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The Effect of Using a Program Depending on Argument Based Inquiry Approach Via "Write-to-Learn Strategy" on 8th Grade Students' Self-Regulation Skills and Their Abilities to Form Scientific Mental Models

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The Effect of Using a Program Depending on Argument Based Inquiry Approach Via "Write-to-Learn Strategy" on 8th Grade Students' Self-Regulation Skills and Their Abilities to Form Scientific Mental Models

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Dedication

I dedicate my dissertation work to my loving parents whose words of encouragement still ring in my ears; I believe that my success is owed to you. I also dedicate this work to my husband and his family, who were patient and supported me throughout the process, thank you for giving me the trust and strength to achieve my dream.

To the two boys who light my world with joy and love, my sons Julian and Adrian, I will always dedicate my success to you.

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Riham Nathim Andrawos Hilal

Declaration:

I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and this thesis has not been submitted for the higher degree to any other university or institution.

Signature: --------------------------

Name: Riham Nathim Andrawos Hilal

Date: 16/8/2017

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Abstract

The Purpose of this study is to investigate the effect of using a program depending on argument based inquiry approach via "write- to- learn strategy" on 8th grade students' self-regulation skills and students' abilities of forming scientific mental models. As well as the effect of the interaction between argument based inquiry approach via write to learn strategy method of teaching, and gender on 8th grade students' self-regulation and students' abilities to form scientific mental models. The study was conducted on a purposive sample of 8th grade students (females and males) enrolled at public schools in Jerusalem district. The schools are: Bethany Secondary School for Girls and Al Ma'ahad Al Arabi School for Boys during the second semester of the academic year 2016\2017. The Sample consisted of 152 students of the 8th grade (71 females and 81 males). Students from both schools were assigned to experimental and control group randomly. The experimental group was taught a whole unit by the argument based inquiry approach via "write-to-learn strategy", while the control group was taught by the traditional method. The experiment lasted for two months. The researcher has prepared two instruments for the study, Self-Regulation Questionnaire and Mental Model Exam. Content validity and reliability was done for both instruments. A pre and post questionnaire and test were done for all of the participants to measure the effect of using a program depending on argument based inquiry approach via "write- to- learn strategy" on 8th grade students' self-regulation skills and students' abilities of forming scientific mental models. The means, standard deviations, and (2-way ANCOVA) test were used in the study. The findings of the study showed that there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to method of teaching in favor of the experimental group, there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to method of teaching in favor of the experimental group, there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to gender in favor of males and there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to the interaction between method of teaching and gender in favor of males in the experimental group. Furthermore, there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to gender, and there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to the interaction between method and gender.

In the light of these results the researcher recommends using the argumentation via "write-to-learn strategy" in teaching science due to its effect in improving students' skills.

أثر استخدام برنامج يعتمد على الدمج بين استراتيجية الاستقصاء المبني على الحجة واستراتيجية الكتابة من أجل التعلم على مهارة التنظيم الذاتي لطلبة الصف الثامن الأساسي وعلى قدرتهم على تشكيل نماذج عقلية علمية

إعداد الطالبة: رهام ناظم أندراوس هلال

إشراف: د. زياد قباجة

الملخص:

هدفت هذه الدراسة إلى تقصي أثر استخدام برنامج يعتمد على الدمج بين استراتيجية الاستقصاء المبني على الحجة واستراتيجية الكتابة من أجل التعلم على مهارة التنظيم الذاتي لطلبة الصف الثامن الأساسي وعلى قدرتهم على تشكيل نماذج عقلية علمية، وكذلك هدفت الدراسة لمعرفة أثر التفاعل بين الطريقة والجنس على مهارة التنظيم الذاتي لطلبة الصف الثامن وعلى قدرتهم على تشكيل نماذج عقليةعلمية. تم تطبيق الدراسة على عينة قصدية من طلبة الصف الثامن الأساسي بلغ عددها 152 طالباً وطالبة (71 إناث و 81 ذكور) في كل من مدرسة بنات العيزرية الثانوية ومدرسة ذكور المعهد العربي. تم اختيار المجموعتين الضابطة والتجريبية في كل من المدرستين عشوائياً. تم تدريس المجموعة التجريبية وحدة كاملة من مادة العلوم العامة للفصل الثاني (الضوء والبصريات) باستخدام الاستقصاء المبني على الحجة والكتابة من أجل التعلم، بينما درست المجموعة الضابطة باستخدام الطريقة التقليدية، استمرت التجربة لمدة شهرين، قامت الباحثة بإعداد أداتين الدراسة وهما استبانة التنظيم الذاتي في تعلم العلوم واختبار النماذج العقلية، تم التحقق من صدق أدوات الدراسة وثباتها بالطرق الملائمة. تم تطبيق أدوات الدراسة على العينة قبل وبعد تطبيق الدراسة لمعرفة أثر استخدام برنامج يعتمد على الدمج بين استراتيجية الاستقصاء المبني على الحجة واستراتيجية الكتابة من أجل التعلم على مهارة التنظيم الذاتي لطلبة الصف الثامن وعلى قدرتهم على تشكيل نماذج عقلية علمية. تم استخدام المتوسطات الحسابية، والانحرافات المعيارية، وتحليل التباين الثنائي. أظهرت نتائج الدراسة وجود فروق دالة إحصائياً عند مستوى الدلالة الإحصائية ($\alpha \leq 0.05$) في المتوسطات الحسابية لمهارة التنظيم الذاتي لطلبة الصف الثامن الأساسي تعزى لطريقة التدريس لصالح المجموعة التجريبية، و وجود فروق دالة إحصائياً عند مستوى الدلالة الإحصائية ($\alpha \leq 0.05$) في المتوسطات الحسابية لقدرة طلبة الصف الثامن الأساسي على تشكيل نماذج عقلية علمية تعزى للطريقة لصالح المجموعة التجريبية، ووجود فروق دالة إحصائياً عند مستوى الدلالة الإحصائية ($\alpha \leq$

0.05) في المتوسطات الحسابية لقدرة طلبة الصف الثامن الأساسي على تشكيل نماذج عقلية علمية تعزى للجنس لصالح الذكور، ووجود فروق دالة إحصائياً عند مستوى الدلالة الإحصائية ($\alpha \leq$ 0.05) في المتوسطات الحسابية لقدرة طلبة الصف الثامن الأساسي على تشكيل نماذج عقلية علمية تعزى للتفاعل بين الجنس والطريقة لصالح الذكور في المجموعة التجريبية. كذلك عدم وجود فروق دالة إحصائياً عند مستوى الدلالة الإحصائية ($\alpha \leq 0.05$) في المتوسطات الحسابية لمهارة التنظيم الذاتي لطلبة الصف الثامن الأساسي تعزى للجنس، وعدم وجود فروق دالة إحصائياً عند مستوى الدلالة الإحصائية ($\alpha \leq 0.05$) في المتوسطات الحسابية لمهارة التنظيم الذاتي لطلبة الصف الثامن الأساسي تعزى للتفاعل بين الطريقة والجنس. في ضوء هذه النتائج أوصت الباحثة باستخدام استراتيجية الاستقصاء المبني على الحجة واستراتيجية الكتابة من أجل التعلم في تدريس العلوم وذلك لأهميتها في تنمية وتطوير مهارات الطلبة العلمية والحياتية.

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Chapter one

Introduction

1.1 Background of the study:

During this rapidly changing society, in a time of knowledge and technological advancement, students have easy and quick access to knowledge, contents and facts. They can find information on anything they want and at any time; this revolution puts the roles of teacher under continuous investigation and development. With this issue, teaching in the 21st century should focus on student centered learning and development of students skills such as creative and critical thinking, problem solving, collaboration, self-regulation, and mental models formation.

Science is the systematic study of the structure and behavior of the physical and natural world through observation and experiment. From this definition, an emphasis of inquiry must be modeled in the classroom, just as it is practiced in the research laboratories(Herr,2008).

Science is also a way of knowing the natural world; many years of work and research in the science education community have provided a coherent, research-based vision for a new era of science education. Therefore teaching science is a dynamic field and it is gaining its importance from the National Science Education Standards (NSES) that were created to coordinate the goals and objectives for science instruction. One of the (NSES) aims is to plan an inquiry based science program for the students. This approach to science teaching motivates and engages all types of students, helping them understand the relevance of science to their lives, as well as the nature of science itself (Next Generation Science Standards (NGSS, 2013).

The National Research Council (NRC, 2000) continued its emphasis on science instruction that directly engages students in the practice of science, the proficiencies that need to be developed for all students are: to know, use, and interpret scientific explanations of the natural world, to be able to generate and evaluate scientific evidence, to understand the nature and development of scientific knowledge, and to participate productively in scientific practices and discourse.

In the past decades, numerous publications have called for inquiry based approaches to science instruction that can effectively help students develop critical reasoning capacities, including the ability of students to pose scientific questions and investigate them, to accurately record and interpret the results, and to be able to link their findings to a developing body of scientific knowledge (NRC, 2001).Understanding the nature of science and scientific inquiry is also an important goal of science education (NRC, 2000).

The rapid advance of cognitive learning theories in the past few years has led educators to realize the need for student to be more actively engaged in their own construction of knowledge. Emerging researches suggest that children's abilities to engage in inquiry and form new conceptual understanding are enhanced when they grasp the nature and construct scientific knowledge. After that, a discussion of the specific aspects of the nature of science and scientific inquiry should be held in both elementary and middle schools for students to understand (Bass, Contant and Carin, 2009).

The NSES frequently encourages the use of inquiry in the science classroom, defining it as a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known in the light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of logical thinking, and consideration of alternative explanations (NRC, 2000).

Although much has been written on the topic of inquiry, understanding it, especially as it applies to instruction, has proven to be challenging for many science teachers. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, judge these explanations against current scientific knowledge and communicate their ideas to others (Sutman, Schmuckler and Woodfield, 2008).

Argument Based Inquiry approach supports a constructivist approach to learning science. According to this approach, learning is a construction based on the learner's prior knowledge. Students take in information from many sources, including personal discoveries and acquisition from teachers, books, videos, and other resources. But in constructing understanding, student must connect new information to their existing knowledge and experiences, reorganize their knowledge structures, assimilate new information to them, and construct meaning for them (Horsley, Hewson, Love, Stiles and Mundry, 1998).

Thrumbull (1999) further pointed out that Argumentation is related to constructivism which involves scientific dialogues based on evidence.

Moreover, the NGSS (2013) unprecedentedly seek to interweave scientific knowledge and practices within learning experiences, of which argumentation is one such example.

Processing and synthesizing information orally is not effective as the researcher noticed from her experience in science teaching. It is crucial to adapt a teaching strategy that helps students to summarize notes, to develop their writing skills and organize their work.

Spolsky (1999) indicated that writing is a major tool of learning and it is a problem-solving activity in which students generate their own ideas and clarify them to themselves as they try to communicate them clearly to their partners. Thus writing may involve assimilation, interpretation, and reformulation of individual opinion. Moreover it is needed to help students to gain greater control over the cognitive strategies involved in composing writing and in developing effective planning strategies. Writing- to- learn can enhance students understanding and develop their writing skills.

Kuta (2008) also revealed that students make their own records or notes in order to use them for learning the content or material, and they can later use them to study for a test. Students are directed to take specific notes in both words and pictures forms.

The ability of students to learn individually is an important aspect; teachers must take care of in order to prepare them for the continuously sophisticated future. For this reason, students' self-regulation in learning, especially in learning science, should be given a significance attention since it has been well documented in the domain of science learning (Hadwin, Jarvella and Miller, 2011).

Many researchers (Schraw, Crippen and Hartley, 2006) further believed that meta-cognitive self-regulation played an especially important role in academic learning since it represents learners' awareness, knowledge, control of cognition, and could help them apply cognitive strategies more effectively.

Moreover, the NRC (2001, and 2012) listed students' understanding of models and modeling as one of the major goals of science teaching.

Furthermore, Gobert et al., (2011) have suggested that teaching models and modeling should not only focus on science concepts, but should also promote sophisticated views of scientific models and modeling.

Thus, the researcher suggested that students should gain lifelong skills which will let them deal with their future learning. From this issue, developing these skills is a big challenge for every science teacher. The researcher thinks that combining two strategies, the argument based inquiry approach as a recommended approach by the NSES and the "write- to- learn strategy", could- as the researcher suggests- enhance the self- regulation skills of students, and improve their abilities of forming scientific mental models. Those two strategies can be applied in the class as concrete methods of teaching, especially science teaching, inducing students to gain lifelong skills such as formation of mental models and self-regulation of their learning. This study is an attempt to investigate The Effect of Using a Program Depending on Argument Based Inquiry Approach via "Write-to- Learn Strategy" on 8^{th} Grade Students' Self-Regulation Skills and their Abilities to Form Scientific Mental Models.

1.2 Statement of the problem

Reflecting from the researcher's experience in the science teaching field for many years, she noticed that most students lack the self-regulation skills in learning, especially in learning science, as evidenced by students' failure to set goals for themselves in order to direct their activities in each study period. Also, when the learning material in the class or the tasks given by the teacher in the period is difficult for them to understand, they get confused and tend to lose their concentration. This prevents them from processing the information deeply and making relations between concepts. As a result, their achievement suffers as can be observed from their results in the standard and unified examination. Moreover, the researcher noticed that students lack the ability to form scientific mental models without the help of the teacher; despite the efforts that teacher devotes to make them understand and connect the information. Thus, this contributes to low achievement in standard exams like TIMSS exam which measures high thinking skills. The literature review showed that self-regulation and mental models play an especially important role in academic learning since they represent learners' awareness, knowledge, and control of cognition. Thus letting students gain these skills may help them understand science deeply and in the self-building of their knowledge. Therefore, it is very crucial to suggest teaching approaches that work on students' acquisition of these skills rather than the traditional teacher-centered strategies. On this issue, the 87th NARST Annual International Conference 2014 recommend using the argument based inquiry approach for its effective role in students' self-knowledge construction. Additionally the NRC (2012) listed students' understanding of models as one of the major goals of science teaching. Therefore, this study is an attempt to find out if there is an effect of using a program depending on argument based inquiry approach via "write-to- learn strategy" to 8^{th} grade students' self-regulation skills and their abilities to form scientific mental models.

1.3 Purposes of the study

The purpose of the study is to investigate the following:

1. The effect of using a program depending on argument based inquiry approach via "write- to- learn strategy" on 8th grade students' self-regulation skills and students' abilities of forming scientific mental models.

2. The effect of the interaction between argument based inquiry approach via "write- to- learn strategy" method of teaching, and gender on 8th grade students' self-regulation and students' abilities to form scientific mental models.

1.4 Questions of the study

This study attempts to answer the following questions:

1. Is there an effect of using a program depending on argument based inquiry approach via "write-to-learn strategy" on 8th grade students' self-regulation skills? And does this effect differ due to method of teaching, gender, and the interaction between them?

2. Is there an effect of using a program depending on argument based inquiry approach via "write- to- learn strategy" on 8th grade abilities to form scientific mental models? And does this effect differ due to method of teaching, gender, and the interaction between them?

1.5 Hypotheses of the Study

The following null hypotheses are derived from the questions of the study:

1. There are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to method of teaching, gender, and the interaction between them.

2. There are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8^{th} grade students' abilities to form scientific mental models due to method of teaching, gender, and the interaction between them.

1.6 Significance of the study

The significance of this study stems from the fact that teachers need to improve the way that students learn by helping them to acquire learning skills which help them in their life-long learning such as self-regulation skills and mental models skills. Thus, this study provides necessary information from theoretical, practical, and research fields.

In the theoretical field, this study is expected to introduce a theoretical background about the argument based inquiry program via "write- to- learn strategy", self-regulation skills, and mental model skills for teachers, curriculum designers and researchers.

In the practical field, the results of the study are expected to be meaningful for curriculum designers to develop such a strategy that could help students to acquire learning skills, especially science learning skills. Also, this study provides a practical strategy that teachers can use to increase their teaching competences , improve the way by which students learn and enhance their self-learning skills, which are crucial for deep learning in science.

In the research field, this study may help to develop the knowledge about self-learning skills and provide reference for further research studies, with further variables and stages and other subjects.

1.7 Definition of Terms:

Argument based inquiry approach: discourse practices through which students attempt to construct, support, evaluate or validate a claim by evidence-based reasoning in science learning contexts. (Erduran and Jimenez-Aleixandre, 2008, p.4).

"Writing –to- learn strategy": informal writing strategies which help learners to engage in different writing activities in order to process and connect information and to do authentic writing (Kuta, 2008).

Argument based inquiry approach via "write- to- learn strategy": an educational strategy in which students construct their own knowledge by attempting to form a claim and validate it using appropriate ways with the emphasis of writing each step of their work using variable writing activities.

The researcher prepared material as a guide for teachers in the form of activities that illustrate how to teach a whole unit in the 8^{th} grade science book for the second semester of the academic year 2015\2016 through the argument based inquiry approach cycle via "write- to- learn strategy" which helps students use writing as a way to promote active learning. (Appendix No.5)

Self-regulation of learning science: processes that learners use to activate and maintain cognition, emotion, and behavior to attain personal goals. (Zimmerman and Kitsantas, 2014, p.145).

It was also considered as a multidimensional construct including cognitive, meta-cognitive, motivational, behavioral, and environmental processes (Dornyei and Ryan, 2015, p.165).

The researcher built an instrument (self- regulation of learning science questionnaire) to measure the self-regulation of learning science skills especially for the study. (Appendix No.1)

Scientific mental models: specially organized representations which show aspects of mechanism, causality, or function to illustrate, explain, and predict phenomena (Schwarz et al., 2009, p.634).

The researcher built an instrument (mental model exam) to check students' abilities of forming mental models especially for the study. (Appendix No.3)

1.8 Limitations of the study

The study is applied within the following limitations:

Regional limitations: the study is conducted on 8th grade students (females and males) enrolled at public schools in Jerusalem district. The schools are: Bethany Secondary School for Girls; Al Ma'ahad Al Arabi School for Boys.

Time limitations: the study is carried out in the second semester of the academic year of 2016-2017.

Conceptual limitations: the study is limited by the concepts and definitions previously mentioned in it.

Chapter Two

Theoretical Framework and Related Studies

This chapter provides a roadmap for the theoretical framework and related studies. The researcher arranged the theoretical framework in a systematic way that covers clarifications of the argument based inquiry approach, the “write- to- learn strategy”, the self- regulation of learning science skills, and the scientific mental models. Additionally, the researcher arranged summaries of related studies that focus on each of them respectively.

2.1 Literature Review

2.1.1 Argument based inquiry approach:

2.1.1.1 Scientific Inquiry:

The NRC (2000) defined scientific inquiry as “ multifaceted activity that involves making observations, posing questions, examining sources of information, planning investigations, reviewing what is already known in light of experimental evidence, using tools to gather, analyze, and interpret data, proposing answers, explanations, and communicating the results” (p.23).

Scientific inquiry reflects how scientists come to understand the natural world, and it is at the heart of how students learn. From a very early age, children interact with their environment, ask questions, and seek ways to answer those questions. Understanding science content is significantly enhanced when ideas are anchored to inquiry experiences. Scientific inquiry is a powerful way of understanding science content. Students learn how to ask questions and use evidence to answer them. In the process of learning the strategies of scientific inquiry, students conduct an investigation and collect evidence from a variety of sources, develop an explanation from the data, communicate and defend their conclusions (Herr, 2008).

The National Science Teachers Association (NSTA) recommended that all teachers embrace scientific inquiry and is committed to helping educators make it the centerpiece of the science classroom. The use of scientific inquiry ensures that students develop a deep understanding of science and scientific inquiry (NSTA, 2000).

Regarding the use of scientific inquiry as a teaching approach, the (NSTA, 2000) recommended that science teachers should write goals which engage the students in inquiry based instructions, implement teaching approaches that foster students to pose questions about the natural world, use teaching strategies that assess students' understanding, design and manage learning environment which provides all of the sources needed to facilitate students' inquiry learning, enhance students to conduct investigations to collect evidence that prove their claims, and encourage them to communicate and defend their results to their peers and others.

Features of Inquiry Instruction:

The NRC (2000) suggested special features that characterize inquiry instruction and learning. These features include:

1. Learners are engaged by scientific questions: at every stage of inquiry, students are connected to objects, organisms, and events in the real world. An early stage in inquiry is the formation of questions for investigation. Ideally, students would generate questions from their own real world or from their experiences. Not all of them could formulate accurate questions, many of them, however, will need considerable assistance in learning to form questions that can be investigated scientifically. In many cases, the focus question or problem is formulated by the teacher.

2. Learners give priority to evidence as they plan and conduct investigations: in inquiry approaches, students design ways to gather evidence to answer their questions. With varying degrees of assistance, students determine what data might be relevant; decide how to collect the data, how to represent it, and how to organize it in useful ways. Students use a variety of investigational approaches to gather evidence, including descriptive, classificatory, and experimental investigations and other sources like books, experienced teachers, or local environment.

3. Learners connect evidence and scientific knowledge in generating explanations: continuing in inquiry, students describe, classify and explain their observations, clarify and justify their work to themselves and to one another. They gradually learn that explanations must involve scientific knowledge and always be based on observational evidence gathered through investigations. Students should reflect on their observations often using prior and developing knowledge to draw inferences from their observations, and collecting more data if necessary.

4. Learners apply their knowledge to new scientific problems: to develop and extend understanding, learners must have the opportunity to apply their new science knowledge to new circumstances.

5. Learners engage in critical discourse with others about procedures, evidence, and explanations: Students love to talk about their experiences. Inquiry science provides a rich context for all students to develop language and thought. Communicating and justifying scientific procedures, by collecting, recording, reporting, reflecting on evidence, and generating interpretations focus the students on what they know, how they know it, and how their knowledge connects to the knowledge of other people, to other subjects, and to the world beyond the classroom.

Moreover, the NRC (2001) suggested criteria for assessment of inquiry learning, which should be based on three guiding questions:

1. Where are students trying to go?
2. Where are students now?
3. How are students going to get there?

The first question leads to a consideration of standards and objectives. The second question involves assessing students' learning. The third question leads to the critical step of teachers using assessment results in making decisions about scaffolding, learning strategies, and instruction.

Where are students trying to go? There is growing consensus that the National Science Education Standards and the standards of the various states define the goals that should be achieved in science at different grade levels. Therefore, teachers should provide students opportunities to attain the objectives and learn standards-based science in active ways.

Where are students now? Students should be required to show evidence of their learning through formal and informal assessments. Assessment in the past centered too often on what was easy to measure with multiple choice items: the recall of facts, concepts, principles, and theories. State and National Science Standards have not lost sight of the importance of a strong knowledge base, but they go beyond knowledge and place emphasis on students' understanding and applying science concepts and principles, as well as on their ability to use a variety of science processes and investigative procedures.

How are students going to get there? Assessments of any kind must always be related to standards and lesson objectives and have a clear purpose. The purpose of classroom assessment is to improve learning and instruction. Assessment results can be used to guide decisions about how modifications in instruction can help learners achieve the objectives. Classroom assessments can also be used to provide summative information on what students have actually learned through instruction.

In Addition, the NRC (2001) assisted that students must be provided opportunities to develop both conceptual understandings and abilities of scientific inquiry. Assessing inquiry abilities formatively through informal assessment is an important part of science learning.

To summarize, scientific inquiry approach is well documented in the field of science teaching, and has proven to be challenging for many science teachers. In inquiry instruction students are engaged in forming questions about their environment or natural world, and then they have to construct their own explanations, judge them using investigation to collect evidence, and communicate their results to others.

2.1.1.1.2 Argumentation:

It is defined as discourse practices through which students attempt to construct, support, evaluate, or validate a claim by evidence based reasoning in science learning contexts (Erduran, Ardac and Yakmaci-Guzel, 2006).

Erduran, Simon and Osborne (2004) defined it as an authentic inquiry-based discourse that coordinates conceptual and epistemic goals across both writing and talking.

Aydeniz and Dogan (2016) stressed that engagement in argument is not only a process that includes claims, evidence, and reasoning but also a process in which students persuade their peers of the validity of their arguments.

In argument based instruction, scientific arguments become a leading framework for teaching and learning of concepts by emphasizing science not as an experimental verification, but rather, as a process of scientific argumentation and explanation. In such practices, no longer is conceptual repetition or factual accumulation the focal point; instead, the concentration is on constructing concepts through scientific argumentation. (Erduran, Ardac andYakmaci-Guzel, 2006).

According to Heng, Surif and Seng (2015) scientific argument is core in knowledge construction and students are needed to propose, support, criticize, evaluate, refine ideas about concepts and use scientific theories and evidence to confirm their claims.

The research of Cavagnetto (2010) examined how argument instruction increases scientific literacy. Three fields or orientations were highlighted within the research for the argument instruction: one is to explore the interaction of science and society to realize the purpose for scientific (or socio-scientific) argument, another is to understand the structure to learn scientific argument, and finally to actively engage, to immerse into argument in order to acquire as skill.

In the science classroom, argument often becomes a monologue, a one-way conversation where the pupils cannot engage in genuine questioning of their teacher because they lack the resources to challenge or question the assertions of the teacher. The result is that the world is portrayed as a set of absolutes, characterized by right and wrong answers with the origins of scientific ideas, their metaphorical roots, and any element of uncertainty is simply excised. Restoring the consideration of evidence, reasoning and argument requires instead the recognition of a contemporary model of science (Erduran, Ardac and Yakmaci-Guzel, 2006).

Gierre's model is an attempt to capture the fact that scientists are involved in studying the material world. In that process, they gather data from instruments and measurements and they develop models of how they think the world behaves. These models allow them to make predictions that they then test. What Gierre's model demonstrates is that observation and experiments are the handmaidens to generating argument about the fit, or lack of it, between theory and data. For data lead to models and theories, models lead to argument, about which evidence is significant, and data, in turn lead to argument about the success or failure of theories. In short, there is a complex cyclical and reflexive interaction between models and evidence to which evaluative argument makes a central contribution (Gierre, 1991).

In this issue, teaching science needs to accomplish much more than simply detailing what we know. In addition to teaching the content of science, of growing importance is the need to educate our students and citizens about how we know, and why we believe in the scientific world view e.g. science is a way of knowing. Such a shift requires a new focus on how evidence is used in science for the construction of explanations that are based on the arguments that form the link between data and the theories that science has constructed, and the development of an understanding of the criteria used in science to evaluate evidence and construct explanations (Driver, Leach, Millar and Scott, 1996).

According to Mason (1996), argumentation is a form of discourse that needs to be appropriated by children and explicitly taught through suitable instruction, task structuring, and modeling.

Thus, argumentation concerning the appropriateness of experimental design, the interpretation of evidence and the validity of knowledge claims which are at the heart of science, and are central to the everyday discourse of scientists. Scientists engage in argumentation and it is through this process of argumentation within the scientific community which its quality control in science is maintained. Beyond coherence with current philosophies of science, there are cognitive values of argumentation in science education to the extent, from the cognitive perspective, that argument involves the public exercise of reasoning (Kuhn, 1992).

According to Vygotsky (1978), lessons involving argument will require children to externalize their thinking. Such externalization requires a move from the intrapsychological plane, and rhetorical argument, to inter-psychological and dialogic argument.

When children engage in the argumentation process, and support each other in high quality argument, the interaction between the personal and the social dimensions promotes reflexivity, appropriation, and the development of knowledge, beliefs and values. Furthermore, to grasp the connection between evidence and claim is to understand the relationship between claims and warrants and to sharpen children's ability to think critically in a scientific context, preventing them from becoming blinded by unwarranted commitments (Quinn, 1997).

Schweingruber, Keller and Quinn (2012) also emphasized that such opportunities promote communication in written or spoken forms and require scientists to describe observations precisely, clarify their thinking, and justify their arguments. These policy changes reflect an expanded and more authentic perspective of science competence in which students are expected to construct and critique written and oral arguments using the rules of evidence and reasoning that are respected in scientific discourse.

Another point is that the findings from current literature indicated that scientific argumentative activities can promote students' scientific literacy, nurture conceptual changes, and enhance their understanding of scientific concepts. Besides, scientific argumentation also fosters students' content knowledge, develops higher order thinking, improves communication skills, and enhances scientific reasoning (Heng, Surif and Seng, 2014).

In the classroom, the argumentation process becomes a beneficial pedagogical technique because it makes students' scientific thinking visible when they articulate why they believe a claim to be true. This enables teachers to identify misconceptions and redirect teaching. Additionally, it is hoped that highlighting competing viewpoints will move students' views of science away from a set of discrete facts toward a body of knowledge that is constructed by a community through discussion, discernment, and revision in light of both contradictory and confirmatory justifications (Erduran, Simon and Osborne, 2004).

