possible and inevitable outcomes.
   - Activity based on comparisons, that pupils learn to organize and integrate separate and distinct bits of information into coordinated and meaningful systems.
   - Activity based on orientation in Space, improved defining problem when no instructions are given, hypothetical thinking: "If . . . then.", use of logic to solve tasks for which the information is not directly provided, applying the relative (internal) system of reference and the absolute (external) system of reference to describe and understand spatial relationships and internalization of the relationship between the elements of the system of reference.
   - Activity based on analytic perception enhances students' ability to differentiate (divide a whole into its parts) and integrate (join parts into a whole).
   - Activity based on family Relations demand precise use of language in encoding and decoding relationships and require

inferential thinking, analytic thinking, and deductive reasoning to justify conclusions based on logical evidence.

- Activity based on illustrations improved pupils' ability to define the problem, use of relevant cues as a basis for inference, use of hypothetical thinking and use of logical evidence to support conclusions and establishment of relationships between the individuals, objects, and events shown in the illustrations.
- Activity based on transitive relations improved pupils' ability to deal with relationships that exist in ordered sets, which differentiates between set members and described by the terms "greater than," "less than," and "equal to." This instrument helps student recognize conditions that permit deductive and inductive reasoning.
- Activity based on categorization help pupils develop flexibility and divergent thinking necessary for categorizing and re-categorizing of the same objects into different sets as the principles and parameters of categorization change with new needs and objectives, and that led to improve reasoning skills.

6. Using the appropriate feedback for pupils, whether material or moral, and showing approval and encouragement to students, all of this has a role in developing reasoning skills.
7. The instrumental enrichment contributed to creating a stimulating environment for reasoning skills, through a variety of different evaluating methods, which helped the pupils to observe, analyze, and distinguish.

16. Conclusions:

Based on the previous results the current study was concluded in the following points:

1. It offered evidence for the effectiveness of using activities based on instrumental enrichment in improving pupils' reasoning skills and their achievement in science.
2. Activities based on instrumental enrichment gave pupils the chance for participating and enriching their learning process.
3. Modifying the teacher's role as a mediator facilitated pupils' learning and created an interactive atmosphere in the classroom.
4. The study validated the results of previous studies that proved the positive effect of utilizing instrumental enrichment on teaching.

5. Through using instrumental enrichment activities, the pupils were helped in understanding the science concepts and processes better.
6. This study has proven that adopting mediated learning experience method make the pupils to become independent knowledge recipients and later become self-mediators in order to extend their knowledge acquisition system.
7. Also, this study showed that the environment where the lesson took place and the materials used significantly influenced the concentration and motivation of the pupils. When the environment was creative and the materials favored the cognitive development of children, the pupils worked more productively, showing enthusiasm and willingness.
8. Additionally, MLE has significant impacts and contributions on the meaningful Science learning also it has significant role on acquisition reasoning skills. When considered from another point of view, the MLE model provides teachers to reconsider their roles as a mediator. MLE gives a role of being "facilitators of the learning", "mediators of knowledge source", "mediators of lifelong learning", and "designers of the learning environment" (Seng, 2003).

17. Recommendations:

Based on the results of the present study, the following are recommended:

1. Curriculum makers should search for new techniques and programs to develop pupils' reasoning skills and their achievement in science.
2. Teachers should integrate the mediated learning experience in teaching science.
3. It is important for teachers to choose the appropriate instrument for the student's performance level, as this program has many instruments that suit all students at all levels.
4. Instrumental enrichment activities should be integrated as a framework for developing reasoning skills of the primary stage.
5. Re-drafting the science curriculum in a way that helps in developing thinking in general and reasoning in particular.

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