Besides this, scientific argumentation is an authentic scientific process in which knowledge is socially constructed through evaluating scientific claims, weighing evidence, and critiquing alternative explanations. For instance, in response to a purported claim, other scientists identify the claim's weaknesses and limitations in terms of how it is being justified (Schweingruber, Keller and Quinn, 2012).

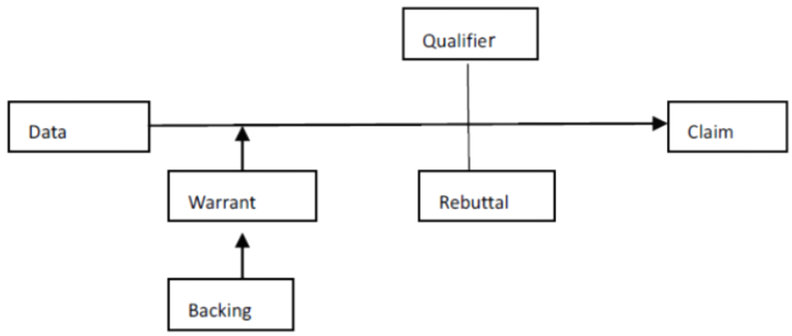

Figure 1. Toulmin's argumentation pattern (TAP)

Figure1. Toulmin's argumentation pattern(Toulmin, Rieke and Janik, 1979, p.51)

2.1.1.1.3 Scientific Argumentation Model:

An influential contributor to the field of argumentation is Stephen Toulmin. His model of argument, referred to as the Toulmin's Argumentation Pattern (TAP) (shown in Fig.1). It had been used to assess students' argument and to support their learning. According to the TAP, an argument includes a claim, data that support the claim, warrants that provide a link between the data and the claim, backings that strengthen the warrants, rebuttals that indicate the circumstances under which the claim would not be true, and qualifiers that state the conditions under which the claim is true (Toulmin , Rieke and Janik, 1979).

It is noted that the application of the pattern is based on the assumption that the presence of more argumentation elements indicates a better quality argument. Arguments that consist of claims supported by data, warrants, and backings are considered simple arguments, whereas arguments that consist of qualifiers and rebuttals, in addition to data, warrants, and backings, are deemed more complex and sophisticated. It is also noted that the TAP does not take into consideration the accuracy of the elements from a scientific perspective. In addition, the TAP also does not assess whether the argument, as a whole, makes sense. The dialogic or social perspective on argumentation focuses on the interactions between two or more individuals in which the participants try to persuade or convince each other of the validity of their claims. Consequently, engaging in argumentation includes the construction and critique of multiple explanations and the use of evidence (Sampson and Clark, 2009).

The construction of scientific argument requires cognitive involvements, such as analyzing and making sense of the data, generating explanations, supporting the idea, and challenging the validity of an idea. In group collaborations, students have the opportunities to explain their thinking about a phenomenon being studied, to listen to the explanation of their peers to observe the strategies of others, and to resolve different perspectives through discussions. Furthermore, group discussions involving collaborative reasoning and arguments lead to a deeper understanding of scientific concepts. Through explicating, comparing and challenging ideas, and explaining, students were able to recognize limitations, anomalies and fallacies of the concept being discussed. This situation is important and can lead to conceptual change when students try to integrate new knowledge with existing conceptual structures (Heng , Surif and Seng, 2014).

Tytler, Duggan and Gott (2001) also focused that the use of evidence is central to the interactions between the public and science. Individuals need to consider, ask questions and use evidence when engaged in regulation, policy formation and decision-making that involve science in their everyday lives. For example, using evidence is important for individuals to engage in problem solving or decision-making in everyday circumstances around a science-related matter, such as deciding to have a child immunized.

In terms of explicit instruction, Venville and Dawson (2010) found that teaching scientific argumentation explicitly through modeling and other instructional practices as well as providing students opportunities to engage in argumentation supports students in developing stronger argumentation skills as well as conceptual knowledge.

There are numerous reasons for including argumentation in science education. First, argumentation is in line with the contemporary perspectives in the philosophy of science, which emphasize that science involves the construction of theories that are open to challenge and refutation. The second reason takes the cognitive perspective into account and explains the importance of argumentation in the externalization of students' thinking and becoming critical thinkers. The final reason touches upon the socio-cultural perspectives of cognition, which clarify the appropriation of community practices, including scientific discourse by students through argumentation (Erduran, Simon and Osborne, 2004).

Sadler and Donnelly (2006), focused on designing interventions around socio-scientific issues that emphasize the moral, ethical, and political influences on decision-making in science. Although there has been considerable work in this area, much of the research suggests that students continue to have difficulties with these practices.

Sadler and Fowler (2006) justified the movement of integration between science and society by arguing that school science should include a dynamic interaction of science and society by giving equal emphasis to the scientific as well as social, political, economic, and moral aspects of issues. From this perspective, socio- scientific issues have had a potential to constitute a platform for an argumentative discourse.

However, Osborne and Patterson (2011) argued that the term explanation is often inappropriately used in standards documents and in research literature when the actual practice being described in which a claim is justified using evidence.

This means that there is a gap between theory and practice of argumentation, to overcome the gap between theory and practice in applying argumentation strategy, Berland and Reiser (2009) argued that in terms of explanation as a practice of science, it is important for students to understand and participate in how explanations are constructed, questioned, evaluated, and revised through the practice of argumentation. They further described argumentation as when, individuals compare conflicting explanations with the support for those explanations and work to identify/construct an explanation that best fits the available evidence and logic. As such, explanation and argumentation are complementary practices.

Moreover, the construction of knowledge claims in science occurs through argumentation in which scientists debate and justify claims using evidence. This social construction of knowledge is essential to the scientific community in which claims are disputed and changed over time as new evidence arises and different theories are debated (Driver, Newton and Osborne, 2000).

Kolsto (2001) implied that when talking about socio-scientific issues, argumentation is also an important part of decision-making. When students engage in argumentation processes, they understand and experience multiple perspectives that are based on evidence.

Furthermore, Khishfe (2012) asserted that when students establish hypotheses, gather data and discuss their results based on their data, they will certainly exhibit how they conceptualize the nature of science aspects in inquiry processes in science classes. Actually, students use argument and try to support their claims with evidence in these processes. Thus, there is a strong link between the nature of science and argumentation.

McDonald (2010) further claimed that the inclusion of argumentation in the curricula is an important component of contemporary science education in many countries. Erduran and Jimenez- Aleixandre (2008) recommended using argumentation while constructing curricula; they emphasized some features that the curriculum must have in argumentative contexts and pointed out that the curriculum needs to be organized around inquiry that provides the discursive practices of scientists. Inquiry facilitates understanding of how scientific knowledge is constructed and how it is validated (justification of claim, evaluating alternative claim, finding evidence to support claim). They also listed the characteristics of curriculum in argumentative contexts as follows:

1. Organized around authentic activities.
2. Structured as problem solving.
3. Designed to generate a diversity of outcomes with different epistemic states.
4. Uses resources that support the development of scientific epistemic practices.

The assessment strategies used for assessing students' work through argumentation focused on students' own performances by means of portfolio, rubric, and self-evaluation journals leading to communication in which students reflect upon their cognitive processes of knowledge construction (Cetin, Metin, Capkinoglu and Leblebicioglu, 2016).

In Summary, argumentation process is composed of claim, question, probe, data, warrant, and rebuttal. The literature review of argumentation revealed the importance of this teaching approach in developing students' reasoning and logical skills, improving the learning outcomes, helping students to acquire valuable experiences in scientific practices, inspiring them to pursue their claims, and helping them to deepen their understanding of the science content, making it more memorable and meaningful to students. Thus, this study is an attempt to highlight this approach and stand on its abilities to develop and influence students' skills.

2.1.2 "Writing- to- learn Strategy":

The literature of writing indicated that an important characteristic of students is their writing strategy. For example, how they cope with the complexity of writing, by dividing a writing task into subtasks, sequencing these subtasks and regulating the attention paid to sub-processes (Torrance and Galbraith, 2006).

Galbraith and Torrance (2004) suggested that writing strategy is necessary for managing the complexity of a writing task. The two most well defined strategies are:

" (A) Planning strategy: in which writers concentrate on working out what they want to say before setting pen to paper, and only start to produce full text once they have worked out what they want to say.

(B) Revising strategy: in which writers work out what they want to say in the course of writing and content evolves over a series of drafts". (p.64)

Writing in a discipline involves describing, summarizing, and integrating information related to that discipline (e.g., science, history) and presenting new ideas related to those concepts. Developing writers learn to engage in disciplinary writing by learning to paraphrase and summarize ideas, and to integrate these ideas to address one or more questions. Additionally, these writers must gain knowledge of the disciplinary content through various sources, such as listening to a lecture or reading a text. One type of essay commonly used in educational settings to provide instruction toward this objective, and to assess students' ability to engage in disciplinary writing is the source-based essay. The term source-based writing can refer to a wide variety of written tasks, including summaries, reaction papers, syntheses, lab reports, constructed responses, argumentative papers, research papers, and essay exam questions. Source-based writing differs from other forms of writing (e.g., persuasive or narrative writing) because it requires the writer to synthesize information from texts in response to a prompt or goal (Braine, 1995).

Galbraith and Torrance (2004) also claimed that offering students writing tasks that match their preferred writing tendencies may help to reduce the cognitive load of writing and may therefore have a positive impact on students' domain learning, because writing strategies (either planning or revising) allow planning the content of the text to be conducted free of the demands of constructing well-formed and coherent texts.

As Newell (2006) pointed out that " constructivist notions of teaching and learning make a strong case for the value of writing in academic learning, yet one challenge that remains is translating that into the ways of knowing and doing in various academic disciplines" (p. 235).

Nelson (2001) argued that writing-to-learn initiatives allow students to use writing to gain authority on a subject or topic and, as they do so, to benefit by learning the ways of writing associated with the discipline.

According to Newell (2006) writing is crucial and essential part of students' activities in secondary school education. Teachers can employ writing tasks in the period as a way of making sense of information and exploring ideas.

Furthermore, Tynjala, Mason and Lonka (2011) stated the importance of writing to learn strategies in ordering, explaining, or clarifying all kinds of learning material in various school subjects. Therefore, writing strategies could help to increase attention of the students while they are writing, and may consequently enhance the learning process from writing (Kellogg, 1988).

Klein (1999) stated that writing is the most dominant instructional activity, and it helps students to become more aware or familiar with the forms of writing acquired by various academic disciplines. He also insisted that writing helps students to think critically and to build their knowledge. In addition to that, writing reveals the relationships between ideas in the text, and this will help students to understand the relations among ideas.

Writing enhances the thinking process. As Menary (2007) stated, there is an overlapping between neural processes and written sentences, this means that writing reflects the internal/mental thoughts and helps to develop high level thinking skills such as analysis, composing, and evaluation skills.

It is crucial to give students short daily writing assignments, as Wright (2012) suggested, and these writing assignments can build students' writing skills and make them more confident, with the importance of providing students with feedback and encouragement about their writing task.

In addition, Kuta (2008) suggested some writing- to- learn activities as the following:

1- Two-column note taking: This kind of writing activity helps students to organize their learning way. In this activity, students are asked to generate two columns, the first column is called the "Recall Column" it is on the right of the page; students are expected to form questions and write them in it. The second column is called " Note Column" this column is on the left and it is wider in space, in this column students can write the answers of their questions, explain definitions, list important details or add visual memory cues. This form of note taking helps students to organize and process information deeply.

2- Foldable: Students make their own foldable in this writing to learn activity in order for them to use as directed, and they can later use it to study for a test. Students are directed to take specific notes in both words and pictures forms. For example, they can write definitions using their own language or draw a flow chart for a certain scientific process. The back of the entire foldable can also be used for students to assess their own learning.

3- Processing information boxes: Main aim is to make students connect and engage with the text. A handout is distributed at the end of a period (lesson / day) with the request to process one, two, or all of the boxes. The first two boxes are for the two types of questions the students have to ask about the lesson or topic, and inference (conclusive) questions like "why is this important?" or "how does this connect to me?" . In the third box students are asked to write a reflection sentence. This forces them to think about their own learning and/or understanding. The fourth box is for a drawing of a memory cue that should represent the main idea of the period, important thought(s) of the lesson, main focus of the day. A discussion can follow in class or an assessment can take place on the following day or in the following class period. Thus, they will learn to connect with the lesson by responding to an open-ended sentence and practice creating visual memory cues to increase comprehension of important points. The purpose of this activity is to trigger active involvement with the material, to induce extraction and thus understanding of important concepts, and last but not least to increase critical thinking.

4-Daily reflections: The purpose of this writing-to-learn activity is to give students the opportunity to reflect on their learning, to write freely their ideas on a graphic organizer, to become aware of the ownership of their learning, and to create responsibility for the quality of it.

There are many ways to make students write in the class in order to help them to acquire writing as a skill: students can be asked to write at the beginning of the class (to pick up on a topic of previous lessons or to brainstorm on an upcoming subject, e.g.; during class to regain control in a heated discussion or to stimulate interest and participation, to ask questions or to clarify the source of confusions, and – as a consequence – even to evaluate their own teaching; and finally, at the end of the class to summarize results, to expose thinking processes (Bean, 1996).

The uses of writing to learn strategy in the classroom are to support students' learning process and to assess them effectively (Camps and Milan, 2000).

In essence, there are processes that must be gained by students to develop writing skills. As Graham and Haris (2012) pointed out, the processes and strategies needed for skilled writing texts include accessing different kinds of knowledge, planning, drafting, evaluating information, and construction of sentences. Although, writing skills are not easy for all students, as Applebee and Langer (2011) insisted, they ensured that writing is a complex skill to be mastered by all students. They also claimed that little time in schools is devoted to teach writing. Brindle (2012) also agreed with these researchers and stated that teachers are not adequately prepared to teach writing skills.

In fact, teaching students how to write takes its important role from these literature examples:

Berninger, Fuller and Whitaker (1996) pointed out that for developing writing skills, students must be able to spell, handwrite, and communicate their ideas. The importance of writing occurs when students can employ their internal ideas in sentences that describe them; also they need to master this skill in order to register at universities, in their employment, and in their life beyond schooling.

In contrast, when students face difficulties in these early writing skills, they will avoid writing and will develop negative attitudes toward writing; when they think that they cannot write (Berninger, Mizokawa and Bragg, 1991).

For instance, improving students' early skills in writing will enhance their abilities to form sentences, and make their work of great quality (Graham, Haris and Fink, 2002).

There are standards for good writing; these standards were published by the Common Core State Standards in the United States. They indicated that students at early ages should gain writing skills and construct meaningful paragraphs. The skills are: to write an opinion that introduces the topic, state their opinion, provide reasons to support the opinion, use linking words to connect between opinion and reasons, and provide a concluding statement (Common Core State Standards, 2010).

Although not all students could write efficiently as (Rijlaarsdam et al., 2012) ensured, they indicated that students vary in their writing capabilities. They recommended much more researches that let us understand what students are capable of achieving under certain circumstances.

Writing influences students learning by actively enhancing meaningful learning. In this kind of learning, the learner constructs relations between new knowledge and the existed knowledge; these relations will be clearly seen through well written scientific text (Glynn, Yeany and Britton, 1991).

Writing activities are the media of fostering students' abilities of forming conceptual relations among concepts, writing also helps to reveal misconceptions of the learners and help the teacher to remedy them (Glynn and Muth, 1994).

Butler (1991) indicated that when students write about scientific topics, they can explore new ideas, develop scientific understanding, and make their thoughts clear.

Writing plays an important role in learning science. Writing skills are considered as a part of the long-term memory as Glynn and Muth (1994) indicated in their model of student cognitive processes as shown in the figure below.

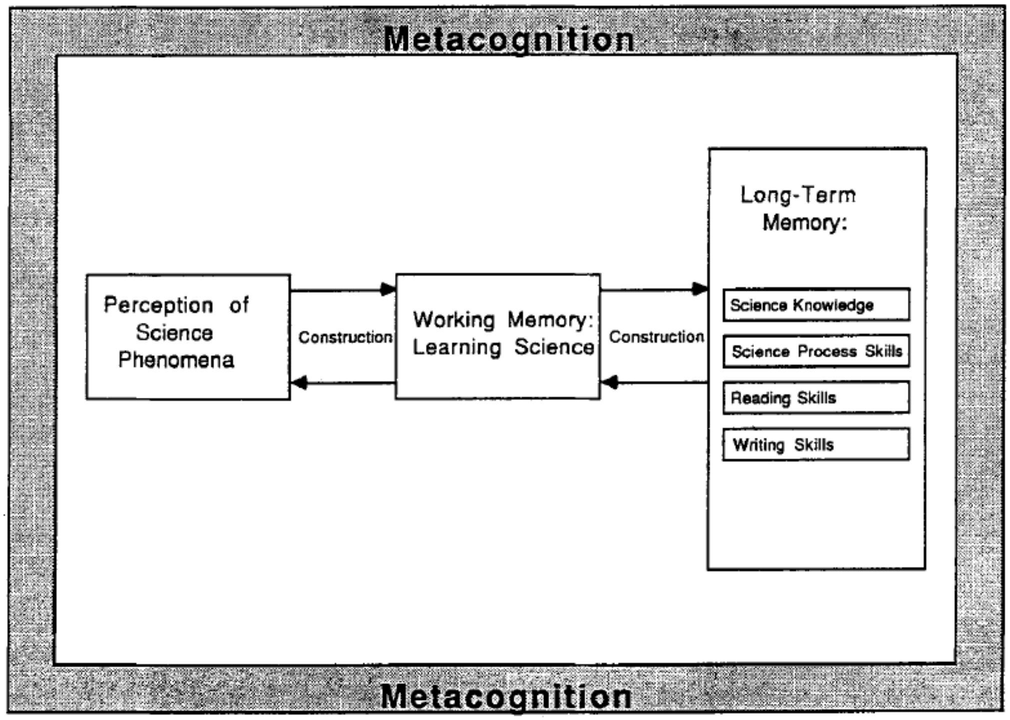

Figure 2. Learning science: a model of student's cognitive processes.
(Glynn and Muth, 1994, p. 1059)

The figure shows that student's cognitive processes are composed of four components: perception, working memory, long-term memory, and meta-cognition which represent all of the cognitive processes. And if writing is located in the long-term memory, then students will retrieve easily what they actually write.

Glynn and Muth (1994) explained that: "Visual, auditory, or tactual information is perceived and then processed in working memory, where higher order learning operations are carried out and intellectual products (e.g., hypotheses, inferences, generalizations, elaborations, and solutions) are formed. The products are formed in working memory using information and skills retrieved from long-term memory; scientific information and science process skills, as well as reading and writing skills, are part of long-term memory. In this model, the science process skills, reading skills, and writing skills are dynamic and interactive components. They are carried out concurrently in working memory" (Glynn and Muth, 1994, p. 1059).

Woolfolk (1993) stated the purposes and goals that his students achieve when they engage in writing activities. The purposes are:

"My students write to explain, to argue a point of view, to prove a hypothesis. My focus is on their message. Eventually their need to present a clear description or persuasive argument will lead to a concern with the clarity and logic of their message. First and foremost, my students are encouraged to write in order to discover and clarify their ideas". (Woolfolk, 1993, p. 503)".

Moreover, Keys (1994) pointed out that writing to learn science is a powerful learning tool since it lets students make the link between scientific processes and their previous knowledge about certain scientific topic. This linkage can achieve deep scientific understanding.

Bereiter and Scardamalia (1987) listed skills needed for students to become competent writers. These skills are: meta-cognition, idea relation, text production, and revision. They also stated that students need to draw on meta-cognitive skills to formulate audience- specific writing goals, and then they have to plan how to meet those goals by constructing ideas related to them.

Furthermore, when students engage in writing activities they organize their thoughts, examine their knowledge in details, and widen their explanations or interpretations. They can also diagnose their knowledge gaps and their misconceptions will be revealed (Glynn and Muth, 1994).

Glynn and Muth (1994, p.1066) also suggested some writing activities that teachers could ask students to perform within the period. Some of these activities include:

"1. Explanatory essays in which students describe a complex science concept (e.g., photosynthesis) in depth.

2. Field trip notes in which students record their observations of, and reactions to, flora and fauna.

3.Laboratory logs in which students report their observations, hypotheses, methods, findings, interpretations, and mistakes-particularly mistakes-as these are a normal part of the scientific process.

4. Science journals or diaries in which students describe their participation in science activities, such as fairs and competitions, and reflect on their actions and experiences.

5. Environmental action letters in which students-under the teacher's guidance-write to politicians, newspaper editors, and companies to promote positive environmental act ions .

6. Newspaper accounts in which students write stories on science and technology topics for their school or town newspapers".

A suggested and widely used strategy is the free writing activity which was first developed by Elbow (1981), when using this strategy; students represent their thoughts freely, generate many ideas and link them without paying attention to the quality of their writing. It's like a brain storming activity; later students rearrange their ideas and design a well written draft.

Another approach for writing was suggested by Graves (1983), which is writing for a conference. In this activity, students write an assignment about certain topic that they will share in a small conference in front of teachers and students. He suggested some questions to guide students' writing. Such as: If you would include something on your lab report, how would it be helpful to the reader? What do you think of the most important sentence in your speech and why?

Bereiter and Scardamalia (1987) suggested assisted monologue strategy for enhancing writing skills of students. In this strategy students think to make relations between causes and effects of certain scientific phenomena or theories, and then they have to organize the causes and effects in tables, flowcharts or drawings.

Furthermore, Light (2001) indicated the amount of writing activities in the period is directly proportional to engagement and activation of the students in the period, and to their level of interest. Besides, Allen, Donham and Bernhardt (2011) focused on improving students' writing abilities especially if "writing-to-learn strategy" was combined with other pedagogical strategy such as problem-based learning.

Arum and Roksa (2014) found that the presence of writing activities during the study period will positively influence students' lives after graduation by helping them to find an employment or by increasing their opportunities to write CVs about themselves.

According to the above explanation, the researcher would like to assert that writing to learn strategy is a fundamental mode of learning. It offers students opportunities to think about what they are learning, clarifies thought, allows for analytical criticism and reflection, and for ideas to be developed even further. It is also an important discursive tool for organizing and consolidating basic ideas into more coherent and better-structured knowledge. Integrating this strategy within argumentation could help students in interacting effectively with science lessons, following steps and writing their notes. The students follow the argumentation steps with writing on each step. So, they could elaborate their learning, comprehension, and their writing will serve as records for information.

2.1.3 Self- Regulation:

Self-regulation is the process of transforming one's intelligence into academic skills, and guiding it to the self. Self- regulation takes result oriented behavior and ideas that it creates on its own as reference. Self-regulation is significant because the purpose of education is to enhance lifelong learning skills. After graduating from high school or university, young adults can learn very important abilities through unofficial ways. Self-regulation includes strategic performance, adjusting processes and self-monitoring (Zimmerman, 2010).

Risemberg and Zimmerman (1992) defined self-regulation as determining objectives, developing strategies to achieve these objectives, controlling the gains of these strategies, and indicating the importance of the utilization of self-regulated learning strategies.

The structure and function of the self-regulatory process consists of the performance phase, self-reflection phase and forethought phase. Performance phase consists of self-control and self-observation phases, and takes the specific method chosen at self-control precaution phase as reference. Self- observation takes self- testing as reference in order to find out the reasons for self-record in self-observation includes self- directed interest. Self- observation is affected by behavioral effects as well as personal processes, composed of meta-cognition planning, purpose composing and self-competence. Self-observation corresponds to meta-cognitive monitoring or record keeping of one's performance, the relevant conditions related to such performance, and the effects that it results in. Self- observation involves recording the frequency, intensity, or quality of behavior. Self-observation is crucial in determining one's progress. In the absence of self-observation, selective memory of successes and failure become activated (Zimmerman, 2002).

The self-reflection phase, which forms the structure of self-regulatory process, consists of self- judgment and self- reaction phases. Self- judgment takes the comparison of self-observation performances under certain circumstances. Self- judgment affects the importance of goal achieving and its purpose features. Self-judgment takes the comparison between one's purpose and present performance as reference. Self- judgment includes self- evaluation by attributing temporal importance to the individual's performance and results (Zimmerman, 2012).

Self- judgment means comparing present performance with one's goal. If a person believes that he/she is making goal progress, self-efficacy increases and motivation sustains. Students who consider a task to be easy may think that they set their goal too low and set their subsequent goal higher. If one knows that similar others performed a task, one can reach increased levels of self-efficacy and motivation (Schunk, 1987).

Self-judgment refers to evaluating one’s learning performance and attributing causal significance to the outcomes. Students who are highly regulated self-evaluate themselves in a more appropriate way and more frequently compared to those who are poorly regulated (Zimmerman and Kitsantas, 2005).

Getting results by self- judgment and the importance of purpose attribution depends on the specifics of purpose and following self -evaluation standards. Self-judgment may become affected by the specifics of the purpose, the significance of failing and contributions to one’s performance (Schunk, 2008).

Students who judge their goal progress to be acceptable would find themselves efficacious about continuing to improve and be motivated. If students believe that they can improve their performance, negative evaluations may not decrease their motivation. Motivation does not increase when students believe they do not have the ability to improve (Schunk and Zimmerman, 2003).

Self-reactions are behavioral, cognitive, and emotional responses to self-judgments. Believing that one is making good progress and the anticipation of satisfaction regarding accomplishing a goal increases the level of self-efficacy (Pintrich and Schunk, 2002).

Uses of self-regulated learning strategies by students render them capable of increasing personal control over their own environments. Self-regulated learning provides the gaining of self-competence senses and may explain the student’s connection to motivation and achievement. Self-regulated learning processes do not just enrich motivation, but also predict outstanding academic and athletic achievement. Self-regulated learning strategies include organization and transformation, data research, record keeping, self- observation, environmental structuring, self-effectuating, repeating, memory, surveying, and social aid (Zimmerman, 1990).

Thus, there is a significant relationship between motivation and self-regulated learning, the high motivation influence self regulation skills in learning. (Mahmoodi , Kalantarib and Ghaslanic, 2014).

2.1.3.1 Self -Regulation Learning Theory: the Role of Cognition, Meta-Cognition, and Motivation

Self-regulated learning refers to our ability to understand and control our learning environment. To do so, we must set goals, select strategies that help us achieve these goals, implement those strategies, and monitor our progress towards our goals. Few students are fully self-regulated; however, those with better self-regulation skills typically learn more with less effort and report higher levels of academic satisfaction (Schunk, 2008).

Self-regulated learning theory had a distinguished history in cognitive psychology, with its origins dating back to the social-cognitive learning theory of Albert Bandura. At the heart of Bandura's theory is the idea of reciprocal determinism which suggests that learning is the result of personal, environmental, and behavioral factors. Personal factors include a learner's beliefs and attitudes that affect learning and behavior. Environmental factors include the quality of instruction, teacher feedback, access to information, and help from peers and parents. Behavioral factors include the effects of prior performance. Reciprocal determinism states that each of these three factors affects the other two factors (Schraw and Moshman, 2006).

During the past two decades, Zimmerman (2002) has applied Bandura's (1997) social cognitive theory to many settings, including school learning. These attempts led to the development of self-regulated learning theory which contends that learning is governed by a variety of interacting cognitive, meta-cognitive, and motivational components. Social-cognitive perspectives of self-regulated learning postulate that individuals learn to become self-regulated by advancing through four levels of development: observational, imitative, self-controlled, and self-regulated levels. Learning at the observational level focuses on modeling, whereas learning at the imitative level focuses on social guidance and feedback. Both of these levels emphasize a reliance on external social factors. In contrast, as students develop they rely increasingly on internal, self-regulatory skills. At the self-controlled level, students construct internal standards for acceptable performance and become self-reinforcing via positive self-talk and feedback. At the self-regulatory level, individuals possess strong self -efficacy beliefs, as well as large repertoires of cognitive strategies that enable them to self-regulate their learning.

Self-regulated learning consists of three main components: cognition, meta-cognition, and motivation. Cognition includes skills necessary to encode, memorize, and recall information. Meta-cognition includes skills that enable learners to understand and monitor their cognitive processes. Motivation includes beliefs and attitudes that affect the use and development of cognitive and meta-cognitive skills. Each of these three components is necessary, but not sufficient, for self-regulation. For example, those who possess cognitive skills but are unmotivated to use them do not achieve at the same level of performance as individuals who possess skills and are motivated to use them. Similarly, those who are motivated, but do not possess the necessary cognitive and meta-cognitive skills, often fail to achieve high levels of self-regulation (Zimmerman, 2010).

The three main components of self-regulation can be further subdivided into the subcomponents shown in Figure 3. A brief description of each of these components is given below, as well as several finer-grained subcomponents.

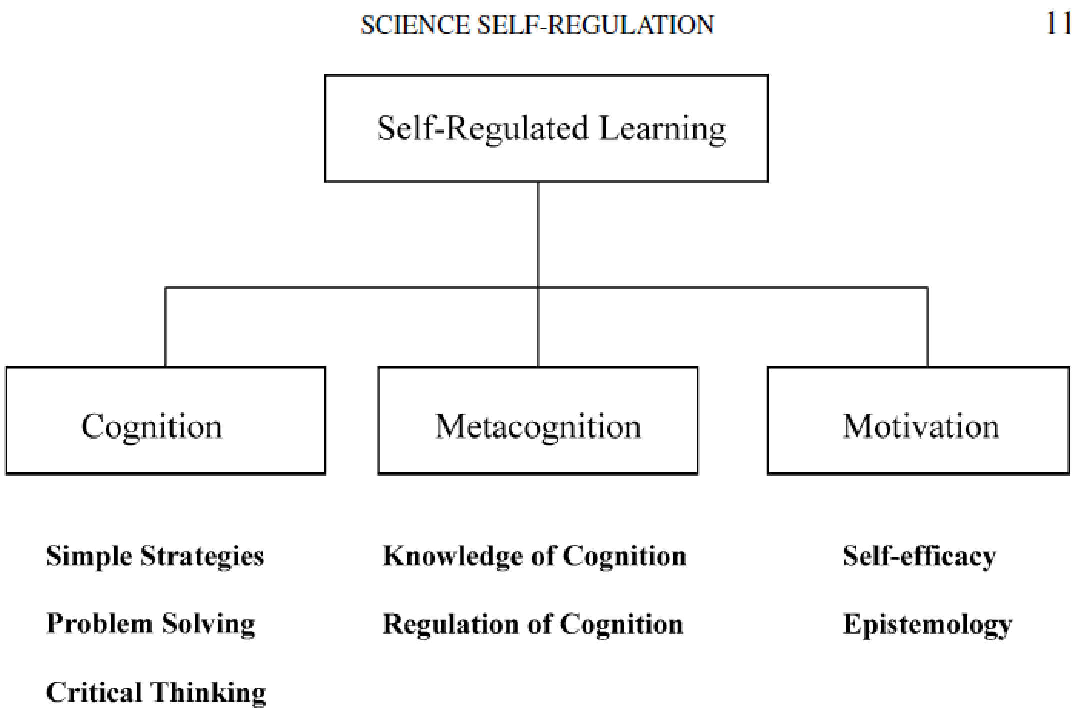

Figure 3. Components of self-regulation learning.
(Zimmerman, 2012, p.287)

2.1.3.1.1 Cognition

The cognitive component includes three general types of learning skills, which are referred to as cognitive strategies, problem solving strategies, and critical thinking skills. Cognitive strategies include a wide variety of individual tactics that students and instructors use to improve learning. One example is the use of student generated questions before or during reading to focus the learner's attention (Chinn and Brown, 2002).

A second example of self-regulation strategies is the use of critical thinking strategies which involve a variety of skills such as the individual identifying the source of information, analyzing its credibility, reflecting on whether that information is consistent with their prior knowledge, and drawing conclusions based on their critical thinking (Linn, 2000).

2.1.3.1.2 Meta-cognition

Meta-cognition includes two main subcomponents generally referred to as knowledge of cognition and regulation of cognition (Schraw and Moshman, 1995).

Knowledge of cognition refers to what we know about our cognition, and may be considered to include three subcomponents. The first, declarative knowledge includes knowledge about ourselves as learners and what factors influence our performance. For example, most adult learners know the limitations of their memory system and can plan accordingly. Procedural knowledge, in contrast, refers to knowledge about strategies and other procedures. For instance, most adults possess a basic repertoire of useful strategies such as note-taking, slowing down for important information, skimming unimportant information, using mnemonics, summarizing main ideas, and periodic self-testing. Finally, conditional knowledge includes knowledge of why and when to use a particular strategy. Individuals with a high degree of conditional knowledge are better able to assess the demands of a specific learning situation and, in turn, select strategies that are most appropriate for that situation (Schraw and Moshman, 2006).

According to Schraw and Moshman (1995) regulation of cognition typically includes at least three components: planning, monitoring, and evaluation. Planning involves the selection of appropriate strategies and the allocation of resources. Planning includes goal setting, activating relevant background knowledge, and budgeting time. Previous research suggested that experts are more self-regulated compared to novices largely due to effective planning, particularly global planning that occurs prior to beginning a task. Monitoring includes the self-testing skills necessary to control learning. Evaluation refers to appraising the products and a regulatory process of one’s learning. Typical examples include re-evaluating one’s goals, revising predictions, and consolidating intellectual gains.

2.1.3.1.3 Motivation

The motivation component includes two important subcomponents, consisting of self-efficacy and epistemological beliefs. Self-efficacy refers to the degree to which an individual is confident that he or she can perform a specific task or accomplish a specific goal (Bandura, 1997).

Self-efficacy is extremely important for self-regulated learning because it affects the extent to which learners engage and persist at challenging tasks. Students with higher self-efficacy are more likely to engage in a difficult task and more likely to persist at a task even in the face of initial failures compared to low-efficacy students (Pajares, 1996).

Higher levels of self-efficacy are positively related to school achievement and self-esteem. The trends observed with respect to student self-efficacy also generalize to teachers and even schools. For example, teachers with higher levels of self-efficacy set higher goals and standards, give more autonomy to students, and help students reach higher levels of achievement than do teachers with lower levels of self-efficacy (Goddard, Hoy and Hoy, 2000).

Self-efficacy is affected by a number of variables, but especially vicarious learning and modeling. Vicarious learning occurs when individuals learn by observing others perform a skill or discuss a topic. Vicarious learning is advantageous to learners because they are not expected to perform the task, and therefore experience less anxiety, and because they also can focus all of their resources on observing experts. Modeling occurs when learners learn intentionally from other individuals such as teachers and students. Modeling typically includes the teacher breaking a complex task into manageable parts and asking students to demonstrate each part separately in sequence (Schraw and Moshman, 2006).

Bandura (1997) proposed that modeling is effective because it raises expectations that a new strategy can be acquired, in addition to providing a great deal of knowledge about the skill. Peer models are usually the most effective because they are most similar to the learner. Indeed, students are most likely to increase their own self-efficacy when observing a model of similar ability level performing the skill.

There are two main ways to increase students' self-efficacy. One is to use both expert (teacher) and non-expert (student peers) models. Modeling can improve cognitive strategies and self-efficacy. The second is to provide as much informational feedback to students as possible. Feedback should indicate not only whether the skill was performed acceptably, but provide as much information as possible about how to improve subsequent performance. Given detailed informational feedback, performance and self-efficacy can increase even after students experience initial difficulty performing a skill (Schraw, Crippen and Hartley, 2006).

Furthermore, Zimmerman and Martinez (1990) listed some characteristics of self-regulated students. These characteristics include: the self- regulated students approach educational tasks with confidence; they are aware when they know a fact and possess a skill and when they do not. Unlike their passive classmates, self -regulated learners proactively seek out information when needed and take the necessary steps to master it. When they encounter obstacles such as poor study conditions, confusing teachers, or abstruse text books, they find a way to succeed. Self-regulated learners view acquisition as a systematic and controllable process, and they accept greater responsibility for their achievement outcomes.

The aim of Self-Regulated Learning (SRL) is to facilitate life-long learning skills. Self-regulated learning has been defined as the feelings and actions that indicate a tendency to achieve individuals' goals. SRL is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior .Studies carried out that focus on self-regulated learning began in the mid-1980's and focused on ways of supporting one's own ability to actively engage in one's own learning process (Zimmerman, 2001).

The structure of the SRL process is broken into three phases: the performance phase, the self-reflection phase and the forethought phase. The performance phase consists of a self-control segment and a self-observation segment. During this first phase, an individual uses a specific selected method based on his/her personal reflections on their past performances (self-control segment). Self-observation is then utilized as one self-tests of their chosen method in reference to the method's success at producing the desired results (Zimmerman, 2002).

The self-control segment of the self-reflection phase helps individuals to focus on the task and optimize their effort. Self-control involves the use of self-instruction, imagery, attention focusing, and task specific strategies (Schunk, 1982).

The self-reflection phase is a self-regulatory process consisting of self-judgment and self-reaction segments. Self-judgment influences the importance one gives to fulfilling one's goal. One conducts a self-evaluation evaluating the temporal importance of one's performance and relevant results (Zimmerman, 2012).

Self-reaction concerns the use of the personal evaluation of one's own performance and then considering appropriate changes in such learners' performances as well as judgments regarding their tasks to best meet the desired outcomes (Pintrich, 2004).

The forethought phase involves task analysis and self-motivation beliefs. Task analysis includes goal setting and strategic planning. Task analysis also involves decomposing a learning task and its context into constituent elements and then constructing a personal strategy from prior knowledge of these elements (Winne and Hadwin, 1998).

One of the most important targets of education in the developing and changing world is to raise individuals to think, explore, question, produce, decide by themselves, undertake the responsibility of learning, control their learning processes, take part actively in such processes, and have self-confidence in their capabilities and correctly use these capabilities, instead of individuals raised with traditional education involving mechanical learning. In recent years, exploration and understanding of their own learning processes by the students as well as the support given by trainers in learning teaching environments has gained importance with respect to achieving effective learning. It is now well-known that the factors effective for learning are not only cognitive as affective factors also have an important role (Tait-McCutcheon, 2008).

Pintrich (2000) however, expressed self-regulation as an active and constructive process by which the students identify their learning objectives and regulate their cognition, motivations, and behavior. Considering the definitions of self-regulation, the requirement for students to play an active role in the learning processes emerges as a common point. The individual will become aware of his/her own learning, will establish his/her own control, and will assess himself/herself in processes in which he/she is active.

One of the fundamental factors that affect the learning process based on self- regulation is self-regulating strategies. Self-regulation strategies are cognitive strategies such as repetition, interpretation, and organization of the effort spent by the students when they are accomplishing a task in the learning-teaching process (Pintrich and De Groot, 1990).

Self-regulation is in a cyclic relationship with a multitude of variables; for example, when the self-efficacy level of the students on a subject increases, it may affect their self-regulation skills on the subject, and using self-regulation strategies may increase their self-efficacies, ensuring more self-regulation. From another perspective, individuals with high academic success may ensure more self-regulation, and individuals who can self-regulate may increase their academic success. (Bozpolat, 2016)

Zimmerman (2002) examined individual differences in academic learning through self-regulation processes and found behavioral skill, knowledge of self-regulated learning principles, positive self-efficacy and interest in topic are essential to self-regulation.

Bembenutty (2001) found students’ goal setting and reward possibilities act as a positive mediator between self-efficacy and student study time.

Schunk (2008) settled goal setting as a critical part in self-regulation skills. Goal setting motivates people to put forth energy needed over time to meet obligations while directing their behavior toward self-monitoring and selecting appropriate strategies that will enhance self-efficacy and lead to attainment of goals. Inconsistency in performance, real or imaged, and goal attainment can enhance effort if self-efficacy is high or lead to relinquishing the goal if self-efficacy is low. According to Schunk goals must have explicit performance criterion, be viewed as attainable within a reasonable amount of time, and the level of difficulty of the task must be realistic if self-regulation is to improve.

In brief, self-regulation is an important aspect to be focused in learning. It consists of three main components, cognition, meta-cognition and motivation. Firstly, Cognition component refers to the learner use of cognitive strategies to learn such as simple strategies, problem solving and critical thinking. Secondly, cognitive processing component refers to knowledge and control of cognitive skills, and usually involves planning, monitoring, and evaluating of learning. And finally, motivation component refers to students' beliefs in their own ability to learn individually. Skilled learners use these three components effectively to achieve deep and adequate understanding.

2.1.4 Mental Models:

Scientific models are defined as "specially organized representations which show aspects of mechanism, causality, or function to illustrate, explain, and predict phenomena" (Scwarz et al., 2009, p.634).

They are also defined as "representations that either explain or predict a scientific process or phenomenon which can be an object, a mechanism, or an event, and is the target. A model has various levels of abstraction of the target depending on its purpose. A non-model, however, does not represent a target and does not serve the modeling purposes. For instance, a photo of a panda does not have a corresponding target and has limited explanatory power" (Lee, Chang and Wu, 2015, p.3).

Maps, diagrams and tables are kinds of models which help to visualize thinking patterns of students (Harrison and Treagust, 1998).

Schwarz et al., (2009) claimed that if students were engaged in model-based activities, their views toward scientific modeling process will be improved.

Gobert et al., (2011) also assisted that students' understanding of scientific models will support their learning. Furthermore, The NRC (2012) listed students' understanding of models and modeling as one of the major goals of science teaching.

Despite the variation in aspects of scientific models, Pluta, Chinn and Duncan (2011) suggested there are four main aspects:

1- The nature of models: it reflects the content of the model, its level of complexity and abstraction or its general characteristics.

2- The nature or process of modeling: it indicates the construction of models and their changing nature.

3- Evaluation and revision of models: which refers to the criteria used to evaluate a model and if it helps to achieve the purpose from it.

4- The purpose of models: This indicates the utility of models in scientific learning and understanding. Some models may be used to communicate, predict, explain, or to test hypotheses.

Modeling helps to provide students with strong power to let them be able to understand complex systems, to learn concepts, and to predict hypothesis about phenomena (Hashem and Mioduser, 2010).

Learning science by modeling is a widely used approach. Although, students' previous knowledge might be contradicted to the scientific models, since the models they form are highly influenced by their beliefs, students will find it hard to learn concepts related to models (Chi, 2005).

In order for students to construct a model, they have to build a network of concepts and principles with clear inter-relations between them (Jacoboson and Wilensky, 2006).

However, some researchers claimed that modeling did not contribute to a lot of understanding, since it increases the complexity and cognitive load on students (Gobert, 2003).

Mental models contribute to meaningful learning which is defined as the ability of the learner to use his acquired knowledge to solve problems with relevant knowledge, then to use his available mental models to solve the problems regarding the nature of the problem. This means that the teacher have to create the active learning environment which help the learners to use their mental models, test them, decide to let them stay and reinforced, or to leave them and construct new ones. Furthermore, students' understanding must be assessed using problem-based learning in which the students are expected to show behaviors related to understanding such as calculating, predicting, and explaining processes. Since students' understanding requires the fact that students should remember knowledge, then they should have the ability to use them carefully (Michael, 2004).

A mental model is a representation in memory of information that has been acquired. It is composed of related or linked pieces of information. There are several purposes for mental models: they help to make decisions, processing information, selecting the knowledge and refine it, and in organizing the newly acquired information inside the learner's cognitive network. In fact, the teacher must understand that any information the student acquire is organized inside the learner as a mental model. Any learner form special mental model for him, this model differs among learners according to their interaction with the environment, and their previous experiences (Norman, 1983).

Lesh and Kelly (1997) claimed that humans tend to create their internal models in each situation they face, the same thing is for students, and they create their models for any learning environment they are engaged in.

Mental models also help the learner to organize the information he acquired, and to link these information to other things he already knows. In addition, students' existing mental models can be used to make predictions, to generate explanations, to solve problems, and to learn new ideas (Michael, 2004).

The students' models are debutant, and not always considered true. Students' models differ from expert models or scientific models. Some of these differences are:

1. Scientific or expert models are complete and contain all of the elements needed to describe the model with their inter-relations, while students' models are incomplete with less or absent relations and connections.

2. Scientific models aren't contradicted and always coherent, but students' models are not completely consistent and often incompatible.

3. Scientific models are strongly connected to other relevant knowledge, while students' models are rarely connected to relevant knowledge.

4. Scientific models are used effectively to solve problems, in contrast to students' models which are frequently used to solve problems, and if the models were incorrect, this will lead to wrong solutions (Michael, 2004).

For instance, it is crucial for the teacher to discover the learner's model, and to decide exactly how the model can be consistent with the scientific model. The teacher must exactly know the components of the scientific models, their inter-relations, and the level of complexity of the model, then the teacher has to decide how the learner can acquire the correct and accurate model. This is of course not a simple work to perform! (Michael, 2004).

One other property of mental models which deserves mentioning is that sometimes these models may contain incorrect elements or relations, or they may miss important details. In this case these mental models are referred to as misconceptions (Michael, 1998).

It is really hard to change misconceptions, they are known to be extremely resistant, and could negatively affect further learning. Besides, the learner's cognitive network contains multiple models, some of them are correct, others are less correct, and others are misconceptions. The learner's choice to use the internal mental model depends on the learning conditions, and to the degree of similarity between the learning environment and student's personal models that were constructed due to their past experiences (Wandersee, Mintzes, and Novak, 1994).

In essence, students must be provided with opportunities to test their existing mental models, when the students realize that their models produce incorrect answers, or fail to make predictions about certain phenomena, students tend to replace their models with new ones. This cycle of building models, testing and refining them must always be available to the learner. In addition, students must acquire the skills of using mental models in different learning conditions. For this reason, it is the responsibility of the teacher to provide students with opportunities to practice problem solving, to test their models, and to receive feedback about their learning tasks (Michael, 2004).

Clark and Linn (2003) asserted that models building by students will greatly influence their understanding. Thus meaningful learning and mental model construction are closely related terms in the active learning process.

Learning takes place only inside the learner, and only the learner can build his own model which will be used in future learning. Although many teachers think that what they do in the classroom makes up the students' learning (Simon, 2001).
One example of an active learning environment is the science laboratory, when students are encouraged to predict hypothesis or expectations about certain events using their own mental models, then testing the model by experiment, followed by a reflection that the student write about the similarity or difference of the right model from his model, with the importance of giving students feedback about their performance (Michael, 1993).

Modeling can provide students with strong background to understand complex systems that were hard to understand and predict their behavior; encourage them to ask relevant questions, and to formulate models related to some hypotheses or theories (Blikstein and Wilensky, 2005).

Hashem and Mioduser (2013) articulated three categorizations for the mental models in order to help students to understand complex systems which include different concepts, principles, theories, and relations between them. The categorizations are structures, behaviors, and functions; each category has its own questions. These questions are shown in table1.

Mental Model	Questions
Structure	Describe what you see in detail (number of agents, how do agents behave before they are part of the system, system environment)?
Function	Who\what initiates the formation of the system? Are there feedback loops within the system? Do they amplify or control the outcome? How do agents behave before they are part of the system? Is the same outcome will be achieved each time the system form? How would the system respond to environmental change, explain why?
Behavior	Is there movement of the agents within the system? How would you design such system\explain its behavior? Is there a difference between agents and system? What draws the system together?

Table 1. Categorization of mental model
(Hashem and Mioduser, 2013, p.81)

Many features of the complex system make it hard to understand for students, in order for them to achieve deep understanding of any complex system or any phenomena; they have to try to form models which help them in the learning process (Hashem and Mioduser, 2011).

However, students' learning about complex systems is not powerful by observing the systems, students must engage in forming models to achieve understanding of the complex systems (Resnick, 1994).

Norman (1983) and Buckley, Gobert, Kindfield, Horwitz, Tinker and Gerlits (2004) had constructed a framework in order to explain the students' perception and understanding of certain phenomena. The frame work is shown in figure 4.

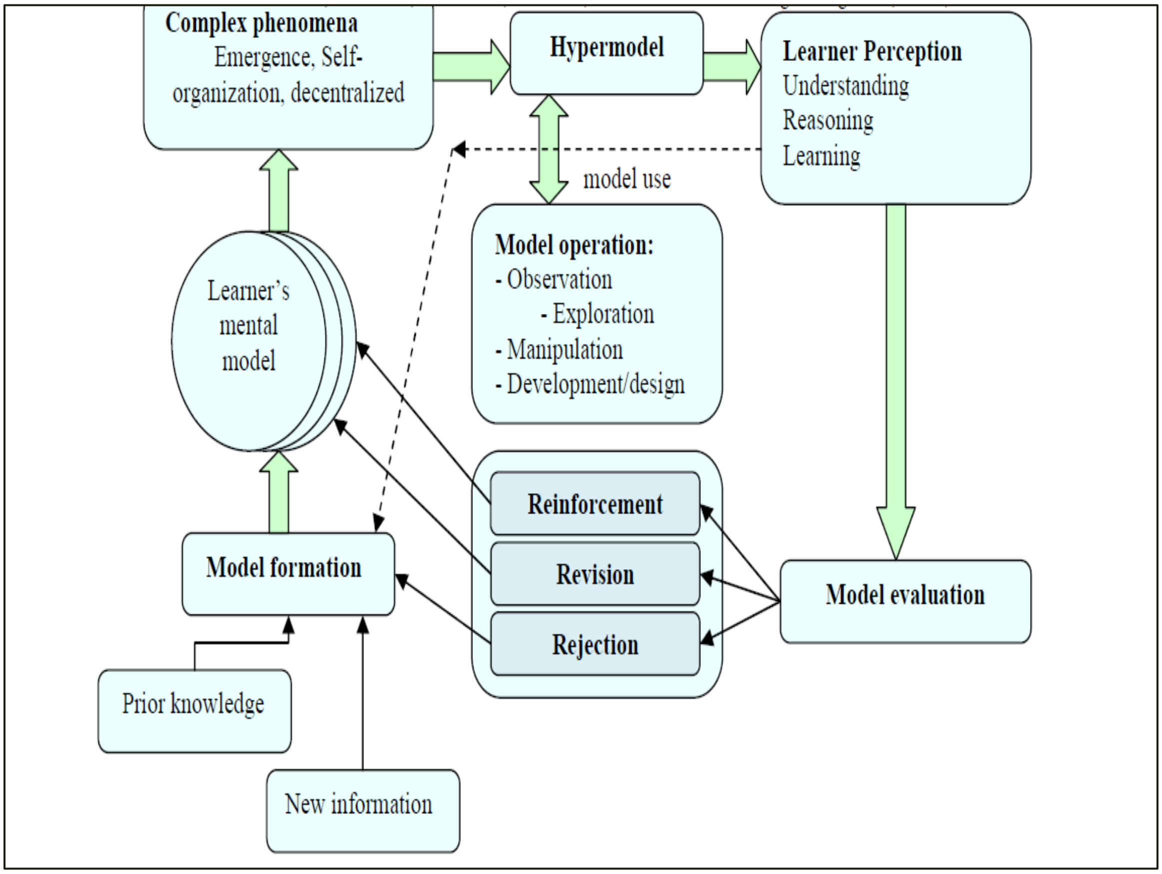

Figure4. Learning by modeling framework
(Buckley et al., 2004, p.24 and Norman, 1983, p.19)

The framework pinpoints the cognitive organization, beliefs and thoughts, and experiences of the learner when he forms a mental model. The hyper models are external representations which differ from mental models that considered internal representations. The representations are considered as models when they represent structural, dynamic, and causal aspect of the target model (Buckley et al., 2004).

Understanding the scientific phenomena requires the formation of mental models, and then the models will be manipulated by different processes such as problem solving, inference, or reasoning. The mental model influence students' perceptions of phenomena, thus the interaction between the phenomena and students' perception affect their current models (Johnson-Laird, 1983).

Clement, Glover, Ronning and Reynolds (1989) asserted that model-based learning involves the formation, testing, and subsequent reinforcement, revision, or rejection of mental models. This is analogous to hypothesis development and testing seen among scientists. The learner's prior knowledge may include a partial mental model of the phenomenon or naive models that are incompatible with the scientifically accepted model. If the learner's model is used successfully to accomplish the task, the model is reinforced.

Buckley (1992) assisted that in order for students to learn about phenomena in response to the demand of the learning tasks, they have to link between their prior knowledge and the new information.

However, if inconsistencies or deficiencies in the model are noted the learner may reject the model and form a new one, or revise the initial model (Chinn and Brewer, 1993).

Model revision may involve modifying parts of the existing model or elaborating the model by adding to or combining existing models. Embedding a model in a larger model is an example of elaboration (Monaghan and Clement, 1994).

Meta-cognitive processes such as selecting which perceptual cues to attend to, directing interactions with representations and phenomena during learning and inquiry, and monitoring the results of those interactions and the evaluation of one's model also play an important part in model-based learning as do reasoning processes such as hypothesis generation from the model, testing that hypothesis, and interpreting the data that are among higher order inquiry skills. Thus, the mental model evolves through multiple recursions as it is made increasingly complex and, hopefully, more accurate (Johnson-Laird, 1983).

To summarize, it is crucial for the teacher to help learners to learn. Personal learning involves constructing of the learner's mental model which might be incorrect and inconsistent with the scientific model. In many cases, the learners constitute wrong or incomplete information about certain topic, which is known as misconception. Misconceptions are common among learners; they even don't try to change them because they sometimes lead to right answers. The role of the teacher is to determine how to help students build scientific models and refine incorrect models.

Due to the importance purposes for the mental models that the literature provides, the researcher decided to study whether these mental models can be discovered and replaced by correct models using appropriate methodologies.

2.2 Related Studies:

This section includes previous related studies about argumentation; write to learn strategy, self regulation, and mental models. In addition, the researcher suggested comments about these studies.

2.2.1 Related studies about argumentation:

Cetin, Metin, Capkinoglu and leblebicioglu (2016) conducted a study in Turkey. The study aimed at seeking the trace of argumentation in Turkish Elementary and Secondary Science Curriculum developed by the Turkish Ministry of Education with an emphasis on inquiry-based learning. The aim is to investigate learning outcomes that might be conducive to argumentation. For data analysis, latent content analysis was used, by means of which the researchers looked for the underlying meaning of the words in learning outcomes.The categorization framework was designed to include argumentation, the nature of science, content of the learning outcomes, domain of the learning outcomes, and the relationship between argumentation and the nature of science. The sample was composed of elementary school for grades 1-4, secondary school for grades 5-8, and high school for grades 9-12. The results showed that the distribution of explicit and implicit argumentation elements, the nature of science aspects, and socio-scientific issues are high in 4th and 5th grades (the percentage of argumentation elements was higher in 4th (31%) and 5th (41%) grades). Argumentation elements exist explicitly or implicitly in all grades, but there is not a clear pattern in their distribution across grades. They occur more frequently in the domain of earth and space learning. Approximately 28% of the learning outcomes of life science, 20% of the learning outcomes of matter and change, and 21% of the learning outcomes of physical science include argumentation elements.

Moreover, Cigdemoglu, Arslan and Cam (2016) implemented a study in Turkey aimed at revealing the effect of argumentation on the domains of literacy. Therefore, they proposed to reveal the effect of argumentation on three domains of chemical literacy related to acids and bases concepts. Participants were 29 freshman pre-service science teachers' enrolled in a General Chemistry-II course. Argumentation practices were implemented throughout six weeks. Open-ended contextual chemical literacy items were developed to assess the difference in chemical literacy domains and the items were administered before and right after the intervention. Responses to chemical literacy items were scored with a rubric and three scores were calculated; knowledge, competency and attitudes. Paired sample t-tests were used to compare the mean scores. All intervention sessions were video recorded and three of them were analyzed according to three criteria, the presence of arguments, the frequency of arguments, and the levels of arguments. Independent sample t-test was used to analyze data. The results indicated that there is no a significant difference between pre-test scores in terms of content knowledge scores [t (54) = -.155, p>0.05], competency scores [t (54) = .466, p>0.05], and attitude scores [t (54) = 10.537, p>0.05]. The findings reveal that argumentation practices contributed to pre-service teachers' chemical literacy skills, mostly to their knowledge and competencies when compared to attitudes. Also, distinct differences in the quality of argumentation levels were observed through weeks.

Furthermore, Knight and McNeill (2015) executed a study in New England; the study's purpose was to investigate the similarities and differences in the ways students construct collaborative oral and individual written socio-scientific arguments and to check the quality of their argument. The study was preceded with one middle school class in an urban New England school district. Data sources consisted of transcripts from three videotaped lessons and associated student work. Three scientific argumentation lessons were observed. The teacher, who previously participated in a workshop about teaching argumentation, was requested to provide opportunities for oral argumentation products for whole class and/or small group, in addition to written products. While the written products were individually constructed, the oral arguments were collaboratively constructed and presented by small groups. The sample consisted of 17 students at 7^{th} grade (9 females and 8 males). The sophistication of both the collaborative oral and individual written argument products were analyzed using a proposed learning progression. Results suggested that the students' collaborative oral arguments tended to be of lower sophistication whereas the individual written arguments tended to be of higher sophistication; however both modalities tended to include inappropriate justifications. Moreover, in the written arguments it was easier for students to include a rebuttal than limit their argument to using only appropriate justifications. These findings suggest that there are both commonalities and differences across the expressive modalities that can be targeted in an effort to strengthen the quality of students' arguments.

Archila (2014) implemented a study in Colombia in order to know how a group of pre-service chemistry teachers has been prepared to promote students' argumentation. A Chemistry degree studies plan from a Colombian university was surveyed, and 18 future teachers' representations about argumentation were analyzed. Firstly, one program offered to future chemistry teachers was surveyed to determine if argumentation was included implicitly or explicitly. Secondly, a questionnaire was applied to 18 pre-service chemistry teachers from ninth semester. Results indicate argumentation is not an explicit priority for the pre-service chemistry teachers training program studied. Additionally, future teachers showed consciousness about the necessity of being prepared to engage students successfully in argumentative activities. Results confirm the mayor difficulties future chemistry teachers have to use pedagogical and didactic tools that enable them to promote argumentative abilities (among others) in students. Nonetheless, pre-service chemistry teachers manifest not to know how to design multiple methodologies to improve argumentation. Therefore, one of the multiple proposals of solution could be the incorporation of a module that allows pre-service chemistry teachers to build their own strategies to promote argumentation.

Heng, Surif and Seng (2014) accomplished a study in order to investigate the mastery level of scientific argumentation, based on Toulmin's Argumentation Model, when students engage in individual and group argumentations. A total of 120 students(62 female and 58 male), selected from four schools, and were selected and were first randomly divided into two groups to answer the Scientific Argumentation Test .One group of students answered individually, while the other group was allowed to collaborate among group members. To achieve the purpose of the study three instruments were used, the scientific argumentation test, the student semi structured interview and teacher semi structured interview which were also conducted on a selected group of students and their teachers to gather additional information to support the data. The t-test was carried out to evaluate the differences in students' mean score. The results indicated significant differences ($t = -3.064$, $df = 118$, $p < .05$). The mean difference of -6.298 showed that students in group argumentation performed better than students engaged in individual argumentation. Similar results were also obtained when the data was analyzed with the chi-square test, where $\chi2$ (3, N = 120) = 23.23, $p<.05$. In comparison, the mastery level of scientific argumentation for students involved in group argumentation was moderate ($\chi2$ (2, N = 60) = 19.20, $p<.05$), whereas the mastery level for students engaged in individual argumentation was weak ($\chi2$ (3, N = 60) = 49.20, $p<.05$). The findings showed that there is a significant difference in the mastery level of scientific argumentation between groups and individuals. Students who participated in group argumentation tend to perform better than those who participated in individual argumentation. However, the mastery level of scientific argumentation for both groups of students was generally unsatisfactory. Therefore, the teaching and learning of science in Malaysian schools need to emphasize more on group argumentative activities to enhance students' mastery of scientific argumentation, which will also their reasoning capabilities and scientific knowledge.

Cetin (2013) implemented a study about explicit argumentation instruction to facilitate conceptual understanding and argumentation skills; the purpose of the study was to investigate the effects of argumentation-based chemistry lessons on pre-service science teachers' understanding of reaction rate concepts, their quality of argumentation, and their consideration of specific reaction rate concepts in constructing an argument. Moreover, students' perceptions of argumentation lessons were explored. The sample of the study composed of 116 participants (21 male and 95 female), who were pre-service first-grade science teachers from a public university. The participants were recruited from the two intact classes of a General Chemistry II course, both of which were taught by the same instructor. Non-equivalent control group design was used as a part of quasi-experimental design. The experimental group was taught using explicit argumentation activities, and the control group was instructed using traditional instruction. The data were collected using a reaction rate concept test, a pre-service teachers' survey, and the participants' perceptions of the argumentation lessons questionnaire. For the data analysis, the Wilcoxon Signed Rank Test, the Mann–Whitney U-test and qualitative techniques were used. The results of the study indicated that an argumentation-based intervention caused significantly better acquisition of scientific reaction rate-related concepts and positively impacted the structure and complexity of pre-service teachers' argumentation. Moreover, the majority of the participants reported positive feelings toward argumentation activities.

Abi El Mona and Abd El Khalick (2011) conducted a study aimed to elucidate college freshmen science students, secondary science teachers, and Scientists' perceptions of 'scientific' argument; to compare participants' perceptions with Stephen Toulmin's analytical framework of argument; and to characterize the criteria that participants deployed when assessing the 'quality' or 'goodness' of arguments. (30) Students, teachers, and scientists, with 10 members in each group participated in two semi-structured individual interviews which served as the instruments of the study. Participants included three groups of 10 members each drawn from a Midwestern university in the USA and its neighboring communities. Participants were mainly self-selected; they were drawn from a pool of individuals who responded favorably to an invitation to partake in the study. First, all participant college freshmen students (seven males and three females) had completed at least two years of high school science. Their ages ranged from 18 to 19 years. The second participant group was secondary science teachers (five males and five females), and the third participant group comprised 10 scientists (four males and six females). During the first interview, participants generated an argument in response to a socio-scientific issue. In the second interview, each participant 'evaluated' three arguments generated by a member from each participant group without being privy to the arguer's group membership. Interview transcripts were qualitatively analyzed. The findings point to both similarities and differences between participants' conceptions of argument and those based on Toulmin's analytical framework. Participants used an array of common and idiosyncratic criteria to judge the quality or goodness of argument. Finally, contrary to expectations, participants independently agreed that the 'best' arguments were those generated by participant science teachers.

McNeill (2011) accomplished a study aimed at investigating 5th grade students' views of explanation, argument, and evidence across three contexts; what scientists do, what happens in science classrooms, and what happens in everyday life. The study also focused on how students' abilities to engage in one practice, argumentation, changed over the school year. Multiple data sources were analyzed. The study took place in an elementary school in a large urban school district in New England with grades 3–5 elementary science specialist. The instruments used were: pre and post student interviews, videotapes of classroom instruction, and student writing. The results from the beginning of the school year suggested that students' views of explanation, argument, and evidence, varied across the three contexts with students most likely to respond ''I don't know'' when talking about their science classroom. A sample of 23 students was interviewed at both the beginning and end of the school year. Students had resources to draw from both in their everyday knowledge and knowledge of scientists, but were unclear how to use those resources in their science classroom. Students' understandings of explanation, argument, and evidence for scientists and for science class changed over the course of the school year, while their everyday meanings remained more constant. This suggests that instruction can support students in developing stronger understanding of these scientific practices, while still maintaining distinct understandings for their everyday lives. Finally, the students wrote stronger scientific arguments by the end of the school year in terms of the structure of an argument, though the accuracy, appropriateness, and sufficiency of the arguments varied depending on the specific learning or assessment task. This indicates that elementary students are able to write scientific arguments, yet they need support to apply this practice to new and more complex contexts and content areas.

Erduran, Ardac and Yakmaci-Guzel (2006) performed a case study for the promotion of argumentation in pre-service science teachers. The participants consisted of (17) trainee teachers (12 females and 5 males) enrolled in a science teacher certification course at an English medium university. The pre-service teachers were trained over a 6 weeks period during the spring term of the 2005-2006 academic year. For the purposes of the present study, the pre-service teachers were expected to plan and implement at least one out of the three lessons as an argument lesson. Pre-service teachers were further familiarized with Toulmin's Argument Pattern (TAP) (1958) which is subsequently used to identify the structure of arguments manifested throughout each lesson. Case studies of two Turkish teachers are used to illustrate how teachers structure lessons and support argumentation in secondary science classrooms after a series of training sessions. The teachers applied their lesson plans about argumentation at in Istanbul secondary schools. The data sources were teacher talk, student group talk, students' written work, teacher lesson plans, and teacher interviews after training and teacher written responses to argument questions. Results indicated that the teachers incorporated those features of pedagogical strategies (e.g. group discussions and presentations) targeted by the training.

Driver, Newton and Osborne (2000) carried out a pilot study in the United Kingdom aimed at determining the extent if which young students are given adequate opportunities to practice argumentation during their science learning. The tool of the study was a systematic observation study of 34 science lessons in secondary schools in the Greater London area involving classes of students between the ages of 11 and 16 years (years 7–11).The case is then advanced that any education about science, must give the role of argument a high priority if it is to give a fair account of the social practice of science, and develop a knowledge and understanding of the evaluative criteria used to establish scientific theories. Such knowledge is essential to enhance the public understanding of science and improve scientific literacy. The researchers developed and used an observation schedule to record student activities and the nature of student–teacher interactions throughout each lesson at 30-second intervals. The results indicated that very little opportunity is given by teachers for students to discuss ideas in groups, or for whole class discussions about the interpretation of events, experiments, or social issues. In the 34 lessons there were only two cases in which the teacher set a group discussion task and these discussions lasted. Less than 10 minute each. The dominant form of interaction in the classrooms was teacher talk. Where opportunities were given for students to work in groups, for example, on practical tasks, these were rarely organized in such a way as to encourage substantive discussion of the science involved. Instead, student talk focused on procedural aspects of the practical work. In cases in which the teacher did give students opportunities for discussion, little guidance was given on how to undertake it effectively and the student groups observed had some difficulties in managing the social aspects of the discussion. Furthermore, the case is advanced that the lack of opportunities for the practice of argument within science classrooms, and lack of teacher's pedagogical skills in organizing argumentative discourse within the classroom are significant impediments to progress in the field.

2.2.2 Related studies about "write- to- learn strategy":

Weston-Sementelli, Allen and McNamara (2016) implemented a study in Arizona State, to examine the impact of reading, writing, and blended (reading and writing) strategy training on students' performance on a content specific source-based essay writing task. In contrast to general source-based writing tasks, content-specific source-based writing tasks are tasks where writers are provided with the source material on which to base their essays. The sample consisted of 175 undergraduate psychology students for credit in their Psychology 101 course and was randomly assigned to one of the four conditions: no instruction control groups, reading only, writing only, or combined instruction, and were provided with strategy instruction and practice in the context of two intelligent tutoring systems. The instruments of the study were pre-test, writing essay and reading test; students first completed a pretest, which was comprised of demographic, motivation, and self-efficacy measures. Participants then completed a timed (25 min) SAT-style essay followed by reading Test .Results indicated that participants in the blended strategy training condition produced higher quality source-based essays than participants in the reading comprehension-only, writing-only, or control condition, with no differences observed between the latter three conditions. Further, the benefits of this blended strategy instruction remained significant regardless of prior reading and writing skills, or time on task.

Abu- Nimah (2015) conducted a master thesis about "The effect of using the Survey Question Predict Read Respond Summarize (SQP2RS) via write to learn strategy to 10th graders' reading comprehension and reflective thinking". The study has been applied on a purposeful sample of 10th grade students in public schools, in Bethlehem district in the academic year 2015/2016. The sample included (139) students (61 males and 78 females) at AL-Awda Basic School for Girls, Bethlehem Secondary Boys' School. Students were assigned to experimental and control groups, the experimental group was taught by using the "SQP2RS via WTL" strategy and the control group was taught by the traditional method. The researcher has prepared two tests: A reading comprehension achievement test and a reflective thinking questionnaire. The findings of the study showed that there were statistically significant differences in the mean scores of 10th graders' reading comprehension in the English language due to the teaching method in favor of the experimental group, the level of pre-achievement in favor of the high achievement group, the interaction between group and gender in favor of the female in the experimental group, the interaction between group and level of pre-achievement in favor of the high achievement in the experimental group, the interaction between gender and level of pre-achievement in favor of the male in the high achievement group and the interaction between group, gender and level of pre-achievement in favor of the high achievement male students in the experimental group. And there were no statistically significant differences in the mean scores of 10th graders' reading comprehension in the English language due to gender. The findings showed also that there were statistically significant differences in the mean scores of 10th graders' reflective thinking in the English language due to the teaching method in favor of the experimental group, the gender in favor of male and the interaction between group and gender in favor of the male in the experimental group. And there were no statistically significant differences in the mean scores of 10th graders' reflective thinking in the English language due to the level of pre-achievement, the interaction between group and level of pre-achievement, the interaction between gender and level of pre-achievement and the interaction between group, gender and level of pre-achievement.

In a study done by Koster, Tribustinina, De Long and Van den Bergh (2015) in Netherlands, In order to identify effective instructional practices of writing at schools, the researchers conducted a meta-analysis of writing intervention studies. The sample of the study involved students in the upper grades of elementary school (grade 4-6) in a regular school setting. Experimental or quasi-experimental studies in which at least two instructional conditions were compared: an experimental condition and a control condition. The instrument used in the study was a posttest, as this provided the best indication of the impact of an intervention on students' writing performance. Average effect sizes were calculated for ten intervention categories: strategy instruction, text structure instruction, pre-writing activities, peer assistance, grammar instruction, feedback, evaluation, process approach, goal setting, and revision. Five of these categories yielded statistically significant results. Pair wise comparison of these categories revealed that goal setting (ES = 2.03) is the most effective intervention to improve students' writing performance, followed by strategy instruction (ES = .96), text structure instruction (*ES* = .76), peer assistance (*ES* = .59), and feedback (*ES* = .88) respectively.

In a study conducted by Atasoy (2013) in order to identify the effect of writing to learn strategy on undergraduates' conceptual understanding of electrostatics. The sample of the study consisted of 54 students (26 experimental group, and 28 control group) prospective elementary school mathematics teachers from two classes of physics II course. The conditions were to let the experimental group conduct writing to learn activities, while the control group will be taught by traditional methods like questioning. The instrument used in this study was an electrostatics conceptual text. The data were analyzed both quantitavely and qualitatively. The results of the study showed that there was a significant difference between the levels of improvement of conceptual understanding in the experimental group.

Graham and Perin (2007) carried out a study in order to identify effective instructional practices for teaching writing to adolescents, the authors conducted a meta-analysis of the writing intervention literature from grades 4 to 12 in New York schools, focusing their efforts on experimental and quasi-experimental studies. They located 123 documents that yielded 154 effect sizes for quality of writing. Each study in this meta-analysis compared at least two groups of students who received different instructional conditions. The authors calculated an average weighted effect size (presented in parentheses) for the following 11 interventions: strategy instruction (0.82), summarization (0.82), peer assistance(0.75), setting product goals (0.70), word processing (0.55), sentence combining (0.50), inquiry (0.32),prewriting activities (0.32), process writing approach (0.32), study of models (0.25), grammar instruction(– 0.32).

Kieft, Rijlaarsdam, and Bergh (2007) carried out a research in Netherlands, their purpose was to examine the effect of writing to learn course on students' abilities to write short literary stories. The experiment took place at three different high schools in three different regions of the Netherlands, 220 students from the 8^{th} grade were involved, experimental group who will be taught by intensive writing to learn strategy and control group who will be taught in normal strategy were both assigned randomly. The researchers used a pre and post test to evaluate students' abilities to write short literature stories and used a questionnaire of 26 items measured students' planning and revising writing strategies in the pretest and posttest. Cronbach's alphas for these two scales were (.75). The results of the writing questionnaire which measures students' level of planning strategy and level of revising writing strategy showed that writing strategy was a rather stable characteristic of students correlations between pretest and posttest: for planning strategy,($r = .55$, $p < .001$), and for revising strategy,($r = .53$, $p < .001$). Furthermore, there was a small but significant correlation between pretest and posttest on literary interpretation skill ($r = .20$, $p = .03$).

2.2.3 Related studies about Self-Regulation:

Cetin (2017) carried out a study to determine whether perceived levels of self-regulated learning and meta-cognition predicted the ultimate grade point average (GPA) attained by 206 female and 70 male college seniors (aged 21 to 27) finishing their elementary education teaching certification studies at a university in Turkey. Data regarding individual levels of meta-cognition were collected through the administration of the "Meta-cognitive Skills Inventory for Adults". A separate scale was administered to the same set of participants to obtain levels of perceived self-regulated learning. Findings indicated that students' self-regulated learning and meta-cognition total scores are correlated with each other, but neither scale was predictive of the students' GPAs at a significant level in the hypothesized positive direction. Interestingly, self- regulated learning scores were significantly related to GPA but in a negative direction. The GPAs of students significantly and negatively correlated with self-regulated learning total scores ($p<.05$). The GPAs of students did not significantly correlate with meta-cognition total scores. There were statistically significant correlations between meta-cognition and self-regulation learning total scores ($p<.01$). And to investigate how meta-cognition and self-regulated learning together could predict GPAs, the overall model generated [F (2-275) = 1.914, $p >.005$] indicated that meta-cognition and self-regulation learning total scores together did not predict students' GPAs. Total scores obtained from the meta-cognition and self-regulated learning scales together explained .048 % of the variance in GPAs.

In a recent study done by Yang, Liu, Fang, Chung-Yuan, Guo-Li, Ying-Tien, Min-Hsien and Tsai (2017) in order to develop and validate an online contextualized test for assessing students' understanding of epistemic knowledge of science (EKS). In addition, how students' understanding of epistemic knowledge of science interacts with learner factors, including time spent on science learning, interest, self-efficacy, and gender, was also explored. The participants were 489 senior high school students (244 males and 245 females) from eight different schools in Taiwan. About 57 % of the participants were 10th graders (151 males and127 females), 17 % were 11th graders (50 males and 34 females), and the rest were 12^{th} graders (43 males and 82 females). The researchers first identified six factors of EKS, such as: 1-status of scientific knowledge, 2-the nature of scientific enterprise, 3-measurement in science, 4-use of models in science, 5-reasoning and argumentation in science, and 5- role of empirical inquiry. An online test was then used for assessing students' understanding of the epistemic knowledge of science. Also, a learner-factor survey was developed by adopting previous survey items to measure the learner factors. The results of the study show that: firstly, the results of the correlation analyses show that the six EKS factors inter-correlate with each other to form an individual's belief system. All of the EKS, except for EKS 4 (Model use) have medium to high correlations with one another ($r = 0.33$, $p < 0.001$). EKS 1 (Status) and EKS 3 (Measurement) have the strongest association ($r = 0.70$, $p < 0.001$). Secondly, the result of the correlation analysis of the learner factors and EKS indicated that two of the learner factors, students' interest in learning science (interest) and their time spent on science learning (TSSL), were positively correlated to all EKS factors. In particular, the enterprise factor (EKS 2) had medium correlations with these two learner factors. Moreover, the other two learning-related factors (i.e., students' self-efficacy for learning science and their frequency of participating in extracurricular science activities) were positively correlated to EKS 2. Accordingly, the enterprise factor (EKS2), which reflects the social aspect of scientific inquiry, could be regarded as a vital factor related to the four learning-related factors. Significant gender differences were found in EKS2 and EKS3. More specifically, the female students were more likely to have higher scores in understanding the nature of scientific enterprise (EKS 2) and the measurements in science (EKS 3) than the male students were. However, no gender differences were found in the two dimensions of epistemic knowledge of science.

Mang, Zheng, Liang, Zhang and Tsai (2016) conducted a study aimed at investigating the relationships among Chinese high school students' conceptions, self regulation, and strategies of learning science. The sample of the study included 333 8^{th} grade students, made up of a similar number of participants from each of six different junior high schools in Beijing. Three questionnaires were used to achieve the study's purpose. The results of the study showed that learners with higher level conceptions were positively related to their basic self regulations and advanced self regulations (path coefficient=0.39, 0.36 respectively, $P<0.001$) in the self regulation of learning science. Furthermore, the higher level conceptions are significantly positive factors for predicting deep strategy (path coefficient=0.18, $P<0.05$), but negative factors for explaining surface strategies such as minimizing scope of the study and rote learning (path coefficient=-0.18,- 0.19 respectively ,$P<0.05$) . Also, a relation were revealed between students self regulation and strategies, basic self regulations is a positive factor for explaining deep strategy (path coefficient=0.23 $P<0.01$) and rote learning (path coefficient=0.14, $P<0.05$). However learners with lower level of conceptions, namely memorizing, testing, practicing and calculating have a direct connection with their surface learning strategies such as minimizing scope of the study and rote learning(path coefficient=0.55,0.62 respectively<0.001) and learners with lower level of conceptions were neither related to the self regulation nor the deep strategy.

Bozpolat (2016) conducted a study in order to reveal whether the low, medium, and high level self-regulated learning strategies of third year students at the Education Faculty of Cumhuriyet University can be predicted by the variables of gender, academic self-efficacy, and general academic average. The study uses the Relational Screening Model. The dependent variable of the study was the "self-regulated learning strategies" of the students and the independent variables were gender, academic self-efficacy, and general academic average. The universe of the study consisted of 1398 third year students from 11 departments of the Education Faculty of Cumhuriyet University. The sample of the study consisted of 826 third year students from 11 departments of the Education Faculty of Cumhuriyet University, all chosen by simple random sampling. In the study, as a tool for data collection, the “Academic Self-Efficacy Scale” was used to identify the academic efficacies of the students, and the “Self-Regulated Learning Strategies Scale” was used to identify the self-regulated learning strategies of the students. In the analysis of the data, a clustering analysis of the dependent variable and the three-category ordinal logistic regression analysis were used since it was ordered. On examining the results of the logistic regression analysis, it could be seen that gender, general academic average, and academic self-efficacy of the students predicted the self-regulated learning strategies to a significant level. For example, students with a high level of self-regulated learning strategy were taken as the “reference category.” The coefficients obtained in accordance with this reveal the effect of students on the probability of having a high level of self-regulated learning strategy. Significance analyses of the model parameters reveals that the variables gender (p = .000), academic self-efficacy (p = .000), and general academic average (p = .002) are significant on self-regulated learning strategies.

Sadi and Dagyar (2015) examined the relationships among epistemological beliefs, conceptions of learning, and self-efficacy for biology learning with the help of the Structural Equation Modeling (SEM) in Anatolian High Schools in Turkey. Three questionnaires, the epistemological beliefs, the conceptions of learning biology and the self-efficacy for learning biology, have been used to investigate 384 high school students' epistemological beliefs, conceptions of learning, and self-efficacy for learning biology, respectively. The participants in this study included 384 high school students (198 males and 186 females). The results indicate that the students' epistemological beliefs about the source/certainty, justification, and development of biology knowledge have some direct and positive relations with some factors of conceptions of learning. Moreover, it has been found that those students' epistemological beliefs about justification and development, and their conceptions of learning about applying, understanding, and seeing in a new way directly and positively relate to the students' self-efficacy for learning. Only the source/certainty of knowledge directly and negatively relates to the students' self-efficacy. In addition, the students' epistemological beliefs play an indirect role in the students' self efficacy through the mediator of conceptions of learning. Thus, all these information about the students' epistemological beliefs, conceptions of learning and self-efficacy for biology learning are required for an effective teaching and learning process.

Zimmerman and Kitsantas (2014) performed a study in an attempt to compare students’ self-discipline and self-regulation measures and their prediction of academic achievement .The sample involved 507 high school students and their teachers. The researchers compared prediction of these students’ academic achievement by a composite of students’ and teachers’ measures of students’ self-regulation (SR) with a composite of students’ and teachers’ measures of students’ self-discipline (SD). The sample of the study consisted of 526 students that were selected from 9 to 12 grades in high schools in New York; they ranged in age from 15 to 19 years with a mean age of 16.8 years. Students were drawn from four high school grades: 28% grade 9, (N = 148); 20% grade 10, (N = 106); 24% grade 11, (N = 125); and 28% of the students were in grade 12, (N = 144). Three questionnaires were used to measure students’ self discipline and self regulation, one questionnaire students answer, the second is answered by teachers, and the third by parents. Hierarchical regression analyses revealed that the SR composite was more predictive of students' grade point average and performance on a state-wide achievement test than the SD composite. Confirmatory factor analyses showed that, although SD and SR latent factors correlated significantly, a two-factor solution provided an acceptable fit for the results. Structural Equation Modeling analyses indicated that the SR latent factor predicted both measures of students' achievement significantly, but the SD factor did not predict either achievement measure significantly. No significant gender differences were found with students' SD, SR, or achievement measures. These results suggest a path for integrating two relatively separate streams in self-regulation research on the basis of a well-established distinction between learning and performance processes.

A Doctoral thesis was conducted by Gaythwaite (2006). The purpose of the study was to investigate whether meta-cognitive self regulation, Self-efficacy for learning and performance, and critical thinking could be identified as predictors of student academic success and course retention among community college students enrolled in online, televised viewing course, and public speaking courses. The study was conducted at Valencia Community College. Data for this study were collected from participating students enrolled in either one of the two online, two televised viewing courses, and two traditional face-to-face public speaking courses chosen for analysis. Fifty-seven participants answered Motivated Strategies for Learning Questionnaire (MSLQ). Quantitative statistical analysis was used to investigate the impact of meta-cognitive self regulation, self-efficacy for learning and performance, and critical thinking on academic success and course completion in the three delivery modes. Data were analyzed and found self-efficacy was a significant predictor of final course grade. A correlation was performed among final course grade percentage and the variables (self-efficacy, self-regulation, and critical thinking). When final grade is correlated with self-efficacy there is a significant relationship ($R = .458$, $p < .01$). There is also a significant relationship ($r = .714$, $p < .01$) between self-regulation and critical thinking. A correlation was performed among informative speech grade and the variables (self-efficacy, self-regulation, and critical thinking). When informative speech grade is correlated with self-efficacy there is a significant relationship ($R = .137$, $p < .05$). No other variable was a statistical significant predictor of informative speech grade. And There was no statistically significant difference ($F = .939$, $df = 2, 54$, $p > .05$) in instructional method when accounting for the nesting of self-efficacy, self regulation, and critical thinking.

2.2.4 Related studies about mental models:

In a study accomplished by Lee, Chang and Wu (2015) in Taiwan to examine the potential impact of the representational characteristics of models and students' educational levels on students' Views of Scientific Models and Modeling (VSMM). An online multimedia questionnaire was designed to address three major aspects of VSMM, namely the nature of models, the nature of modeling, and the purpose of models. The three scales of representational characteristics included modality, dimensionality, and dynamics. A total of 102 eighth graders and 87 eleventh graders were surveyed. Both quantitative data and written responses were analyzed. The influence of the representational characteristics seemed to be more prominent on the nature of models and the purpose of models. Some interactions between the educational levels and the representational characteristics showed that the high school students were more likely to recognize textual representations and pictorial representations as models, while also being more likely to appreciate the differences between 2D and 3D models. However, some other differences between educational levels did not necessarily suggest that the high school students attained more sophisticated VSMM. For instance, in considering what information should be included in a model, students' attention to particular affordances of the representation can lead to a more naive view of modeling. Implications for developing future questionnaires and for teaching modeling are suggested in this study.

Schwartz and Skjold (2012) described the instruction and effectiveness of teaching about the nature of scientific models in the context of an undergraduate science course for future elementary and middle school teachers in Western Michigan University. The sample of the study was 71 under graduate science teachers studying at Western Michigan University. The instruments of the study were an interview about views of scientific inquiry. Results indicated that participants initially considered models to be physical representations of objects to be visualized, the process scientists use to do an experiment, and a chart scientists use to record data. Posttests interview indicated increased recognition of models as representations of scientists' ideas and explanations of processes. Despite explicit instruction, few came to understand the role of models in making and testing predictions.

In a study implemented by Hashem and Mioduser (2011) which describes a part of a project about Learning by Modeling (LbM) in Jerusalem. This study investigates the effect of different modes of involvement in exploring scientific phenomena using a computer agent-based modeling tool on students' understanding of complexity concepts. Participants are 121 undergraduate students (ages ranging from 18 to 20 years old) from the science department at Al-Quds University in Jerusalem, divided into four groups by the kind of involvement in working with models: observation, exploration, manipulation, and model-development modes. The students were selected based on their scientific background, all have done the tawjehi exam as required by the ministry of education for the scientific track, and they are all studying first year compulsory science courses in the faculty of science. The instruments of the study were pre- test to check the students' background, structured observation and data forms, and mental model worksheet Quantitative and qualitative methods are used to report about 121 freshmen students that engaged in participatory simulations about complex phenomena, showing emergent, self organized and decentralized patterns. Results show that there is an increase in students' understanding of complexity concepts in all four groups (observation, exploration, manipulation, and development and design). Significant difference was observed (paired-samples t test) between the pre-test and post-test. Moreover, there is a significant relationship between the modes of involvement and understanding complexity concepts ($\chi 2$ (df = 25) = 137.643, $p < .001$). Concerning the tasks complexity level (complicated vs. complex models) results showed significant relationship between the different modes of involvement and understanding complexity concepts for the complicated model ($\chi 2$ (df = 25) = 85.216, $p < .001$) and for the complex model ($\chi 2$ (df = 25) = 120.128, $p< .001$).

A research addresses high school students' understandings of the nature of models, and their interaction with model-based software in three science domains, namely Biology, Physics, and Chemistry were accomplished by Gobert, O'Dwyer, Horwitz, Buckley, Levy, and Wilensky, (2011) in United States. All the students in the study were in high school, the grade levels ranged from the 9th through the 12th grade (420 physics students, 218 chemistry students, and 98 biology students from our 13 Partner schools). Data from 736 high school students' understandings of models were collected using the Students' Understanding of Models in Science (SUMS) survey as part of a large scale, longitudinal study in the context of technology-based curricular units in each of the three science domains. The results of ANOVA and regression analyses showed that there were differences in students' pre-test understandings of models across the three domains, and that higher post-test scores were associated with having engaged in a greater number of curricular activities, but only in the chemistry domain Models as Multiple Representations (MR) (2, 733; $F = 3.12$; $p < .05$), and Uses of Scientific Models (USM) (2, 733; $F = 3.65$; $p < .01$). For these three constructs, post-hoc tests revealed significant differences between the pre-test means in physics and biology; additionally, for the Uses of Scientific Models subscale, significant differences were observed between chemistry and biology as well as between physics and biology. There were no statistically significant differences found for the subscales Models as Exact Replicas (ER) or Changing Nature of Models (CNM) across any of the three domains. The analyses revealed statistically significant differences between pre-test means across the domains, namely, Models as Explanatory Tools (ET) (2, 733; $F = 4.36$; $p < .05$).

A study made by Chiilebrough and Treagust (2009) in Australia to investigate students' views on models in science and to propose a framework to show how models are involved in learning. The results show that students' understanding of the role of models in learning science improved in later grades, and that many students were able to distinguish the purpose of scientific models from teaching models. Participants of the study included 210 students from three different schools and across four year levels; they were from 8th, 9th, 10th and 11th grades. The instrument of the study was an exam named as "My Views Of Models in Science" (MVOMS). The results are used to identify the criteria students use to classify models and to support pedagogical approaches of using models in teaching science. The responses showed that a majority of students (>70%) view models as a representation of ideas or how things work; that there could be many other models to explain ideas; and that models are used to explain scientific phenomena. An independent t-test performed on the six items found that only item 5 was statistically significantly different ($p < 0.05$) in respect of gender. In that item, the female students responded more positively, demonstrating a more scientifically sophisticated view of models. An ANOVA analysis on the results for each item with respect to year level showed statistically significant differences ($p < 0.05$) between the year levels for items 1 and 2. For both items there was an increase in the number of students choosing the more scientifically valid response with age.

Buckley, Gobert, Kindfield, Horwitz, Tinker, and Gerlits (2004) conducted a research study in 15 schools across the United States as part of a project called modeling across the curriculum which is a large scale research study. Data were collected in multiple classes from one middle school and eight high schools. The data presented in this study is based on a hyper model, interactive environment for learning genetics, which was implemented in multiple classes in eight high schools. Biology activities, data logging, and assessments were refined across this series of implementations. All students took a genetics content knowledge pre- and post-tests. Traces of students' actions and responses to computer-based tasks were electronically collected (via a "log file" function) and systematically analyzed. An intensive 3-day field test involving 24 middle school students served to refine methods and create narrative profiles of students' learning experiences, outcomes, and interactions with biology. Researchers report on one high school implementation and the field test as self-contained study to document the changes and the outcomes at different phases of development. An Analysis of Variance (ANOVA) was computed in order to determine whether there were any statistically significant differences on the total posttest score between the experimental and control group. There was a statistically significant difference found between the control group and the experimental group on two concepts: monohybrid and other. For both concepts the experimental group scored higher than the control group. No statistically significant difference was found on inheritance, dominance, sex linkage, genotype and phenotype, or pedigree.

2.3 Comments on the related studies:

Several studies had been accomplished that are related argumentation; write to learn strategy, self regulation, and mental models. For example, Cetin et al (2016) proved that argumentation is well covered in Turkish curricula especially in 4^{th} and 5^{th} grades. Cigdemoglu, Arslan and Cam (2016) also confirmed that argumentation practices contribute to pre-service teachers' chemical literacy skills. Thus, Weston-Sementelli, Allen and McNamara (2016) asserted that writing activities enhances students' abilities to write high quality essays, and Kieft, Rijlaarsdam, and Bergh (2007) also proved that writing strategies foster students' abilities to write short stories. Furthermore, Mang, Zheng, Liang, Zhang, and Tsai (2016) confirmed that self regulation is a positive factor for enhancing students to use deep learning strategies. Zimmerman and kitsantas (2014) also demonstrated that self regulation is strongly correlated with students self learning, academic achievement and performance. Buckley, Gobert, Kindfield, Horwitz, Tinker, and Gerlits (2004) showed that modeling across the curriculum is related to students' understanding of complex biological concepts. Hashem and Mioduser (2017) proved that learning by modeling develops an increase students' understanding of complexity concepts. All of these attempts are different in their purposes, variables and methodologies, but they give an empirical reason about the importance of this study which is an attempt to find out the effect of argumentation via write to learn strategy on self regulation and mental models of students. This study is unique in gathering all of the modern issues concerning science teaching and students learning together in one title. It is also special in its dependent and independent variables, its instruments and its methodology.

Chapter Three

Methods and Procedures

This chapter describes the methodology the researcher used to choose the sample of the study, the research instruments and their validity and reliability, data collection procedure and implementation, and finally statistical tests used for data processing.

3.1 Research Methods

The researcher used the experimental method by the quasi-experimental design due to its relevance and appropriateness to achieve the purposes of the study.

3.2 Population of the Study

The population of the study consisted of all of the students who are enrolled in 8th grade at East Jerusalem District government and private schools (4690) students, in which (2483) of them are females, and (2207) are males) in the second semester of the academic year 2016\2017 as the researcher got these data from the ministry of education of East Jerusalem District.

3.3 Sample of the Study

The sample of the study consisted of 152 students of the 8th grade (71 females and 81 males) in Bethany Secondary School for girls and Al-Maad Al-Arabi School for boys respectively. The researcher selected these two schools as a purposive sample due to the following reasons:

- The schools are close to the researcher's place of work.
- The administration of both schools accepted the implementation of the research in their schools.
- The presence of different sections of the same class within both schools. Thus, this will help the researcher assign control and experimental group in each school in order to fit with the methodology of the study.

In each school, both an experimental and control group were assigned randomly by toss.

Table 2: distribution of the participants of the study

Name of the school	Control group	Experimental group	Total
Al-Maad Al-Arabi School for boys	41	40	81
Bethany Secondary School for girls	36	35	71

3.4 Instruments of the Study

To achieve the objectives of the study the researcher used two instruments:

- Self-Regulation of Learning Science Questionnaire.(Appendix No.1)
- Mental Model Exam.(Appendix No.2)

The researcher followed these procedures for preparing the instruments and for checking their validity and reliability.

3.4.1 Self-Regulation of Learning Science Questionnaire:

The researcher constructed a questionnaire to measure students' self-regulation by constructing some of its items from previous studies (Mang , Zheng, Liang, Zhang, and Tsai, 2016) and by adopting some items of (Miller and Brown's, 1991) self-regulation questionnaire. (Appendix No. 1)

The researcher made the instrument in its first draft.

3.4.1.1 Validity of the Questionnaire:

Questionnaire was admitted to several educational specialists including Arabic language teachers, science teachers and supervisors, and a list of Al-Quds University Educational Sciences Doctors (Appendix No.8). All of their modifications were taken into consideration.

3.4.1.2 Reliability of the Questionnaire:

The questionnaire was applied to a pilot study composed of 16 females of 8th grade students studying at Orthodox School of Bethany in East Jerusalem in order to calculate the reliability coefficient of the questionnaire using Chronpach Alpha which equals (0.844). The questionnaire was also used to check students' abilities to answer all of its items, and to calculate the time needed to finish it.

3.4.2 Mental Model Exam:

The researcher built the mental model exam by analyzing the content of the 8th grade science book unit (Light and Spectacles) and its models, then the researcher adopted two questions from Lee, Chang, and Wu's (2015) mental models exam . Another two questions were constructed by the researcher according to specific criteria related to the nature of the unit. (Appendix No. 3)

3.4.2.1 Validity of the Exam:

The first draft of the test was submitted to several specialists including Arabic language teachers, science teachers and supervisors, and a list of Al-Quds University Educational Sciences Doctors (Appendix No.8). All of their modifications were taken into consideration.

3.4.2.2 Reliability of the Exam:

The exam was given to a pilot study composed of 16 females of 8th grade students studying at Orthodox School of Bethany in East Jerusalem in order to calculate the reliability coefficient of the exam using Chronpach Alpha which equals (0.812). The test was also used to check student understanding of its items, and to calculate the time needed to finish it.

In addition to these two instruments, the researcher prepared a teacher's guide to teach the Light and Spectacles unit using argumentation and write- to- learn strategy using the literature review and related studies that were mentioned previously. The teacher's guide was shown to science teachers of the 8th grade, supervisors, and Al-Quds University

Educational Science Doctors and all of their adjustments were taken into consideration. (Appendix No. 5)

3.5 Procedure of the Study

During the application of this study, the researcher carried out the following:

- Received a letter of permission from Faculty of Educational Sciences at Al-Quds University (Director of the Methods of Teaching Department) to facilitate the researcher's work at the schools. (Appendix No.6)
- Received permission from the Directorate of Education in Jerusalem District in order to allow application of the research in schools. (Appendix No.7)
- Decided the population of the study which consists of all of the 8^{th} graders studying in Jerusalem District and enrolled in public and private schools during the academic year 2016\2017.
- Determined the purposive sample of the study.
- Visited both schools to receive permission from the administration to apply the research.
- Assigned a unit from 8^{th} grade science book of the second semester (Light and Spectacles Unit) to design a teacher's guide book for instructing using the target teaching method.
- Designed the teacher's guide book.
- Constructed the self- regulation questionnaire and mental model exam, and checked content validity and reliability for both of them.
- Met the science teachers of both schools to explain to them about the design of the study, and chose the experimental and control group randomly in both schools.
- Questionnaire and exam were given to the purposive sample in both schools.
- Asked teachers to begin performing the research.
- Visited each school twice per week to ensure the teachers applied the research in both control and experimental groups.
- Distributed the questionnaire and mental models exam after ending the research (after two months from starting the unit).
- Collected the data for statistical analysis as well as identifying findings.

3.6 Variables of the Study

3.6.1 Independent Variables:

- Teaching method (Argumentation via “write- to- learn strategy”, and traditional strategy).
- Gender (male and female).

3.6.2 Dependent Variables:

- Self-regulation
- Mental models

3.7 Design of the Study

The researcher used a quasi-experimental design:

Experimental group: O1 O2 × O1 O2

Control group: O1 O2 --- O1 O2

O1: the self- regulation questionnaire (pre and post)
O2: mental model exam (Pre and post)
× : treatment using argumentation via” write- to- learn strategy”
---: the traditional method

3.8 Statistical Treatment of the Data

In the process of analyzing data, the Statistical Package for the Social Science (SPSS) was used, the researcher used means , standards deviations, Chronpach alpha, as well as the analysis of covariance (2- way ANCOVA) to treat the collected data and to examine the hypotheses of the study.

Chapter Four

Research Findings

This study aims to investigate the effect of using argument based inquiry approach via "write- to- learn strategy" on 8th grade students' self-regulation skills and students' abilities of forming scientific mental models. This study will also find the effect of the interaction between argument based inquiry approach via "write- to- learn strategy" method of teaching, and gender on 8th grade students' self-regulation and students' abilities to form scientific mental models. This chapter shows the results of the study which will be presented according to the research questions.

4.1 Results related to the first question of the study:

Is there an effect of using a program depending on argument based inquiry approach via "write-to-learn strategy" on 8th grade students' self-regulation skills? And does this effect differ due to method of teaching, gender, and the interaction between them?

To answer this question, mean scores and standard deviations of the scores of the participants on the self-regulation pre and post questionnaire were calculated.
The results are shown in table 4.1 and 4.2.

Table 4.1: Means and standard deviations for learners' scores in the pre and post self-regulation questionnaire according to method of teaching (experimental, control)

Method	**Mean**		**Standard Deviation**		**N**
	Pre	**Post**	**Pre**	**Post**	
Experimental	146.54	177.81	20.70	8.917	75
Control	155.80	155.66	19.03	18.99	77

Data shown in this table reveals that there are distinct differences between the mean scores of learners in the pre and post self-regulation questionnaire according to group (experimental, control).

Table 4.2: Means and standard deviations for learners' scores in the pre and post self-regulation questionnaire according to gender (male, female)

Gender	Mean		Standard Deviation		N
	Pre	Post	Pre	Post	
Male	148.89	166.58	20.71	18.25	81
Female	154.51	167.35	19.50	18.88	71
Total	151.11	166.88	20.36	18.44	152

Table 4.2 shows that there are apparent differences in the mean scores of learners in the pre and post self-regulation questionnaire according to gender (male, female).

To check if these differences in mean scores of learners in the pre and post self-regulation questionnaire according to method of teaching and gender are statistically significant, (2-way ANCOVA) was applied using these data. The results are shown in table 4.3.

Table 4.3: (2-way ANCOVA) results for the learners' mean scores in the self-regulation questionnaire according to method of teaching, gender, and the interaction between them

Source	Sum of Squares	df	Mean Square	F	Sig.
pretest	100.47	1	100.47	0.46	0.49
Method	17198.82	1	17198.82	79.32	0.00**
Gender	525.68	1	525.68	2.424	0.12
Gender * Method	212.67	1	212.67	0.98	0.32
Error	31873.31	147	216.82		
Corrected Total	51389.09	151			

****** Significant difference.

Results related to method of teaching:

Table 4.3 shows that F value for the method of teaching is (79.32) for the differences in the mean scores of learners in the self-regulation questionnaire according to method (experimental, control). Also the significant level for the method is (0 .00) which is less than the significant level ($\alpha = 0.05$). Thus there are statistically significant differences at

($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to method of teaching.

To identify the source of these differences, adjusted means and standard errors were used as shown in table 4.4.

Table 4.4: Estimated Marginal means and standard errors of learners' post questionnaire scores according to method of teaching (experimental, control)

Method	Mean	Std. Error
Experimental group	177.61[a]	1.70
Control group	154.52[a]	1.90

According to this table, the adjusted mean for the experimental group is (177.6) which is more than the adjusted mean for the control group (154.5). Therefore the differences are in favor of the experimental group.

Results related to gender:

Table 4.3 shows that the F for the gender value is (2.42) in the difference between the mean scores of learners in the post self-regulation questionnaire, and the significant level is (0.12) which is more than the significant level ($\alpha = 0.05$). This results in no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to gender (male, female).

Results related to the interaction between method and gender:

Table 4.3 also shows that F value for the interaction between method and gender is (0.98) and the significant level is (0.32) which is more than the significant level ($\alpha = 0.05$). This means that there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to the interaction between method and gender.

4.2 Results related to the second question of the study:

Is there an effect of using a program depending on argument based inquiry approach via "write- to- learn strategy" on 8th grade abilities to form scientific mental models? And does this effect differ due to method of teaching, gender, and the interaction between them?

To answer this question, mean scores and standard deviations were calculated for the learners' scores in the pre and post mental model exam. The results are shown in tables 4.5 and 4.6.

Table 4.5: Means and standard deviation for learners' scores in the pre and post mental model exam according to method of teaching (experimental, control)

Group	Mean		Standard Deviation		N
	Pre	Post	Pre	Post	
Experimental	12.61	22.12	5.57	4.83	75
Control	11.32	14.11	6.55	6.48	75

*Note: two females students from the control group were absent during the application of post mental model exam.

Table 4.5 shows that there are apparent differences in the mean scores of learners in the pre and post mental model exam according to method of teaching (experimental, control).

Table 4.6: Means and standard deviation for learners' scores in the pre and post mental model exam according to gender (male, female)

Gender	Mean		Standard Deviation		N
	Pre	Post	Pre	Post	
Male	13.32	20.08	7.07	6.91	81
Female	10.40	15.75	4.29	6.35	69

*Note: two females students from the control group were absent during the application of post mental model exam.

Table 4.6 shows that are apparent differences in the mean scores of learners in the pre and post mental model exam according to gender (male, female).

To check if these differences in mean scores of learners in the pre and post mental model exam according to method of teaching and gender are of statistical significance, (2-way ANCOVA) was applied using these data. The results are shown in table 4.7.

Table 4.7: (2-way ANCOVA) results for the learners' mean scores in the mental model exam according to method of teaching, gender, and the interaction between them

Source	Sum of Squares	df	Mean Square	F	Sig.
Pretest	0.59	1	0.59	0.021	0.88
Method	2393.07	1	2393.07	85.43	0.00**
Gender	608.11	1	608.11	21.71	0.00**
Method * Gender	132.39	1	132.39	4.72	0.031**
Error	4061.46	145	28.01		
Corrected Total	7261.33	149			

** Significant differences

Results related to method of teaching:

This table shows that F value for the method of teaching is (85.43) for the differences in the mean scores of learners in the mental model exam according to method of teaching (experimental, control). Also the significant level for the method is (0.00) which is less than the significant level ($\alpha = 0.05$). Thus there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to method of teaching.

To identify the source of these differences, adjusted means and standard errors were used as shown in table 4.8

Table 4.8: Estimated Marginal means and standard errors of learners' post mental model exam scores according to method of teaching (experimental, control)

Method of Teaching	Mean	Std. Error
Experimental group	22.02[a]	0.61
Control group	13.96[a]	0.61

It is clear from this table that the adjusted mean scores for the experimental group (22.02) are much bigger than the control group (13.96). This indicates that the differences are in favor of the experimental group.

Results related to gender:

Table 4.7 shows that F value for the gender is (21.71) for the differences in the mean scores of learners in the mental model exam according to gender (male, female). Also the significant level for the gender is (0.00) which is less than the significant level ($\alpha = 0.05$). So there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8^{th} grade students' abilities to form mental models due to gender.

To identify the source of these differences, adjusted means and standard errors were used as shown in table 4.9.

Table 4.9: Estimated Marginal means and standard errors of learners' post mental model exam scores according to gender (male, female)

Gender of Student	Mean	Std. Error
Male	20.07[a]	0.60
Female	15.91[a]	0.64

According to this table, the differences in the adjusted mean scores are in favor of males, as shown that the adjusted mean for males are (20.07) while the adjusted mean of females are (15.91).

Results related to the interaction between method of teaching and gender:

It is clear from table 4.7 that the F value for the interaction between group and gender is (4.72) for the differences in the mean scores of learners in the mental model exam according to the interaction between method of teaching and gender. Also the significant level is (0.03) which is less than the significant level (α= 0.05). So there are statistically significant differences at ($\alpha \leq$ 0.05) in the mean scores of 8th grade students' abilities to form mental models due to the interaction between method of teaching and gender.

To identify the source of these differences, adjusted means and standard errors were calculated as shown in table 4.10.

Table 4.10: Estimated Marginal means and standard errors of learners' post mental model exam scores according to the interaction between method of teaching and gender

Method of Teaching	Gender of Student	Mean	Std. Error
Experimental	Male	23.15[a]	0.84
	Female	20.88[a]	0.90
Control	Male	16.98[a]	0.84
	Female	10.94[a]	0.90

This table shows that the differences are in favor of males in the experimental method of teaching.

4.3 Summary of the results:

There are statistically significant differences at ($\alpha \leq$ 0.05) in the mean scores of 8th grade students' self-regulation skills due to method of teaching in favor of the experimental group, there are statistically significant differences at ($\alpha \leq$ 0.05) in the mean scores of 8th grade students' abilities to form mental models due to method of teaching in favor of the experimental group, there are statistically significant differences at ($\alpha \leq$ 0.05) in the mean scores of 8th grade students' abilities to form mental models due to gender in favor of males and there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to the interaction between method of teaching and gender in favor of males in the experimental group. Furthermore, there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to gender, and there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to the interaction between method and gender.

Chapter five

Discussion, Conclusion and Recommendations

The purpose of this study is to investigate the effect of using a program depending on argument based inquiry approach via “write- to- learn strategy” on 8th grade students’ self-regulation skills and students’ abilities of forming scientific mental models. Additionally, to study the effect of the interaction between the argument based inquiry approach via “write- to- learn strategy” method of teaching, and gender on 8th grade students’ self-regulation and students’ abilities to form scientific mental models. The experimental group was taught an entire unit by the argument based inquiry approach via “write-to-learn strategy”, while the control group was taught by the traditional method. The researcher prepared two instruments for the study, Self-Regulation Questionnaire and Mental Model Exam. A pre and post questionnaire and test were done to all of the participants to achieve the purposes of the study. After implementation of the study and analyzing the data, the results showed the following:

5.1 Discussions of the findings related to the first question

Is there an effect of using a program depending on argument based inquiry approach via “write-to-learn strategy” on 8th grade students’ self-regulation skills? And does this effect differ due to method of teaching, gender, and the interaction between them?

Results related to method of teaching:

Results showed that there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students’ self-regulation skills due to method of teaching in favor of the experimental group.

The researcher suggests that the reason for these results is the use of argumentation via “write-to-learn strategy” for the experimental group in learning an entire science unit for two months. According to this approach, science was taught as an experimental verification of principles and rules, as a process of scientific argumentation in which students are asked to construct a claim supported by data, warrants, backings, qualifiers and rebuttals. In addition, students have to write down their own arguments using specific writing exercises. Scientific argumentation is core in knowledge construction because students need to propose, support, criticize, evaluate, and refine ideas about concepts and use theories and evidence to confirm their claims. In such practices, conceptual understanding is nurtured, scientific literacy skills are fostered and students’ communication and life skills are developed.

This teaching method has been proved to be positive and could influence the self-regulation skills of students in learning the science content. As these skills are important skills to be mastered by students in order to let them organize their learning way as well as their progression toward achieving certain individuals' goals determined previously, this will lead to more academic success and achievement, let students become aware of their own learning and play an active role in the learning process.

The results of the study agrees with the results of Cidgemoglu, Arslan and Cam (2016) which proved that there are statistically significant differences between pre and post tests

scores of pre-service science teachers content knowledge, competency and attitudes due to teaching method in favor of the group which was taught using argumentation.

The results also agrees with Cetin (2013) which proved that argumentation-based intervention caused significantly better acquisition of scientific concepts and positively impacted the structure and complexity of the argumentation model that the learners construct.

The results also correspond with the results of Erduran, Ardac and Yakmaci-Guzel (2006) which proved that training pre-service science teachers how to use argumentation has improved their pedagogical strategies. The results also agreed with Yang, Liu, Fang, Chung-Yuan, Guo-Li, Ying-Tien, Min-Hsien and Tsai (2017), which proved that students' self-efficacy of learning science is positively correlated with the nature of scientific enterprise which reflects the social aspect of scientific inquiry. The results also correspond with Mang, Zheng, Liang and Tsai (2016) which proved that self-regulation is positively related to higher levels of conceptual understanding and using of deep learning strategies.

In terms of "write-to-learn strategy", the results of this study agreed with the results of Weston-Sementelli, Allen and McNanaras' results. They indicated that using writing and reading strategies had helped learners to produce higher quality source-based essays. The results also correspond with Abu-Nimah (2015) study which evidenced that there are statistically significant differences in the mean scores of 10^{th} graders' reading comprehension in the English language due to teaching method in favor of the experimental group. The results also coincide with Atasoy (2013) which showed that there was a significant difference between the levels of improvement of conceptual understanding in favor of the experimental group who taught using "writing-to-learn strategy". Furthermore, the results correlate with Kieft, Rijlaarsdam and Bergh (2007) which showed that "writing-to-learn strategy" affects student's abilities to write short literacy stories.

Results related to gender:

The findings show that there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to gender. The researcher believes that the reason behind this is that self-regulation is a skill that could be learned from the surrounding environment as a lifelong skill that needs to be mastered by any individual (male\female) in order to have success in his\her life. Gaining these skills enables a person to set goals for himself\herself, develop strategies to achieve these goals, control the gain of these strategies, and evaluate his\her progression toward achieving the determined goals. According to Banduras'(1997) social cognitive theory, self-regulation skills could be learned through modeling and advancing by four levels of development: observational, imitative, self- controlled and self-regulated levels. Thus, gaining these skills depends on social guidance and feedback, that's why there are no statistically significant differences in acquisition of this skill due to gender.

Numerous studies have reported that gender does not cause significant differences on self-regulation of learning. For example, the following researchers have also arrived at the same conclusion: Cebesoy(2013), Sağırlı and Azapağası (2009), Gömleksiz and Demiralp (2012), and Zimmerman and Martinez-Pons (1990).

However, the results disagree with Bozpolat's (2016) results which indicated that gender affects self-regulation learning in favor of female students and showed that the female students used the self-regulatory learning strategies more than the male students. Also, Akkaya (2012), Alci and Altun (2007), Erdoğan and Şengül (2014), Zimmerman and Kitsantas (2014) agreed that the female students are more effective in using the self-regulation in learning.

Results related to the interaction between method and gender:

The study shows that there are no statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' self-regulation skills due to the interaction between method and gender.

The researcher believes that the argumentation via "write-to-learn strategy" was suitable for both genders and lead to the equal acquisition of the self-regulation skills.

No single study that the researcher surveyed examined the interaction between method and gender on self-regulation skills.

5.2 Discussions of the findings related to the second question

Is there an effect of using a program depending on argument based inquiry approach via "write- to- learn strategy" on 8th grade abilities to form scientific mental models? And does this effect differ due to method of teaching, gender, and the interaction between them?

Results related to method of teaching:

Results evidenced that there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to method of teaching in favor of the experimental group.

The researcher believes that using the scientific argumentation model via "write-to-learn strategy" as a teaching method for two months with the experimental group has been proved to be challenging in developing the abilities of students to form mental models. This explains the importance of this approach in the externalization of students' critical thinking and developing mental skills. Students were debating and justifying claims using evidences in a writing manner, this enabled them to understand and experience multiple perspectives that are based on evidence.

These results agreed with Goberts' et al (2011) results which showed that there were statistically significant differences in students' understanding of models due to teaching method. The results also correspond with Buckley et al (2004) who proved that there was a statistically significant difference found between the control and the experimental group in understanding of biology concepts in favor of the experimental group which taught by modeling. Furthermore, the results agree with Schwartz and Skjold (2014) who proved the effectiveness of teaching about the nature of scientific models for future elementary and secondary science teachers.

Results related to gender:

Results showed that there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8th grade students' abilities to form mental models due to gender in favor of males.

Both genders were exposed to the same conditions of learning, but the males' scores in the post mental model exam were higher than the females' scores. They also formed sophisticated and correct models which fit with the scientific models.

However, Chiilebrough and Treagust (2009) found that female students demonstrated a more scientifically sophisticated view of models. Also Liu, Fang, Chung-Yuan, Guo-Li, Ying-Tien, Min-Hsien and Tsai (2017) proved that female students were more likely to have higher scores in understanding epistemic knowledge of science such as the nature of scientific enterprise and the measurements in science.

Results related to the interaction between method and gender:

Results showed that there are statistically significant differences at ($\alpha \leq 0.05$) in the mean scores of 8^{th} grade students' abilities to form mental models due to the interaction between method of teaching and gender in favor of males in the experimental group.

Males of the experimental group scored more than females in the experimental group, and showed the abilities to form scientific mental models accurately. The researcher suggests that these differences are due to the nature and physiology of males, males tend to have more sophisticated models which help them to understand and predict different conditions, and they have more mental imagination of the real world.

None of the previous studies that the researcher surveyed checked the interaction between method and gender on abilities of students to form scientific mental models.

5.3 Recommendations and Suggestions:

- To use the argumentation via "write-to-learn strategy" in teaching science due to its effect in improving students' skills.

- To train science teachers how to teach argumentation to students and to write teaching objectives that engage students with written argumentative activities as well as assessing students' performance and progression toward the objectives and receiving feedback from students about the effectiveness of this approach in their learning and understanding.

- To focus on the quality of argumentation done in the classroom. For example, simple argumentation consists of: claims supported by data, warrants, and backings, whereas complex argumentation is composed of qualifiers and rebuttals in addition to the simple argumentation components.

- More studies should be done on the interaction between method of teaching and gender on student's self-regulation and mental models skills.
- More studies should be done which focus on the quality of argumentation in science classrooms.
- To design activities in the curriculum and teacher's guide book which includes written argumentative tasks and write-to-learn activities.

- To conduct similar studies using this approach on different variables and different ages.

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Appendixes:

Appendix No.1 Self-Regulation questionnaire in English

Al-Quds University

Deans of Graduate Studies

Master Program in Teaching Methods

SELF-REGULATION QUESTIONNAIRE

Dear student of the 8th grade:

The purpose for this instrument is to discover the importance of self-regulation skills in learning science. The answers that you will give on this questionnaire will indicate the self-processes that you practice while studying science. Please read the sentences of the questionnaire carefully, answer them to the best of your ability. I ensure that your answers will only be used for scientific research.

Please circle the information which best describes you:

Section: A B

Gender: Boy Girl

General academic average: 60-69 70-79 80-89 90 and more

The questionnaire contains (41) sentences indicating your actual processes and behaviors which you perform while learning science. Please put the sign (√) on the degree that represents your actual behavior.

Part	#	Behavior / process	Always	Usually	Generally	Rarely	Never
Receiving	1-	I set goals for myself while I am in the class.					
	2-	I work on my progress toward achieving my goals.					
	3-	I can organize my actions in order to attain my personal goals.					
	4-	I learn from the mistakes I have made.					
	5-	I do not give any attention toward my actions in the science period.					
Evaluating myself	1-	During the science lesson, I consider what I would like to learn from the lesson.					
	2-	When studying science, I try to assign the concepts that I do not understand well.					
	3-	I compare my performance with others performance.					
	4-	I frequently think about my actions in the science period.					
	5-	I judge what I do in the science period from the results of my work.					
	6-	I behave according to my personality.					
The ability to change	1-	I repeat the same methods even if they fail.					
	2-	I try to discover others methods in performing different activities.					
	3-	It is easy for me to find something which helps me change the way I studying.					

	4-	When I get confused about something in the science period and I cannot take notes, I make sure that I will take and organize them later.						

Part	#	Behavior / process	Always	Usually	Generally	Rarely	Never
	1-	When I start studying I can achieve the goals I set for myself.					
	2-	When I face problems in understanding the material I study, I seek the help of others.					
Searching for alternatives	3-	I use more than one way in making the material I study understandable.					
	4-	I doubt I can change my habits in studying science.					
	5-	When I find the science material I study hard to understand, I change the way I am reading it.					
	1-	Before I start studying the science material, I skim the whole unit or lesson to know the ways it is organized and viewed.					
	2-	When I study the science lesson, I link the material to something the teacher said or did in the classroom.					
	3-	When I study science, I ask myself questions to concentrate on studying the material.					
Planning	4-	I have a problem in making a plan, setting and achieving goals related to studying time and covering material.					
	5-	When I have a goal, I know how I can plan to achieve it well.					
	6-	I always take notes in the science period even if the teacher didn't ask me to do so.					
	7-	When I study I use my personal					

		methods that help me to study effectively and remember the important points.					
	8-	When I study I summarize in my own way the material to help me to evaluate my efficiency in studying as well as remembering the important details.					
	9-	I cannot concentrate on something when I study.					

Part	#	Behavior / process	Always	Usually	Generally	Rarely
Implementation of the plan	1-	I have motivation to concentrate on the topic of the science lesson and to mentally organize its ideas.				
	2-	The purpose of studying science is to enhance gaining life-long skills.				
	3-	When I study science I use the diagrams and figures in the book to help me in understanding the lesson.				
	4-	I can perform the tasks that the science teacher asks me do in the period.				
	5-	I ask myself questions in the science period to ensure I understand the material.				
	6-	When I study science, I tend to construct maps, tables and arrow charts to help me to understand the material.				
	7-	When I get confused about something I read when I study, I return to it again and keep trying to understand it.				

Evaluating the effectiveness of the plan	1-	I perform all of the tasks the science teacher asked me to do with strong motivation and engagement.							
	2-	I evaluate the results of my work in those tasks.							
	3-	I can handle the full responsibility toward my learning.							
	4-	I tend to analyze the material I study according to its relevance with the previous knowledge I own about the subject.							
	5-	I evaluate my study habits according to my mark on the exam.							

Appendix No.2 Self-Regulation questionnaire in Arabic

جامعة القدس

عمادة الدراسات العليا

ماجستير في أساليب تدريس التخصص

أداة الدراسة\ استبانة التنظيم الذاتي في تعلم العلوم :

تقوم الباحثة بدراسة بعنوان: **فاعلية برنامج يستند إلى الدمج بين منحى الاستقصاء على أساس الحجة واستراتيجية الكتابة من أجل التعلم لطلبة الصف الثامن الأساسي في مهارة التنظيم الذاتي في تعلم العلوم وعلى قدرتهم في تشكيل نماذج عقلية علمية.** وذلك كمتطلب للحصول على درجة الماجستير في أساليب التدريس من جامعة القدس.

حضرة المحكم\ة:

يرجى من حضرتك التعاون في تحكيم فقرات استبانة التنظيم الذاتي في تعلم العلوم:

التنظيم الذاتي في تعلم العلوم:

التنظيم الذاتي يعرّف بأنه: العمليات التي يستخدمها المتعلمون لتنظيم المعارف، والمشاعر، والسلوك لتحقيق أهداف شخصية. ويمكن تعريفه أيضاً أنه مفهوم متعدد الاتجاهات يضم المعرفة، وما وراء المعرفة، والدافعية، والسلوك، والعمليات البيئية.

تكمن أهمية امتلاك الطالب لمهارة التنظيم الذاتي في التعلّم بشكل عام ، وتعلّم العلوم بشكل خاص في علاقته الوثيقة بتحصيل الطالب. وقد أثبتت الكثير من الدراسات أن التنظيم الذاتي يلعب دوراً مهماً في زيادة دافعية الطالب للتعلّم وإكسابه مهارات التعلّم الذاتي؛ لأنه يمثل وعي المتعلم لما يدرسه، وتنظيمه العقلي للمعارف التي يتعلّمها وقدرته على استخدام استراتيجيات ما وراء معرفية لتحقيق الفهم العميق للموضوع قيد الدراسة.

وتتضمن هذه المهارة:

1.مهارات تنظيم ذاتي أساسية:وتشمل مهارات تزيد من قدرة الطالب على التركيز والاهتمام بموضوع الدراسة، وتمكّنه من تحديد أهداف لنفسه حتى ينظم سير عمله في الحصة الدراسية.

2. مهارات تنظيم ذاتي متقدمة: وتشمل مهارات تعلم ذاتي متقدمة عقلياً يوظفها الطالب ، لتنظيم سلوكه، وأفكاره ،ومعارفه ،وطريقته في فهم وإدراك المادة للوصول إلى تعلّم ذي معنى و فهم عميق.

الصف الثامن الأساسي	**استبانة التنظيم الذاتي في تعلم العلوم**	**الاسم:**
التاريخ :		**الزمن : 25 د**

عزيزي الطالب\ة:

إن الغرض من هذا المقياس هو التعرف إلى أهمية مهارة التنظيم الذاتي في تعلمك لمادة (العلوم العامة)، لذا فإن استجابتك لكل فقرة من فقراته تعد تعبيراً عن ممارساتك الفعلية أثناء عملية التعلّم، وليس كما ترغب أن تكون عليه هذه الممارسة، أرجو منك قراءة العبارات بتمعن، علماً بأن المعلومات التي ستعطيها ستعامل بسرية تامة، ولن تستخدم إلا لأغراض البحث العلمي فقط.

كما ويرجى العمل على وضع دائرة حول العبارة المناسبة فيما يأتي:

1. الشعبة: أ □ ب □

2. الجنس: ذكر □ أنثى □

3. المعدل العام : 60- أقل من70 □ 70- أقل من 80 □ 80-أقل من 90 □ 90- فأكثر □

تشتمل الاستبانة على (41) فقرة، وهي مؤشرات تدل على ممارساتك الفعلية أثناء عملية التعلّم ، نرجو منك وضع إشارة (√) عند الدرجة التي تراها مناسبة لكل ممارسة.

الفرع	الرقم	الممارسة	دائماً	غالباً	أحياناً	نادراً	أبداً
الاستقبال	1-	عندما أكون في الصف أضع أهدافاً لنفسي.					
	2-	أحافظ على مسار تقدمي نحو تحقيق أهدافي.					
	3-	أستطيع تنظيم أفعالي من أجل تحقيق أهدافي.					
	4-	أتعلم من أخطائي التي أرتكبها.					
	5-	لا أعطي أي انتباه لما أقوم به من أفعال في حصة العلوم.					
تقييم نفسي	1-	أحاول التفكير في موضوع درس العلوم لأقرر ما أريد أن أتعلم منه .					
	2-	عند دراسة مادة العلوم أحاول أن أحدد المفاهيم التي لا أستطيع أن أفهمها جيداً.					
	3-	أقارن أدائي بأداء الآخرين.					
	4-	أفكر كثيراً بما أفعله في حصة العلوم.					
	5-	أحكم على ما أقوم به من نتائج أعمالي.					
	6-	أتصرف من خلال شخصيتي.					
إحداث التغيير	1-	أقوم بإعادة عمل الشئ نفسه حتى وإن					

		فشل.					
	-2	أتعّرف على طرق الاخرين في عمل النشاطات المختلفة.					
	-3	من السهل عليّ ايجاد شئ يساعدني على تغيير طريقتي في الدراسة.					
	-4	عندما أشعر بالارتباك وعدم القدرة على أخذ الملاحظات في الحصة، أكون متأكداً أنني سأقوم بأخذها وترتيبها لاحقاً.					
البحث عن بدائل	-1	عندما أبدأ بالدراسة أستطيع إنجاز أهداف حددتها لنفسي.					
	-2	عندما أواجه مشكلة تعيق فهمي للمادة أطلب مساعدة الاخرين.					
	-3	أستخدم أكثر من طريقة لتسهيل فهم مادة العلوم.					
	-4	أشك أني قادر على تغيير طريقتي في دراسة مادة العلوم.					
	-5	إذا وجدت مادة العلوم المقروءة صعبة الفهم، أغير من طريقتي في قراءة المادة.					
صياغة خطة	-1	أقوم بالإطلاع السريع على مادة العلوم قبل البدء بدراستها كاملة لرؤية كيفية تنظيمها وعرضها.					
	-2	عندما أدرس مادة العلوم أقوم بربط المادة بموقف سلكه المعلم أثناء الحصة.					
	-3	عند دراستي لمادة العلوم أطرح أسئلة					
		حتى تساعدني على التركيز في المادة.					
	-4	لديّ مشكلة في عمل خطة لتساعدني على تحقيق أهدافي من تعلم مادة					
		العلوم.					
	-5	عندما يكون لدي هدف أستطيع أن أخطط كيف سأحققه.					
	-6	أحرص دائماً على أخذ الملاحظات في الحصة حتى وإن لم يطلب المعلم ذلك.					
	-7	أستخدم طرق واستراتيجيات خاصة بي لتساعدني على استذكار المادة.					
	-8	ألخص مادة العلوم بطريقتي الخاصة أثناء دراستي لها ، ليساعدني الملخص على تقييم نفسي وعلى التركيز على التفاصيل المهمة.					
	-9	أواجه مشاكل أثناء التركيز على موضوع ما.					

تطبيق الخطة	1-	لدي دافعية للانتباه والتركيز على موضوع الدرس لتنظيم أفكاره عقلياً.					
	2-	الهدف من تعلم مادة العلوم هو تحفيز امتلاك مهارات تعلم لمدى الحياة.					
	3-	أوظف الرسوم والأشكال في كتاب العلوم لتساعدني على فهم الدرس.					
	4-	أستطيع إنجاز المهمات التي يكلفني المعلم بها في حصة العلوم.					
	5-	أسأل نفسي أسئلة حتى أتأكد أنني فهمت المادة التي تعلّمتها في الصف.					
	6-	أثناء دراستي لمادة العلوم أقوم ببناء رسم تخطيطي أوجداول لتساعدني على فهم المادة.					
	7-	عندما أشعر بالارتباك حيال شئ ما قرأته عند دراستي للمادة، أعود له وأحاول فهمه وإدراكه من جديد.					
تقييم فاعلية الخطة	1-	أنجز المهام التعليمية التي يوكلني بها المعلم بدافعية قوية.					
	2-	أقيم نتائج أعمالي في تلك المهام.					
	3-	أتحمل المسؤلية الذاتية في التعلم.					
	4-	أحلل المادة التي أدرسها من حيث مطابقتها لمعلوماتي السابقة التي تعلمتها عن نفس الموضوع.					
	5-	أقيّم طريقتي في دراسة مادة العلوم من خلال نتيجتي في الاختبار.					

انتهت الاستبانة

Appendix No.3 Mental model exam in English

Al-Quds University

Deans of Graduate Studies

Master Program in Teaching Methods

Mental Model Exam

Dear student of the 8th grade:

The researcher has designed an exam especially for you using your science textbook to measure your abilities to form scientific mental models.

The researcher chose exam questions for you to answer from the unit *"Light and Spectacles"*. There are four questions.

The answers of these questions will give signs that indicate the importance of mental models in helping you to represent your knowledge, analyze it, comprehend it, and link it with your previous experiences.

Please read the questions carefully. I ensure that your answers will be used only for scientific research.

Please circle the information which describes you:

Section: *****A *B

Gender: *****Boy *Girl

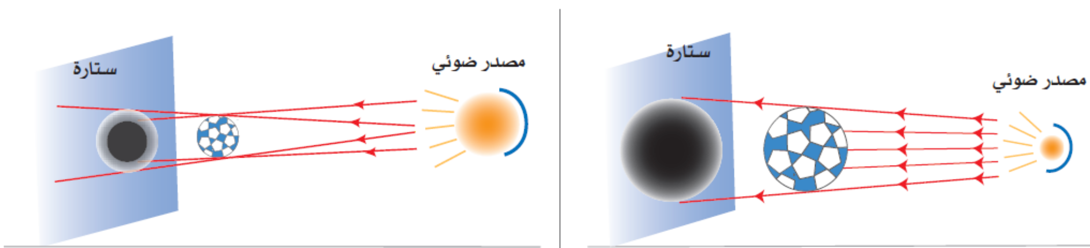
General academic average: 60-69 70-79 80-89 90 and more

Questions:

You have two methods given below which explain the process of shadow formation for the dark objects, and the properties of the shadow.

A- The shadow is clear in features and dark when the source of light is small in size and far in distance from the dark object. But, when the source of light is bigger in size than the dark object and close in distance, the shadow is unclear with two regions; one region with complete shadow and the other region with incomplete shadow.

B-



الشكل (٢-ب): تكون منطقة شبه ظل لجسم

الشكل (٢-أ) تكون ظل تام لجسم

Q1.

In your opinion:

- Method A and method B give the same explanation.
- Method A and method B do not give the same explanation.

Please justify your answer:

____

____

____

Q2. Depending on the two methods shown in the previous question, which method is better, in your opinion, to learn about shadow formation process and the properties of shadow:

- Method A (learning by texts)

- Method B (learning by models)

Please justify your answer:

____
____
____
____

Q3. Read the following paragraph carefully.

One of the most important applications about light is laser or light fibers, which means enhancing the light radiation. This is a package of light with waves which are similar in frequency, so the light waves cross each other and convert to a light pulse with high energy. Studies show that light rays can pass through air, water, glass, and transparent objects. Further, a light ray can change its path when it penetrates two transparent objects, such as water and air and can reflect when it beams on mirrors or bright surfaces.

In addition, a light ray penetrates through a pyramid of glass and separates into visible colors on a spectrum that appear in a rainbow. This begins with violet, blue, and green, yellow, and ends with red. The light ray also contains invisible waves which are located to the right side of the violet rays and are called ultraviolet rays. There are also invisible rays located to the left side of the red rays, and called infra-red rays.

Try to represent this paragraph using an arrow chart, diagram, or another appropriate way to help you to understand this information.

Q4. Draw a mind map using the keywords below and the proper linking words.

Keywords: lenses, produce illusionary image, produce real image, scatter, collect, parallel rays, concave, convex

Appendix No.4 Mental model exam in Arabic

جامعة القدس

عمادة الدراسات العليا

ماجستير في أساليب تدريس التخصص

أداة الدراسة\ اختبار النماذج العقلية:

حضرة المحكم\ة:

تقوم الباحثة بدراسة بعنوان: **فاعلية برنامج يستند إلى الدمج بين منحى الاستقصاء على أساس الحجة واستراتيجية الكتابة من أجل التعلم لطلبة الصف الثامن الأساسي في مهارة التنظيم الذاتي في تعلم العلوم وعلى قدرتهم في تشكيل نماذج عقلية علمية.** وذلك كمتطلب للحصول على درجة الماجستير في أساليب التدريس من جامعة القدس.

يرجى من حضرتك التعاون في تحكيم فقرات اختبار النماذج العقلية:

النموذج العقلي يمثل عملية تفكير الشخص بكيفية عمل شيء ما ، أي يمثل كيفية فهم الشخص للعالم المحيط به. تستند النماذج العقلية إلى حقائق غير مكتملة، وإلى التجارب الماضية، والتصورات البديهية. إنها تعطي لسلوك الانسان شكلاً محدداً، كما تؤثر على قرارات الناس في كيفية حل المشكلات وفهمها. وقد عرّف نيلسون جاكوب النموذج العقلي Mental Model بأنه "ما يعتقده الإنسان عما يشاهده كل يوم من أشياء ،أو بعبارة أخرى كل ما يمثله العقل داخلك من العالم المحيط بك". أي أنه تمثيل للواقع الخارجي بالعقل، كل ما نتعامل معه في حياتنا اليومية يكون العقل له "نموذجاً" يتم تمثيله في الدماغ، **فعندما نتعامل معه مرة أخرى سنتعامل معه -في الغالب- وفق النموذج العقلي وليس الواقع الحقيقي.**

ونظراً لأهمية النماذج العقلية في تعلم العلوم، وبما أن المجلس الوطني للأبحاث (NRC) أقر أن فهم الطلبة للنماذج العلمية ولعملية النمذجة يعتبر من الغايات الرئيسة لتدريس مادة العلوم.(NRC, 2012).ولأهمية الدور الذي تلعبه النماذج العقلية في مساعدة الطلبة على تمثيل المعلومات عقلياً وتحليلها وفهمها وربطها بتجاربهم وخبراتهم السابقة، قامت الباحثة بتصميم اختبار النماذج العقلية لوحدة الضوء والبصريات في كتاب العلوم للصف الثامن الجزء الثاني.

وشكراً لكم على حسن تعاونكم **الباحثة: ريهام هلال**

الصف الثامن الأساسي	اختبار تشكيل النماذج العقلية العلمية	الاسم:
التاريخ :		زمن الاختبار: 20 د
		العلامة:(\30)

عزيزي الطالب\ة:

قامت الباحثة بتصميم اختبار النماذج العقلية لوحدة (الضوء والبصريات) في كتاب (العلوم العامة) المخصص لصفك الأكاديمي (الصف الثامن)\ الجزء الثاني. يشتمل الاختبار على أربعة أسئلة تعطي الإجابة عنها مؤشرات دالة على أهمية النماذج العقلية في مساعدتك على تمثيل المعلومات عقلياً وتحليلها وفهمها وربطها بتجاربك وخبراتك السابقة، أرجو منك قراءة الأسئلة بتمعن، علماً بأن المعلومات التي ستعطيها ستعامل بسرية تامة، ولن تستخدم إلا لأغراض البحث العلمي فقط. كما ويرجى العمل على وضع دائرة حول العبارة المناسبة فيما يأتي:

1. الشعبة: أ □ ب □
2. الجنس: ذكر □ أنثى □
3. المعدل العام : 60- أقل من70 □ 70- أقل من 80 □ 80-أقل من 90 □ 90- فأكثر □

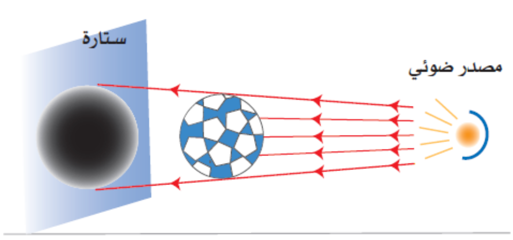
الأسئلة:

لديك طريقتان لتفسير عملية تكوّن الظل للأجسام المعتمة التي لا ينفذ منها الضوء، وصفات الظل:

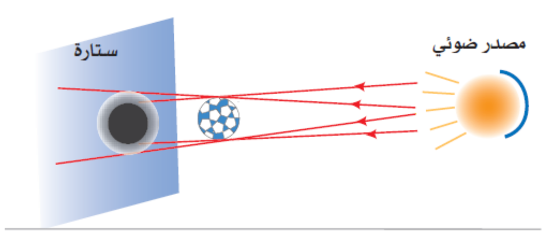
أ- يكون الظل محدداً وواضح المعالم ومظلماً، عندما يكون المصدر الضوئي بعيداً عن الجسم المعتم وعندما يكون حجم المصدر الضوئي صغيراً.

وأما عندما يكون المصدر الضوئي كبيراً بالنسبة للجسم وقريباً منه تتكوّن منطقة ظل تام، ومنطقة شبه ظل.

ب-



الشكل (٢-أ) تكوّن ظل تام لجسم



الشكل (٢-ب): تكون منطقة شبه ظل لجسم

السؤال الأول: (3 علامات)

أ- من وجهة نظرك: (علامة)

- الطريقة (أ) والطريقة (ب) تعطيان نفس التفسير.
- لا تعطي الطريقتان نفس التفسير.
-

ب- وضح السبب في اختيار إجابتك للفرع السابق: (علامتان)

السؤال الثاني: (3 علامات)

أ- بالاعتماد على الطريقتين في السؤال السابق، أي طريقة هي الأفضل من وجهة نظرك للتعلّم عن كيفية تكوين الظلال للأجسام المعتمة وصفات هذه الظلال؟ (علامة)

- طريقة أ (طريقة التعلّم من خلال النص).
- طريقة ب (طريقة التعلّم من خلال الأشكال والرسومات).

ب- وضح السبب في اختيار إجابتك للفرع السابق: (علامتان)

السؤال الثالث: (17 علامة)

لديك المعلومات التالية ، أقرأها بتمعن :

من التطبيقات المهمة على الضوء الليزر أو الألياف الضوئية وتعني: تضخيم الضوء بانبعاث الإشعاع المحفز، وهي عبارة عن حزمة ضوئية ذات موجات تشترك في ترددها ،وتتطابق موجاتها بحيث تحدث ظاهرة التداخل البّناء بين موجاتها لتتحول إلى نبضة ضوئية ذات طاقة عالية. وأكدت الدراسات أن أشعة الضوء لها قدرة على النفاذ فى الهواء والماء والزجاج والمواد الشفافة . و تنحرف أشعة الضوء عند مرورها فى الماء والمواد الشفافة ، كما تنعكس عندما تسقط على المرايا والأسطح اللامعة، وتتداخل أشعة الضوء نتيجة انحرافها وانكسارها فيما يعرف بظاهرة الحيود الضوئى.

هذا و تنفصل مكونات أشعة الضوء الأبيض عند سقوطها على سطح المنشور الزجاجى الهرمي ، ثم تتجزأ إلى ألوان الطيف المرئى التى تظهر فى قوس قزح ، وتبدأ باللون البنفسجى فالنيلي فالأزرق فالأخضر فالأصفر إلى أن تنتهى باللون الأحمر. وقد تبين فيما بعد أن الضوء الأبيض يحتوي إلى جانب الألوان السابقة موجات لأشعة غير مرئية ، منها ما هو على يمين اللون البنفسجي ويسمى بالأشعة فوق البنفسجية،ومنها ما هوعلى يسار اللون الأحمر ويسمى بالأشعة تحت الحمراء.

حاول تمثيلها بمخطط سهمي أو رسم توضيحي أو أي طريقة تراها مناسبة لتساعدك في تسهيل فهمها :

السؤال الرابع: (7 علامات)

قم برسم خريطة ذهنية من خلال الاستعانة بجميع المفاهيم التالية وباستخدام أدوات الربط التي تراها مناسبة:

(العدسات،تنتج خيالا وهمياً، تنتج خيالا حقيقياً ، تفرق، تجمع، الأشعة المتوازية ، محدبة، مقعرة)

انتهى الاختبار

Appendix No.5 Teacher's guide book in teaching using argumentation via "write-to-learn strategy" in Arabic

مادة العلوم العامة

الصف الثامن

دليل المعلم لتدريس وحدة الضوء والبصريات

تم اعتماد كتاب العلوم العامة الفصل الثاني نسخة 2016م

اعتمدت الباحثة في تصميمها لهذا الدليل على ورقة بحثية (Cigdemoglu, Arslan and Cam (2016).

يعتمد هذا الدليل على استخدام استراتيجية الاستقصاء المبني على أساس الحجة واستراتيجية الكتابة من أجل التعلم، وفيما يلي شرح عن كلا الاستراتيجين:

استراتيجية الاستقصاء المبني على أساس الحجة:

يعرّف العلم بأنه مجموعة من الحقائق التي توصل إليها العلماء والطريقة المتبعة في الوصول إليها، ومن هذا التعريف يتوجب علينا كمعلمي علوم تقدير أهمية الحقائق العلمية وكذلك تقدير الطريق الذي سلكه العلماء في الوصول إليها. لذا فإن انخراط الطلبة في أعمال يقوم بها العلماء من شأنه أن يكسبهم مهارات الاستكشاف والبحث العلمي، وهذا الأمر الذي لا بد وأن يكون الغاية الأساسية لأي برنامج تعليمي لتعليم العلوم.

أثبتت الدرسات والأبحاث العلمية بأن استخدام استراجية الاستقصاء في تدريس العلوم وبالتحديد استراتيجية الاستقصاء المبني على أساس الحجة يلعب دوراً مهماً في جعل الطلبة يحاولون بناء ودعم وتقييم أي افتراض أو إدعاء يفترضونه بأنفسهم لفهم أو تفسير ظاهرة أو مشكلة تواجههم أو سؤال يثير تفكيرهم ، بالاعتماد على مصادر علمية موثوقة مثل الموسوعات والكتب و التجارب العلمية الدقيقة. كما أثبتت الدراسات أن النقاش والجدال الذي يحدث بين الطلبة تحت إشراف المعلم وتوجيهه من شأنه أن يدعم أو يرفض الإدعاء، ولهذه الاستراتيجية تأثير كبير في الكشف عن الأخطاء المفاهيمية المتواجدة لدى الطلبة ومعالجتها، وتساعد في إكساب الطلبة مهارات عقلية عليا. (Cigdemoglu, Arslanand Cam , (2016).

والاستقصاء في أبسط توصيفاته هو تقصي الحقيقة والتأكد من صحتها عن طريق مساءلتها، بل ويمكن القول أن الاستقصاء يولد كلا من الجدل والحوار، فنحن نتحاور أو نتجادل عندما نختلف في تفسيراتنا لظاهرة أو حادثة ما. من جهة أخرى، فإن عملية الاستقصاء تتضمن جمع المعلومات وتفسيرها للوصول إلى النتائج، هذه النتائج هي بمثابة إدعاءات في مرحلة ما وتحت ظروف معينة، وهذه الإدعاءات تتطلب تفسيراً مستنداً إلى مشاهدات وأدلة، وهنا يتقاطع الاستقصاء مع الجدل، ولأن التفسيرات تبنى في ضوء الفهم الذاتي للدلائل، فإن الحوار والجدل يتأسسان في ضوء هذه التفسيرات.

إن أهم شرط للحوار هو الاعتراف المتبادل، ومع أن وجود المعلم والمتعلم في الصف معاً يعني ضمنياً توفر هذا الشرط ، إلا أن ما يحدث في الغالب هو عكس ذلك، فثمة افتراض مسبق لدى المعلمين بأن الطلبة لن يكون بوسعهم بناء معرفة مفيدة وذات صلاحية إذا كانت هذه المعرفة غير صادرة عن معلم أو كتاب ، وعلى هذا الأساس فإن ثقة المعلم بما ينتجه الطلبة من كلام فردي شرط أساسي للنهوض بعملية الحوار الصفي ولاستخدام هذه الاستراتيجية كطريقة تدريس.

الجدل العلمي :Argumentand argumentation

على الرغم من أن نظرية الجدل تطورت عبر عقود، فإن تولمين أول من وضع نموذجاً يصف بنية الجدل والاستقصاء العلمي، ومكوناته:(Simon et al,2006)

1- البيانات (Data): وهي المعلومات في صورتها الأولية التي يستخدمها الطلبة لدعم الإدعاء.

2-الادعاء (claim): يمثل الاستنتاج أو الخلاصة المراد تعميمها والمختلف بشأنها.

3- العلاقات(warrants): وهي الروابط (قواعد، مبادئ، حقائق، ...الخ) التي تربط ما بين البيانات والادعاءات.

4- الدلائل\ المساندات(Backing): وهي الأدلة التي تسند الادعاءات.

أما خطوات الجدل العلمي والتي يقوم بها الطلبة بإشراف المعلم كما وردت في دراسة :(Cigdemoglu, Arslanand Cam (2016)

1- تكوين إدعاء من مع إعطاء مبرر لهذا الإدعاء.

2- دعم أو معارضة الادعاء مع إعطاء مثال يوضح سبب الدعم أو المعارضة.

3-صياغة أسئلة للتحقق من صحة الإدعاء.

4- تكوين ادعاء آخر مع مبرر له.

5- التحقق من الادعاء بالطرق الملائمة.

6- صياغة استنتاج بعد التحقق بالتجربة أو بطرق أخرى من صحة الادعاء وبعد الاتفاق مع باقي أفراد المجموعة.

استراتيجية الكتابة من أجل التعلم:

إن المهام الكتابية في الحصة الدراسية تساعد الطلبة على التفكير في المفاهيم أو الأفكار التي قُدمت خلال الدرس، وفي كثير من الأحيان فإن مدة هذه المهام لا تتعدى الخمسة دقائق من عمر الحصة الدراسية.

إن الكتابة على نحو أكثر تواتراً تساعد الطلبة على التقاط الأفكار والصور والتفاصيل الحسية ، و تكسبهم القدرة على ربط الأفكار ببعضها البعض، وعمل المقارنات والقياس وغيرها من عمليات العلم المختلفة.

وفيما يتعلق بأهمية الكتابة في تنمية التفكير، فإن للكتابة دوراً محتملاً في صقل وتهذيب التفكير وفي إمكانية حدوثه في مستوى أعلى عند إتاحة الفرصة للطلبة للنقاش والتأمل والإقناع من خلال تقديم الأدلة.

إن الكتابة ترتبط ارتباطا وثيقاً بالتفكير الناقد بحيث يستطيع الطلبة أن يعرفوا أكثر عن محتوى المادة التعليمية، كما أن الكتابة المتواترة تساعد الطلبة على التفكير والتأمل بالمادة التعليمية، لذلك تعتبر المهام الكتابية ضرورية في كل حصة دراسية.

لقد تنوعت المهمات الكتابية التي وجدت في الدراسات السابقة التي اهتمت بأثر الكتابة في التعلم ومنها:

- كتابة لتوضيح التطبيقات على مفهوم علمي معين في الحياة العملية.
- مقالة توضيحية يشرح فيها الطالب بلغته مفهوماً علمياً صعباً.
- كتابة ملخصات من صفحة واحدة لمقالات من مجلات عن موضوع الدروس مع ربطها بقضايا عالمية في الحياة.
- تحويل خرائط مفاهيمية تم بناؤها بعملية العصف الذهني ومن خلال المناقشة الجماعية.
- كتابة قصة قصيرة.
- الحواشي التفسيرية Annotation: حيث يُطلب ملاحظة الأفكار الأساسية من مقالة وتقويم نقاط الضعف والقوة فيها.

أنواع الأنشطة الكتابية:

هناك العديد من الأنشطة الكتابية التي يمكن استخدامها من خلال إستراتيجية الكتابة من اجل التعلم، مثل:

1. نشاط (K.W.L) Know-Want to know-Learned:

وهي اختصار عن: ماذا يعرف الطالب-ماذا يريد أن يعرف الطالب-ماذا تعلم الطالب. ويتم تطبيقه قبل بداية الوحدة وقبل أي درس ثم بعد عدة دروس من الوحدة، وأيضاً يتم تطبيقه في نهاية الوحدة.

ولاستخدام هذا النشاط يكتب الطلاب على ورقة ثلاثة أعمدة:

- العمود الأول: ماذا أعرف عن الموضوع.
- العمود الثاني: ماذا أريد أن أعرف عن الموضوع.
- العمود الثالث: ماذا تعلمت عن الموضوع.

وفي البداية يطلب المعلم من الطلبة ملء أول عمودين من الأعمدة الثلاثة، ومن خلال استجابات الطلبة يمكن للمعلم أن يحدد الخبرات السابقة لدى طلابه ويكشف عن اهتماماتهم.

وفي نهاية الوحدة يطلب المعلم من طلبته ملء العمود الثالث لمعرفة ما تم تعلمه أو مقدار التقدم الحاصل لدى الطلبة.

2. مراحل الكتابة بحسب جيمس بريتون

من خلال ملاحظة توظيف المعلمين لاستراتيجيات الكتابة من أجل التعلم تم تحديد خمسة مراحل يمكن للطلاب من خلالها تحسين فهمهم لمضمون المحتوى التعليمي واحتفاظهم به، وهذه المراحل الخمس بحسب ما اقترحها جيمس بريتون هي:

I. مرحلة التسجيل:

يقوم الطلبة بشكل مبدئي بتسجيل فهمهم للمحتوى التعليمي، فعلى سبيل المثال يمكن للطلبة التسجيل على الفور بعد مشاهدتهم لفيديو تعليمي قصير، وهنا يكلف المعلم طلابه بتسجيل ملاحظاتهم عما تعلموه على دفتر الملاحظات أو أية وسيلة يمكن استخدامها لذلك.

وتوجه هذه المرحلة هو التلخيص، وعلى الرغم من أن الطلبة مطالبين بتسجيل ملاحظاتهم على شكل جملة كاملة ومفهومة، إلا أنه لا يتم هنا التركيز على علامات الترقيم أو الهجاء، بحيث يعطي الطلبة مشروع أولي خام، ويمكن للمعلمين في هذه المرحلة تشجيع طلبتهم على الكتابة من خلال التمثيل بالرسم أو الأشكال والبيانات.

II. مرحلة المقارنة:

في هذه المرحلة يقوم الطالب بمشاركة ما سجله مع زميله من أجل ملاحظة نقاط الاختلاف والتشابه بين تسجيليهما، ويدل تشابه المحتوى أن الطالبين قد سجلا نفس المعلومة الصحيحة، أما اختلاف المحتوى فمعناه أما أن أحد الطالبين قد سجل معلومة مهمة لم يسجلها زميله، أو أن الطالبين كلاهما قد التبس عليهما المحتوى. وفي هذه الحالة على المعلم متابعة طلابه من خلال الإجابة عن أسئلتهم أو إزالة اللبس عن الفهم الخاطئ لديهم، وإذا لاحظ المعلم أن بعض الطلبة قد أساءوا فهم محتوى الدرس فعليه أن يعالج هذه المشكلة مع الصف بأكمله قبل الانتقال إلى المرحلة التالية.

III. مرحلة التنقيح:

تأتي هذه المرحلة مباشرة بعد مرحلة المقارنة، بالرغم من أن بعض المعلمين يميلون إلى تكليف الطلبة بوظيفة بيتية بدلاً من ذلك.

هنا يقوم الطلبة بإنشاء نسخة كاملة ومنقحة لما تم تسجيله في مرحلة التسجيل، مع مراجعة علامات الترقيم والأخطاء النحوية لإزالة أي سوء فهم لأي معنى تم تداوله.

ومن الممكن تكرار دورة التسجيل- المشاركة- التنقيح Record-Comparison-Revision خلال الوحدة الدراسية أو خلال مجموعة من الدروس ذات العلاقة.

IV. مرحلة الجمع:

هنا يمكن للطلاب جمع ما توصلوا إليه خلال دورة من أجل إعطاء صورة متكاملة عن التعميمات الجديدة والدفاع عنها.

V. مرحلة الاستعراض:

وهي مرحلة ما قبل التقييم، وهنا يقوم الطلبة بعرض ما توصلوا إليه في المراحل السابقة من تعميمات بشكل فردي أو من خلال مجموعات، وهنا قد تتولد لدى الطلبة أسئلة جديدة على المعلم أن يجيب عليها من خلال مشاركة كل الصف.

3. اكتب واتبع الاتجاهات:

في هذا النشاط, يبني أحد الطلبة هيكل أو تنظيم عن الموضوع ويسجل مجموعة من الاتجاهات من خلال استخدام عدد كبير من المصطلحات الرياضية، ثم يعطيه لزميله ليتبع الاتجاهات المسجلة ويبني نفس الهيكل أو التنظيم عن نفس الموضوع.

4. فكر- زاوج – شارك:

وهذا نشاط بسيط وسهل الاستخدام، ومفاده أنه عندما يلاحظ المعلم أن بعض طلبته لم يفهموا محتوى المادة التعليمية، فإنه يتوقف ويسألهم عن المشاكل التي واجهتهم، وذلك بعد أن ينتهي الطلبة من الكتابة الحرة، ويشارك كل طالب ما كتبه مع زميله مباشرةً ثم مع مجموعة من الزملاء من باقي أفراد المجموعة، الأمر الذي من الممكن أن يؤدي إلى إزالة حالة الارتباك لدى الطلبة.

5. مجلة الكتابة:

وهي عبارة عن مذكرات تشكل سلسلة من مهمات الكتابة، بحيث تكتب كل مهمة بشكل قصير ونثري بعيداً عن الأنماط الرياضية التقليدية.

ويمكن للطلبة أن يكتبوا في مجلاتهم الأهداف اليومية، والمفاهيم التي تم تعلمها ، أو الطرق التي تم استخدامها في حل المشكلات. وهذا من شأنه أن يعطي كلاً من المعلم والطالب بصيرةً توضح مدى تقدم الطلبة في تعلمهم.

6. الكتابة الإبداعية:

هنا يتم تشجيع الطلبة على كتابة قصائد أو قصص أو مسرحيات عن المفاهيم الرياضية التي تم تعلمها، ومن الممكن أن يُطلب من الطلبة كتابة رسالة إلى:

- علماء الرياضيات السابقين.
- صديق يشرح له كيف يصحح خطأه، أو كيف يحل مشكلة واجهته، أو أن يشرح درس العلوم له بشكل مختصر ومفيد.

7. الكتابة الحرة Free Writing:

يقوم الطلبة بكتابة خطوط عريضة حول موضوع محدد سلفاً خلال فترة زمنية وجيزة تتراوح بين (1-3) دقائق يسمح لهم باسترجاع معلوماتهم السابقة، والهدف من ذلك هو تنشيط المعرفة المسبقة وتوليد أفكار جديدة من خلال المشاركة الفاعلة، متجاهلين التركيز على قواعد اللغة أو الترقيم أو الإملاء أو ما شابه ذلك، وتمثل الكتابة الحرة تمارين إحماء لتمارين أخرى داخل غرفة الصف.

8. الاختبارات الوهمية (Mock Tests):

يقوم الطلبة بصياغة اختبار يركز على ما تم تعلمه في غرفة الصف، ثم يقومون بمناقشة أسئلة الاختبار مع أقرانهم، وهذا لا يساعد الطلبة على المراجعة والتفكير قبل الاختبار فقط، بل يساعدهم أيضا على التعبير عما تعلموه من مفاهيم وإدراك العلاقات بين أجزاء محتوى المادة التعليمية.

9. مسودات ملاحظات الزملاء (Drafts for Peer Feedback):

في هذا النشاط يقدم الطلبة مسودات قبل نهائية من عمل مكتوب مثل مقالات أو تقارير مختبر وغيرها، وهذه المسودات لا توفر للطلبة تغذية راجعة متنوعة وانية فقط ، وإنما تساعدهم أيضا على تطوير التواصل والتفكير الناقد والعمل التعاوني واكتساب مهارات التعلم الحياتية.

10- **نشاط ورقة الأعمدة:** يكلف المعلم الطلبة بعمل وسيلة تعليمية بسيطة مكونة من أوراق ملونة، ثم يقوم الطلبة برسم عمودين على الورقة، العمود الأيمن يتم كتابة أسئلة فيه ، والأيسر وهو العمود

الأسمك تكتب فيه إجابات للأسئلة المطروحة، وتلخيص لأهم التفاصيل والملاحظات، وتفسير المصطلحات الجديدة، وإضافة صور أو رسوم يمكن دراستها في اليوم التالي أو لموعد الاختبار.

11- **نشاط مطوية المراجعة:** يكلف المعلم الطلبة بعمل مطوية من الورق الملون أو الأبيض بحيث يكتب الطلبة على الجهة الأمامية **المفاهيم الجديدة التي تعلموها،** وعلى الجهة الخلفية **ملخص** كتابي وملخص آخر بطريقة الرسم، **وثلاثة أفكار** يريدون دراستها قبل الاختبار، وكيف هذه المطوية ساعدتهم في التعلم.

قامت الباحثة بتصميم هذه الوحدة (وحدة الضوء والبصريات) للصف الثامن الأساسي الجزء الثاني اعتماداً على الدمج بين هاتين الاستراتيجيتين وذلك لمناسبتهما لطبيعة الوحدة الدراسية وأنشطتها:

نموذج حصص صفية

الدرس الأول: الضوء

الحصة الأولى:

الأهداف:

1- أن يبين الطالب كيف ينتقل الضوء في وسط ما.

2- أن يفسر الطالب بعض الظواهر المتعلقة بانتقال الضوء في خطوط مستقيمة.

استراتيجيات التدريس المستخدمة: استراتيجية الاستقصاء المبني على أساس الحجة و استراتيجية الكتابة من أجل التعلم.

المواد والأدوات: جهاز العرض، وشمعة، وثلاث قطع متشابهة من الكرتون مثقوبة في مراكزها، أوراق ملونة، لوحة كسوف الشمس وخسوف القمر(إن توافرت).

التمهيد: يعرض المعلم الصورة التالية على جهاز العرض، ثم يطرح عليهم هذه الأسئلة :

1- لماذا يوجد ظل للأجسام ؟ 3- لماذا يحدث كسوف الشمس وخسوف القمر ؟

2- لماذا لا تشاهد الجسم الموجود خلف جدار؟

يستمع المعلم لإجابات الطلبة وفي حال لم يتمكن الطلبة من الإجابة عن السؤال الثالث يكلفهم المعلم بواجب بيتي ويطلب منهم مناقشته مع الرسم أمام الصف في الحصة القادمة مع الاستعانة باللوحة التوضيحية لكسوف الشمس وخسوف القمر.

المعلم: سنتعرف على خصائص الضوء من خلال القيام بالأنشطة التالية:

يقسم المعلم الطلبة في مجموعات غير متجانسة ، ويكون في كل مجموعة خمسة أفراد تجهيزاً لجلسات الاستقصاء، ويوزع عليهم الأرقام من (1-5) ويطلب من كل طالب حفظ دوره ورقمه، ويقسم الأدوار على كل مجموعة بحيث يأخذ كل طالب هذه الأدوار: (ملاحظة يمكن تغيير الأدوار في كل حصة أو حصتين)

الطالب (1): المدعي: تكوين إدعاء مع إعطاء مبرر لهذا الإدعاء.

الطالب(2): فريق الدعم أو المعارضة: يدعم أو يعارض الإدعاء مع إعطاء مثال يوضح سبب الدعم أو المعارضة.

الطالب (3): المحقق : يصوغ أسئلة للتحقق من صحة الإدعاء.

الطالب (4):المدعي الآخر: تكوين إدعاء آخر مع مبرر له.

الطالب (5): الناطق باسم المجموعة: صياغة استنتاج بعد التحقق بالتجربة أو بطرق أخرى من صحة الإدعاء وبعد الاتفاق مع باقي أفراد المجموعة.

ويذّكر المعلم الطلبة أن الاستنتاج من عملية الاستقصاء أو الاستخلاص يجب أن يكون مكتوباً، وكذلك الأمر بالنسبة لجميع النقاش حيث يكون مكتوبا في جدول يوضح العمود الأيمن فيه اسم الفرد والعمود الأيسر الذي يكون أعرض و يكون فيه أقوال الفرد.

المعلم: هل ينتقل الضوء في خطوط مستقيمة في الوسط الواحد ؟

يعطي الطلبة من(5-7) دقائق أو أكثر للمناقشة، ويطلب من الأفراد رقم 1 و 4 في المجموعات التفكير في إدعاء والذي يمثل إجابة للسؤال المطروح مع المبرر.

بعد انتهاء المناقشة يستمع المعلم لأحد المجموعات وقد يأخذ النقاش الشكل التالي :

الطالب (1): يسير الضوء في خطوط مستقيمة في الوسط الواحد، لأننا نرى الظل يتكوّن لأجسامنا في الصباح عندما نقف لسماع الإذاعة الصباحية ونراه كذلك عندما نخرج من المدرسة في ساعات الظهيرة.

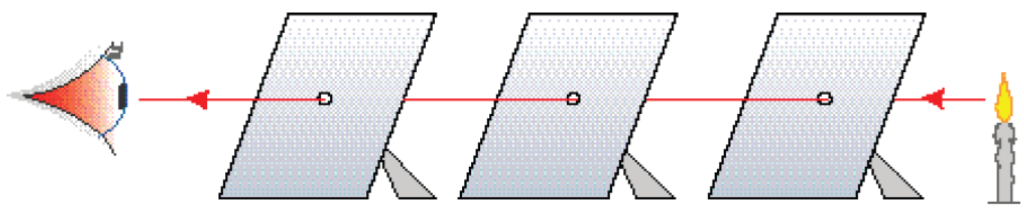
الطالب(2): أدعم إدعاء زميلي الفرد(1)، لأننا درسنا في صفوف سابقة عن ظاهرة كسوف الشمس والتي يكون فيها القمر في الوسط ما بين الشمس والأرض مما يجعله يحجب جزءا من أشعة الشمس القادمة للأرض والتي تسير بخطوط مستقيمة.

الطالب (3): كيف نثبث أن الضوء يسير في خطوط مستقيمة في الوسط الواحد ؟

الطالب(4):يسير الضوء في خطوط مستقيمة في الوسط الواحد، لأننا درسنا سابقاً عن ظاهرة خسوف القمر والتي تكون فيها الشمس والأرض والقمر على استقامة واحدة ويسير ضوء الشمس في خطوط مستقيمة ويتكون ظلاً للأرض على القمر.

المعلم: دعونا نقوم بالتجربة الاتية للتحقق من صحة الإدعاءات:

- ضعْ قطعَ الكرتون الثلاث، بحيث تكون الثقوب فيها على خط مستقيم، كما في الشكل (١).
- انظر الى الشمعة من خلالِ الثقبِ الموجودِ في القطعة (ج)، هل تشاهدُ ضوْءَ الشمعة؟ ما تفسيرُك لذلك؟
- حرك القطعة (ب) أو(أ) جانبا، وانظر من خلالِ الثقبِ في القطعة (ج)، هل تشاهد ضَوْء الشمعة؟ ما تفسيرك لذلك؟



الشكل (1): انتقال الضوء في خط مستقيم

المعلم: هل نستطيع رؤية ضوء الشمعة إذا حركنا أحد قطع الكرتون بحيث لا تصبح الثقوب على استقامة واحدة ؟ على ماذا يدل ذلك ؟

الطالب(5): إن مشاهدتنا لضوء الشمعة عندما تكون الثقوب الثلاثة على خط مستقيم فقط تعني أن الضوء ينتقل في خطوط مستقيمة في الهواء.

لاستخدام استراتيجية الكتابة من أجل التعلم:

نشاط ورقة الأعمدة: يكلف المعلم الطلبة بعمل وسيلة تعليمية بسيطة مكونة من أوراق ملونة ، ثم يقوم الطلبة برسم عمودين على الورقة، العمود الأيمن يتم كتابة أسئلة فيه ، والأيسر وهو العمود الأسمك تكتب فيه إجابات للأسئلة المطروحة، وتلخيص لأهم التفاصيل والملاحظات، وتفسير المصطلحات الجديدة، وإضافة صور أو رسوم يمكن دراستها في اليوم التالي أو لموعد الاختبار.

مثال: يتم تقسيم الورقة إلى عمودين:

العمود الأيمن	العمود الأيسر
كتابة أسئلة متعلقة بالدرس	**كتابة إجابات الأسئلة**
	أخذ ملاحظات لأهم التفاصيل وتوضيح المصطلحات الجديدة.
	أخذ ملاحظات بالصور والأشكال.

يوجه المعلم السؤال : هل يحتاج الضوء إلى وسط مادي لكي ينتقل خلاله ؟ أعط مثالاً يدل على أن الضوء لا يحتاج وسطاً مادياً للانتقال فيه ؟ ما أهم الظواهر التي تعد شواهد على انتقال الضوء في خطوط مستقيمة ؟ (يكلف كل طالب بكتابته ثم يناقشه مع المعلم).

التقويم: غاب طالبان\ طالبتان عن حصة اليوم، ساعدهم في تزويدهم بملخص كتابي لأهم أحداث وتفاصيل الحصة.

الدرس الأول: الضوء

الحصة الثانية:

الأهداف:

1- أن يكتشف الطالب شروط تكوّن الظل وصفاته.

2- أن يصمم الطالب آلة التصوير ذات الثقب كتطبيق على انتقال الضوء في خطوط مستقيمة.

المواد والأدوات: ستارة، مصباح ضوئي، كتاب، طاولة.

المعلم يوجه الطلبة لجلسة الاستقصاء الثانية:

في أي لحظة من النهار يكون ظل جسمك أقصر ما يمكن ؟ وفي أي لحظة يكون أطول ما يمكن ؟

الطالب(1): إدعاء: يكون الظل أقصر ما يمكن في فترة الظهيرة لأننا عندما نكون في حصة الرياضة الأخيرة في ملعب المدرسة أشاهد ظلا لجسمي قصيرا جدا.

الطالب(2): أعارض هذا الإدعاء لأني في الصباح عند القدوم للمدرسة وفي ساعات غروب الشمس أرى ظلا أقصر من جسمي.

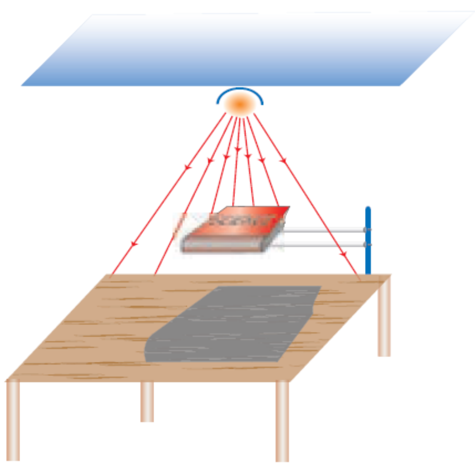
الطالب (3): كيف يمكننا التحقق صفات الظل عندما يكون المصدر الضوئي قريباً أو بعيداً ؟

الطالب (4) : يكون الظل أقصر ما يمكن في فترة الظهيرة لأن الشمس تكون قريبة من الأرض، لأني أعرف أن القدماء استخدموا الظل لتحديد الوقت، ويمكننا وضع جسم معتم بالقرب من نافذة الصف المطلة على الشمس للتحقق.

يكلف المعلم الطلبة بعمل هذه التجربة البسيطة للتحقق، ويكلف الجميع بمراقبة ظلهم في أوقات مختلفة وتسجيل قياساته لمدة أسبوع.

- لاحظ الظلَّ المتكوِّنَ للكتاب على الطاولة
- حرِّك الكتاب بحيثُ يقعُ على أبعادٍ مختلفةٌ عن المصباح؟ لاحظ مساحةَ الظلِّ المتكونِ ودرجة وضوحهِ، واكتشف العلاقةَ بين مساحة الظلِّ ووضوحهِ، وبُعْدِ الجسم عن مصدر الضوء .

لعلك لاحظت أنَّ مساحةَ الظل تكبرُ، ودرجةَ وضوحه تقلُّ عندما يقترب الجسمُ من مصدر الضوء .



الشكل (3): تكون ظل لكتاب

الطالب (5): لاحظنا أن الظل يكبر عندما قربنا الكتاب من الضوء ويصغر عندما نبعد الكتاب عن الضوء، ولاحظنا أيضا أن الظل يصبح غير واضحاً عندما يقترب الكتاب من الضوء ويصبح واضحاً عندما يبتعد عنه ، وبهذا نستنتج أن الظل يكون أقصر ما يمكن في وقت الظهيرة لأن الشمس تكون قريبة من الأرض ويكون غير واضحاً ، أما في وقت الصباح ووقت الغروب يكون الظل أكبر ما يمكن وواضحاً.

المعلم: يربط استنتاج الطلبة بكيفية استخدام القدماء للظلال لتحديد الوقت. ويذهب المعلم برفقة الطلبة لملعب المدرسة لاستكشاف الظل واللعب معه والتأكيد على صحة ما توصل إليه الطلبة من استنتاج.

مطوية المراجعة: يكلف الطلبة بعمل مطوية من الورق الملون أو الأبيض بحيث يكتب الطلبة على الجهة الأمامية **المفاهيم الجديدة التي تعلموها**، وعلى الجهة الخلفية **ملخص لكيفية تكوين الظلال**

كتابي وملخص آخر بطريقة الرسم، **وثلاثة أفكار** يريدون دراستها قبل الاختبار، وكيف هذه المطوية ساعدتهم في التعلم.

التقويم: زميلك لا يميز بين صفات الظل المتكوّن للجسم المعتم عندما يكون المصدر الضوئي قريباً وكبيراً، وعندما يكون المصدر الضوئي بعيداً وصغيراً، اكتب رسالة له توضح فيها بالصور والكتابة كيف يمكنك مساعدته.

الواجب البيتي لهذه الحصة: مشروع: تصميم الة التصوير ذات الثقب تطبيقا على مبدأ انتقال الضوء في خطوط مستقيمة.

إن تكوّن خيال مقلوب للشمعة في هذه الآلة يؤكد انتقال الضوء في خطوط مستقيمة.

للتجريب: كيف يمكنك الحصول على خيال مقلوب لجسم مماثل له في طوله، باستخدام آلة التصوير ذات الثقب ؟

الدرس الأول: الضوء

الحصة الثالثة:

الأهداف:

1- أن يوضح الطالب المقصود بالأوساط الشفافة والأوساط المعتمة والأوساط شبه الشفافة.

2- أن يستدل الطالب على سلوك الضوء في الأوساط الشفافة والأوساط المعتمة.

3- أن يتوصل الطالب إلى العلاقة بين سمك الوسط الشفاف ومقدار الضوء النافذ من خلاله.

4- أن يفسر الطالب بعض الظواهر المصاحبة لتحول الطاقة الضوئية إلى طاقة حرارية.

المواد والأدوات: لوح زجاج شفاف سمكه 4 ملم، وقطعة نقود معدنية، وحوض به قليل من الماء، ومجموعة أوراق شفافيات بلاستيكية متماثلة، وصورة، وموسوعة علمية عن الضوء(إن توافرت).

المعلم: ما المقصود بالأوساط الشفافة ؟ والأوساط المعتمة ؟ والأوساط شبه الشفافة ؟ يناقش الطلبة في إجاباتهم

تمهيداً لجلسات الاستقصاء المبني على أساس الحجة، يطرح المعلم السؤال التالي:

ماذا يحدث للضوء إذا سقط على جسم شفاف ؟

الفرد(1): يستطيع الضوء المرور في الأوساط الشفافة، لأننا نستطيع رؤية الأشياء خارج نافذة الصف.

الفرد(2): أدعم ما قاله زميلي لنفس السبب لأن زجاج النافذة شفاف ويستطيع الضوء المرور من خلاله.

الفرد(3): كيف يمكننا دراسة سلوك الضوء في الأوساط الشفافة ؟

الفرد(4): يستطيع الضوء النفاذ في أوساط شفافة أخرى مثل الماء النقي، والسبب مشاهدتنا للأسماك التي تسبح في بركة صغيرة.

الفرد(5): إذا نظرنا لقطعة نقود فإن ما يفصلها عن أعيننا هو الهواء ونستطيع رؤيتها، وإذا وضعناها خلف لوح زجاجي أو في حوض به ماء نقي كذلك نستطيع رؤيتها. يمكننا الاستناج أن الأوساط الشفافة تسمح للضوء بالمرور من خلالها.

يكلف المعلم الطلبة بتدوين الاستنتاج الذي توصلوا إليه على دفاترهم بشكل فردي.

المعلم: الآن دعونا ندرس العلاقة بين سمك الوسط الشفاف ومقدار الضوء النافذ من خلاله.

يستمع المعلم في كل مرة لأحد المجموعات، ويمكن أن تأخذ جلسة الاستقصاء الشكل التالي:

الطالب(1): لا أعتقد وجود علاقة بين سمك الوسط الشفاف ومقدار الضوء النافذ من خلاله ، لأننا نستطيع رؤية الأشياء خلف نافذة الصف حتى لو وضعنا عدة ألواح زجاجية متماثلة بجانبها.

الطالب(2):أعارض زميلي الفرد (1)، لأن الرؤية لا تصبح واضحة عندما نضع ألواح زجاجية كثيرة.

الطالب(3): كيف يمكننا دراسة أثر سمك الوسط الشفاف على مقدار الضوء النافذ من خلاله ؟

الطالب(4): العلاقة عكسية بين سمك الوسط الشفاف ومقدار الضوء النافذ من خلاله، فإذا كان سميكاً يقل الضوء النافذ من خلاله فلا نستطيع رؤيته جيداً، وأبرر هذا الإدعاء بنفس تبرير زميلي الفرد (2).

يتم تنفيذ (نشاط5: تأثير سمك الوسط الشفاف على انتقال الضوء) بإشراف المعلم.

الفرد(5):.بعد القيام بالتجربة (نشاط 5: تأثير سمك الوسط الشفاف على انتقال الضوء) وزيادة عدد الشفافيات أي زيادة سمك الوسط الشفاف لاحظنا أن درجة وضوح الصورة تقل، وبهذا يمكننا التوصل لاستنتاج أن مقدار الضوء النافذ من الوسط الشفاف يتناقص بازدياد سمك هذا الوسط.

المعلم: يوجه الأسئلة التالية ويطلب من الطلبة التفكير فيها ثم تدوين الإجابة:

- هل يمكنك إعطاء مثال آخر من حياتك اليومية يدعم هذه النتيجة ؟ تشاور مع زملائك.
- فسر وجود الظلام في قاع البحر ؟
- فسر سبب عدم المشاهدة الواضحة لجسم موجود في قاع بركة مياه ساكنة بوضوح ؟
- ما هي الأوساط شبه الشفافة ؟ أعط مثالاً عليها.

المعلم: دعونا الآن ندرس سلوك الضوء في الأوساط المعتمة.

الطالب(1): لا يستطيع الضوء النفاذ في الأوساط المعتمة لأننا لا نستطيع رؤية الأجسام الموجودة خلف جدار أو ستارة.

الطالب(2): أدعم صحة الإدعاء لأننا لا نرى مثلا ما يوجد داخل أجسامنا لأن جلد الإنسان من الأوساط المعتمة.

الطالب(3): كيف يمكننا دراسة سلوك الضوء في الأوساط المعتمة ؟

المعلم: بإمكانكم البحث عن الإجابة في الموسوعة العلمية.

الطالب(4): الأوساط المعتمة لا تسمح للضوء بالمرور من خلالها فهي تقوم بامتصاص الضوء أو تعكسه، ومثال عليها باب الصف.

الطالب(5): إن أي جسم يسقط عليه الضوء يمتص جزءاً منه، ولكن هناك بعض الأوساط التي تمتص معظم الضوء الساقط عليها أو تعكسه ولا تسمح بنفاذه منها، وتسمى هذه الأوساط بالمعتمة، ومن الأمثلة عليها الخشب،وأوراق النبات، وجلد الإنسان، والمعادن.

لدراسة أهمية الضوء بالنسبة للكائنات الحية:

نمط آخر من أنماط استراتيجية الكتابة من أجل التعلم: صناديق معالجة المعلومات:

يكلف المعلم الطلبة برسم ثلاثة صناديق، يكتب الطلبة في الصندوق الأول أسئلة بعد قراءتهم لنص الكتاب ص58، وفي الثاني يكتبون إجابات هذه الأسئلة والتي تكون موجودة في النص، وفي الصندوق الثالث يكتب كل طالب جملة تأملية بكلمات الطالب الخاصة يستخلص فيها ما تعلمه من النص.

التقويم:

1- اكتب في دفترك عن الأشياء التي تعلمتها في هذه الحصة واشرحها لزميلك بعد الانتهاء من الكتابة.

2-ماذا يحدث للشعاع الضوئي إذا سقط على حاجز، وكان هذا الحاجز: الة حاسبة، ورقة نبات، إنسان، مرآة، زجاج ؟

3- صمم خارطة مفاهيمية لسلوك الضوء في الأوساط المختلفة.

الواجب البيتي لهذه الحصة: اكتب مقالة صغيرة في مجلتك تبين فيها أهمية الضوء بالنسبة للكائنات الحية جميعها.

الدرس الثاني: انعكاس الضوء

الحصة الأولى:

الأهداف:

1- أن يوضح الطالب مفهوم انعكاس الضوء.

2- أن يوضح الطالب كيفية انعكاس الضوء عن الأسطح المصقولة والأسطح الخشنة.

3-أن يتوصل الطالب عملياً إلى قانوني الانعكاس.

المواد والأدوات: مصدر ضوء تصدر عنه حزمة ضوئية، وقطعة ورق ألمنيوم ملساء(تستخدم في المطبخ)، ومصباح ضوئي تصدر عنه حزمة ضوئية، ومرآة مستوية، ومنقلة هندسية، ومصدر ضوء(قلم ليزر).

للتوصل إلى مفهوم الانعكاس يوجه المعلم الطلبة لقراءة النص وكتابة أسئلة عليه مع كتابة إجابات لتلك الأسئلة وبعدها يتم مناقشة مفهوم الانعكاس.

الأسئلة هي:

- ما المقصود بانعكاس الضوء ؟
- ما فوائد انعكاس الضوء ؟

التمهيد لنوعي الانعكاس:

يطرح المعلم هذه الأسئلة: ما المسار الذي يسلكه الشعاع الضوئي عند سقوطه على سطح ما ؟ هل ينعكس الضوء على جميع الأجسام بالكيفية نفسها ؟ كيف ينعكس الضوء إذا كان السطح مصقولاً (أملساً)، وكيف ينعكس إذا كان السطح خشناً ؟

يوجه المعلم الطلبة لجلسة الاستقصاء مع تكليفهم بتدوين جميع جلسات النقاش ويوضح لهم أن الأجسام تعكس لونها وتمتص بقية الألوان.

الطالب(1): ينعكس الضوء بشكل منتظم وفي اتجاه واحد عن الأجسام المصقولة (الملساء)، وينعكس بشكل غير منتظم وفي عدة اتجاهات إذا كان السطح خشناً، وأبرر ذلك أن المرآة تكون ملساء لذلك نتمكن من رؤية أنفسنا بوضوح.

الطالب(2): أدعم هذا الإدعاء لأن الأجسام في الطبيعة تعكس لونها بينما تمتص باقي الألوان، فنحن نشاهد لون ورقة النبات أخضر لأنها تمتص جميع الألوان وتعكس اللون الأخضر الذي لا يمكن امتصاصه.

الطالب(3) : هل يوجد قوانين تضبط أو تتحكم في انعكاس الضوء ؟

الطالب(4): نفس إدعاء الفرد(1).

يطلب المعلم من الطلبة القيام بأنشطة الكتاب: نشاط(6): الانعكاس عن السطح المصقول،ونشاط(7): الانعكاس عن السطح الخشن. ويطلب منهم تسجيل النتائج التي حصلوا عليها وتوضيحها بالرسم في كلتا الحالتين،وعرضها أمام المجموعات ،ويناقشهم في النتائج.

الطالب(5): ينعكس الضوء بشكل منتظم وفي اتجاه واحد عندما يكون السطح مصقولاً، وينعكس بعدة اتجاهات إذا كان السطح خشناً ويسمى هذا بالانعكاس غير المنتظم أو التشتت.

المعلم: فسر كيفية حدوث الانعكاس غير المنتظم ؟ أذكر أمثلة من حياتك اليومية لسطوح تعكس الضوء بانتظام وسطوح أخرى تشتت الضوء وتبعثره ؟

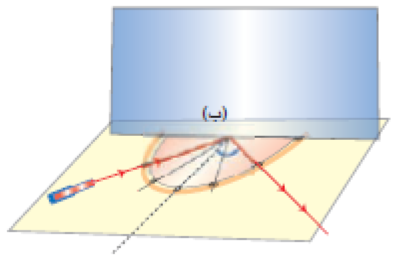
يوجه المعلم المجموعات لتنفيذ نشاط (8): قانونا انعكاس الضوء ويوزع على المجموعات المواد اللازمة لهذا النشاط أو يطلب منهم إحضارها في اليوم السابق.

نشاط(٦): قانون انعكاس الضوء

المواد والأدوات:

مرآة مستوية، ومنقلة هندسية، ومصدر ضوء (قلم ليزر).

خطوات العمل:

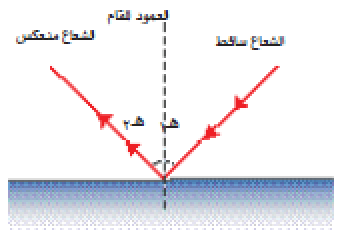


الشكل (٧): زاويتا السقوط والانعكاس

- ضع المرآةَ المستويةَ بشكل عموديٍّ على سطح الطاولة في غرفة مظلمة.
- ثبّت المنقلة في وضع أفقيّ على المرآة كما في الشكل (٧).
- وجّهْ حزمةً ضوئيةً رفيعة (شعاعا) من مصدر

> ● احذر من النظر مباشرة الى مصدر ضوء الليزر ومن توجيهه مباشرة لعيون زملائك.

٦٧



الشكل (٨): انعكاس الضوء في مرآة مستوية

الضوء، واجعلْها تلامسُ سطح المنقلة وتسقط على المرآة عند نقطة (ب) في الشكل.

- قِسْ باستخدام المنقلة الزاويةَ المحصورةَ بين الشعاع الساقط والعمود المقام من نقطة السقوط التي تسمى زاوية السقوط.
- راقب الشعاعَ الضوئي المنعكس (المرتد) عن المرآة، ثمّ قِس الزاويةَ المحصورةَ بينه وبين العمود المقام من نقطة السقوط؟ ماذا تسمى هذه الزاوية؟
- سجّلْ مقدار زاويتي السقوط والانعكاس في الجدول الآتي:

زاوية السقوط هـ١						
زاوية الانعكاس هـ٢						

- غيِّر زاوية سقوط الأشعة، بزيادة ١٠ درجات كل مرة، وراقب الأشعة المنعكسة، وفي كل مرة قِسْ مقدار زاويتي السقوط والانعكاس، وسجّلها في الجدول.

بعد الانتهاء من تطبيق التجربة، يطلب المعلم من الطلبة التأمل في البيانات التي حصلوا عليها، ويوجه لهم الأسئلة التالية:

- هل تلاحظ وجود علاقة بين زاوية السقوط وزاوية الانعكاس؟ ما هذه العلاقة ؟
- ماذا تتوقع أن تكون قيمة زاوية الانعكاس إذا كانت زاوية السقوط 83 درجة مئوية ؟

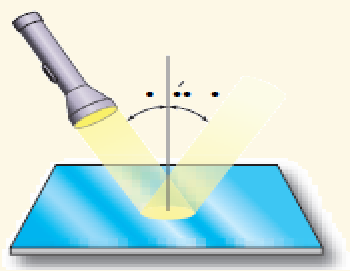
- ارسم على ورق رسم بياني البيانات التي سجلتها في الجدول. ماذا يعني لك الرسم البياني الناتج ؟ كيف تستخدم هذا الرسم لايجاد قيمة زاوية السقوط إذا كانت زاوية الانعكاس 35 ؟ و اذا كانت صفراً ؟
- كيف ينعكس الضوء إذا سقط عمودياً على المرآة المستوية ؟
- ما هو قانون الانعكاس الأول، وقانون الانعكاس الثاني ؟

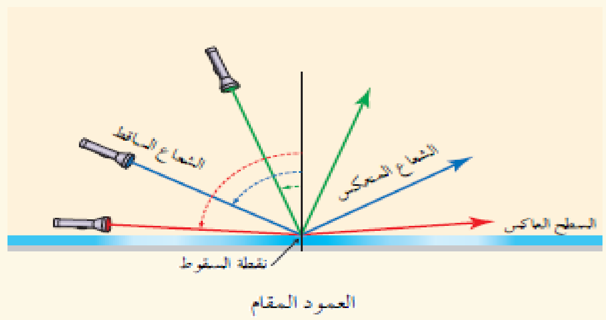
القانونُ الأولُ

الشعاعُ الساقطُ والشعاعُ المنعكسُ والعمودُ المقامُ على السطحِ العاكسِ من نقطةِ السقوطِ تقعُ جميعُها في مستوى واحدٍ عمودي على السطحِ العاكسِ.

القانونُ الثاني

زاويةُ السقوطِ(θ) تساوي زاويةَ الانعكاس (θ́)





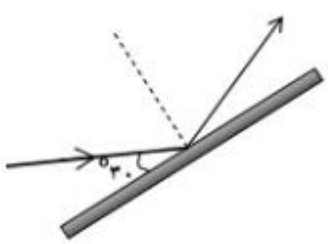
قانونا الانعكاس

يناقش المعلم الطلبة في إجاباتهم مع تدوينها.

التقويم :

1- اكتب مقالة في مجلتك الخاصة توضح فيها مفهوم الانعكاس و أهميته في الحياة اليومية.

في الشكل المجاور ، يسقط شعاعٌ ضوئيٌ على سطح مرآةٍ مستويةٍ بحيث يصنع زاوية (٣٠°) مع سطحها ، ما مقدار زاوية الانعكاس ؟



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الواجب البيتي : يكلف المعلم الطلبة بكتابة تقرير تأملي للحصة يشمل التقرير ما تعلموه في الحصة مع إظهار أهميته بحياتهم اليومية وكتابة الأفكار التي يريدون الحصول على معرفة إضافية فيها، وكيف ساعدتهم جلسات الاستقصاء في تطوير وتعميق الفهم وتحمل المسؤولية الذاتية في التعلم.

الدرس الثاني : انعكاس الضوء

الحصة الثانية :

الأهداف:

1- أن يوضح الطالب المقصود بالمرايا المستوية.

2- أن يستدل الطالب عمليا على صفات الأخيلة المتكونة في المرايا المستوية.

3- أن يبني الطالب بعض الأجهزة البسيطة المعتمدة على المرايا المستوية مثل البريسكوب.

4- أن يحدد الطالب عملياً عدد الأخيلة المتكونة عند وضع مرآتين مستويتين بزوايا مختلفة.

المواد والأدوات: مرايا مستوية ، ورق مربعات ، شمعة، أقلام.

التمهيد : المعلم : هل سبق لك وأن نظرت لوجهك في قطعة فلزية مصقولة مثل الملعقة ؟ هل يختلف شكل وجهك عند النظر إلى سطحي الملعقة الأمامي والخلفي ؟ هل يتشابه طول الأخيلة المتكونة لوجهك في كلتا الحالتين ؟ كيف سيكون خيالك إذا نظرت لمرآة مستوية ؟ ما هي أنواع المرايا ؟؟ وما هي المرايا المستوية ؟

بعد مناقشة الإجابات مع الطلبة، يوجه المعلم الطلبة لجلسة الاستقصاء التالية بعنوان: **اكتشاف صفات الخيال في المرايا المستوية** مع الاستمرار في تدوين جلسات النقاش.

الطالب(1): يكون الخيال في المرايا المستوية واضحاً وليس مقلوباً، لأننا عندما ننظر لأنفسنا في المرآة نرى صورة واضحة وليست مقلوبة.

الطالب(2): أوافق لأن المرايا تعطينا صورة مماثلة لجسمنا في الطول.

الطالب(3): كيف نكتشف صفات الخيال المتكوّن في المرايا المستوية ؟

الطالب(4): نفس إدعاء الفرد(1).

يوجه المعلم الطلبة للقيام بنشاط(9): صفات الخيال في المرايا المستوية ، في المجموعات ويكلفهم بالإجابة على الأسئلة الواردة في النشاط ثم يناقش إجابات المجموعات أمام الصف.

يكلف المعلم الطلبة بعدها بصياغة استنتاج لصفات الخيال:

الطالب(5): يكون الخيال المتكوّن للجسم في المرآة المستوية مماثلاً للجسم في الطول ، فقد كان الخيال مماثلاً لطول الشمعة ومعتدلاً وليس مقلوباً كما أنه يبعد نفس بعد الشمعة عن المرآة،ويكون معكوس جانبياً فعندما رفعنا يدنا اليمنى رأينا اليد اليسرى التي تتحرك.

يوجه المعلم الطلبة إلى أخذ ملاحظات بطريقة الرسم للخيال الذي يتكون في المرآة المستوية.

للتعرف على مبدأ عمل البيرسكوب يقسم المعلم طلبة الصف إلى قسمين، ويطلب منهم قراءة التطبيقات على البيرسكوب بتمعن ثم يكلف القسم الأول بكتابة أسئلة على البيرسكوب، ويكلف القسم الثاني بكتابة ملاحظات كتابية أو جمل أو حقائق عن البيرسكوب. بعدها يستمع لأسئلة الطلبة وكل طالب يجد جواباً عن السؤال المطروح في ملاحظاته يشارك هذا الجواب أمام بقية الصف.

مشروع بيتي: بناء بريسكوب بسيط.

المعلم: ربما أثار انتباهك في صالون الحلاقة عند نظرك إلى المرآة تكوّن عدة أخيلة إذا وجدت مرآة مستوية أخرى خلفك. هل حاولت في إحدى المرات تحديد عدد الأخيلة ؟ وهل فكرت كيف يمكنك استخدام مرآتين مستويتين للحصول على عدة أخيلة لجسم واحد ؟

لاكتشاف العلاقة ما بين عدد الأخيلة المتكوّنة والزاوية التي تفصل المرآتين المستويتين يقوم الطلبة بتنفيذ نشاط (10): تكثير الأخيلة في المرايا المستوية.

يسجل الطلبة البيانات التي حصلوا عليها في الجدول.

المعلم: هل تستطيع التفكير بعلاقة رياضية تربط بين الزاوية بين المرآتين وعدد الأخيلة المتكونة بعد التأمل في البيانات ؟

في حال لم يتكمن الطلبة من الوصول للعلاقة، يكتب المعلم العلاقة الرياضية على اللوح ويطلب منهم التحقق من أن البيانات التي سجلوها تحقق هذه العلاقة.

ورقة الدقيقة الواحدة: يكلف المعلم الطلبة بكتابة ملخص لأهم النقاط التي تم تعلمها في درس اليوم ويستغرق هذا خمس دقائق.

التقويم:1- ما عدد الأخيلة المتكوّنة إذا كانت الزاوية بين المرآتين المستويتين: 45 ، 60، 90، 120، 180 ؟

2- حاول تصميم خارطة مفاهيمية لأنواع المرايا.

3- وضح بالرسم صفات الأخيلة (الصور) المتكوّنة في المرايا المستوية.

4- علل ما يلي:

أ- تكتب كلمة إسعاف معكوسة على مقدمة سيارة الإسعاف.

ب- يحتاج طبيب العيون الذي أبعاد حجرته (3م * 3م) إلى مرآة مستوية لفحص النظر الذي مسافته الطبيعية (6م).

الواجب البيتي : يكلف المعلم الطلبة بكتابة تقرير تأملي للحصة يشمل التقرير ما تعلموه في الحصة مع إظهار أهميته بحياتهم اليومية وكتابة الأفكار التي يريدون الحصول على معرفة إضافية فيها ، وكيف ساعدتهم جلسات الاستقصاء في تطوير وتعميق الفهم وتحمل المسؤولية الذاتية في التعلم.

الدرس الثاني: انعكاس الضوء

الحصة الثالثة: المرايا الكروية

الأهداف:

1- أن يوضح الطالب المقصود بالمرايا الكروية.

2- أن يميز الطالب بين المرآة المحدبة والمرآة المقعرة.

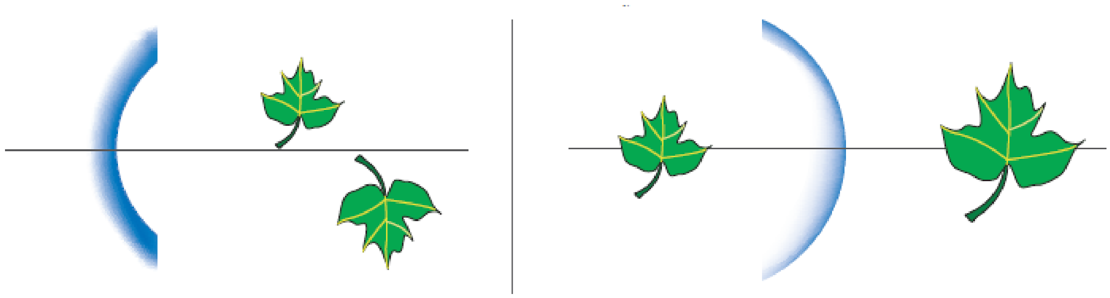
3- أن يتعرف الطالب على بعض المصطلحات المتعلقة بالمرايا الكروية مثل قطب المرآة، ومركز التكوّر، والمحور الرئيس للمرآة، وبؤرة المرآة، والبعد البؤري، والخيال الحقيقي،والخيال الوهمي،والتكبير.

4- أن يوضح الطالب كيف تتكون الأخيلة في المرآة المقعرة بوساطة رسم الأشعة.

المواد والأدوات: جهاز العرض ، فيلم تعليمي يوضح بالرسم المصطلحات المتعلقة بالمرايا.

قبل البدء بالحصة يستخدم المعلم نشاط **KWL)know-want to know- learned): وهي اختصار عن ماذا يعرف الطالب- وماذا يريد أن يعرف الطالب- وماذا تعلم الطالب.** ويتم تطبيق هذا النشاط في بداية الدرس حيث يكلف المعلم الطلبة بعمل ثلاثة أعمدة على ورقة وبملء أول عمودين ومن خلال استجابات الطلبة يمكن أن يكشف المعلم خبرات الطلبة السابقة ويحدد اهتماماتهم، أما العمود الثالث فيتم ملؤه بعد الانتهاء من الدرس.

التمهيد : يعرض المعلم الصورة التالية على جهاز العرض :



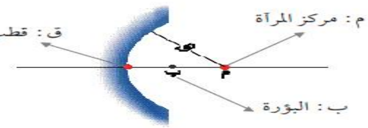
شكل (١٥-أ) : مرآة محدبة

شكل (١٥-ب) : مرآة مقعرة

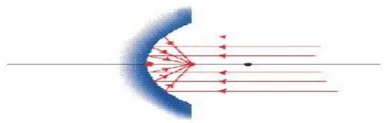
يطرح السؤال: **مستعينا بالرسم، ما الفرق بين المرآة المحدبة والمرآة المقعرة ؟** ويناقش الطلبة في إجاباتهم ويبين لهم كيف تعمل الملعقة كمرآة محدبة ومقعرة في نفس الوقت.

للتعرف على بعض المصطلحات المتعلقة بالمرايا يعرض المعلم الفيلم التعليمي، ويكلف الطلبة بأخذ ملاحظات وعمل ملخص كتابي وملخص بالرسم لهذه المصطلحات. (يمكن عرض الفيلم أكثر من

مرة في حال لم يتمكن الطلبة من تكوين أشكال صحيحة). ثم يكلف الطلبة بقراءة النص الذي يوضح المصطلحات المتعلقة بالمرايا:



الشكل (١٧): المرآة المقعرة


الشكل (١٨): اشعة متوازية تسقط على مرآة مقعرة

عندما تسقطُ الأشعةُ الضوئيةُ المتوازية على سطحِ مرآةٍ مقعَّرةٍ تنعكسُ عنها وتتجمَّعُ في بؤرتها الرئيسة التي يرمز لها (ب) كما في الشكل (١٨). والسؤال الآن: ماذا تتوقع أن يحدثَ إذا وضع جسم مضيء في بؤرة المرآة المقعرة؟ للإجابة عن هذا السؤال تتبع مسار الأشعة الضوئية الصادرة عن المصدر الضوئي الموضوع في نقطة (ب) في الشكل (١٩) الآتي. ماذا تلاحظ؟

لعلك لاحظت أنَّ الأشعة المنعكسة في هذه الحالة تكون متوازية.


الشكل (١٩): اشعة متوازية تسقط على مرآة مقعرة

ثم يطلب من الطلبة عمل الجدول الآتي وتعبئته:

العمود الأيمن	العمود الأيسر
كتابة أسئلة متعلقة بالدرس	كتابة إجابات الأسئلة
	أخذ ملاحظات لأهم التفاصيل وتوضيح المصطلحات الجديدة.
	أخذ ملاحظات بالصور والأشكال.

يوضح المعلم بالرسم على اللوح سقوط الأشعة على مرآة مقعرة ، وكيفية تحديد موقع خيال جسم في المرآة، ويكلف الطلبة بالرسم على دفاترهم.

التقويم:

1-عبر بلغتك الخاصة عن كل من: البعد البؤري للمرآة، بؤرة المرآة المقعرة، المحور الرئيس للمرآة.

2- حدد موقع خيال جسم في مرآة مقعرة بطريقة رسم الأشعة.

3- كوّن أسئلة على الدرس واكتبها على بطاقة لتسألها لزميلك في الحصة القادمة.

الواجب البيتي: عمل تلخيص للدرس وللمفاهيم الجديدة التي تم تعلمها بلغة الطالب الخاصة ورسم الأشكال الجديدة التي تم تعلمها ومناقشة الواجب مع المعلم في الحصة القادمة.

الدرس الثاني: انعكاس الضوء

الحصة الرابعة المرايا الكروية

الأهداف:

1- أن يوضح الطالب كيف تتكون الأخيلة في المرآة المقعرة بوساطة رسم الأشعة.

2- أن يحدد الطالب عملياً صفات الأخيلة في المرايا المقعرة لأربع حالات مختلفة لبعد الجسم عن المرآة المقعرة.

المواد والأدوات:مرآة مقعرة بعدها البؤري معروف، وشمعة، وستارة، ومسطرة.

يوضح المعلم كيفية تحديد موقع خيال جسم موضوع أمام مرآة مقعرة بأسلوب رسم الأشعة.

يكلف الطلبة بالرسم على دفاترهم.

لتحديد خصائص الأخيلة المتكونة في المرايا المقعرة لأربع حالات مختلفة لبعد الجسم عن المرآة المقعرة.

يقوم الطلبة بتنفيذ نشاط(11): خصائص الأخيلة المتكوّنة في المرايا المقعرة وتعبئة البيانات التي حصلوا عليها في الجداول، ثم يتحقق الطلبة عملياً من صحة القانون الرياضي العام للمرايا.

ويوجه المعلم الأسئلة التالية:

◄ ما التغيرات التي حدثت في صفات الخيال عندما انتقل من حالة إلى أخرى؟

◄ حدد موقع الخيال وصفاته في كل حالة بالرسم التوضيحي مستعينا بالشعاعين اللذين تم اختيارهما سابقا.

◄ تحقق رياضيا من قانون المرايا العام الآتي:

$$\frac{١}{س} + \frac{١}{ص} = \frac{١}{ع}$$

مستخدماً قانون المرايا احسبْ بُعد الخيال (ص) عن المرآة، ثم قارن هذه القيمة مع مقدار (ص) في الجدول.

◄ احسب مقدار التّكبير في الحالات الثلاث الأولى باستخدام القانون الآتي:

$$\text{مقدار التكبير} = \frac{ص}{س} = \frac{\text{طول الصورة}}{\text{طول الجسم}}$$

ملاحظة هامة: عند تطبيق قانون المرآيا العام في حل مسائل عددية، تعدُّ إشارةُ البعدِ البؤري (ع) موجبةً في حالة المرآة المقعرة، وسالبةً في حالة المرآة المحدبة. وتكون إشارة (ص) موجبة في حالة الخيال الحقيقي المقلوب، وسالبة في حالة الخيال الوهمي المعتدل.

يناقش المعلم الطلبة في البيانات التي حصلوا عليها. وفي الرسومات التي رسموها خلال تنفيذ النشاط.

يعرض المعلم على جهاز العرض الشكل(8-21) الذي يوضح صفات الأخيلة في المرايا المقعرة ويكلف المجموعات بمقارنته بالأشكال التي رسموها ويناقشهم في صحة إجاباتهم ويؤكد عليها.

التقويم:

1- وضح بالرسم خصائص الأخيلة المتكونة لجسم موضوع أمام مرآة مقعرة في الأربع حالات المختلفة لبعد الجسم عن المرآة.

الدرس الثاني: انعكاس الضوء

الحصة الخامسة:

الأهداف :

1- أن يقارن الطالب بين الرسم الذي قام برسمه لصفات الأخيلة المتكونة في المرايا المقعرة وبين شكل الكتاب التوضيحي.

2-أن يحسب الطالب بعد الخيال عن المرآة المقعرة وقوة التكبير عند إعطائه مسائل عن تكوّن الأخيلة في المرايا المقعرة.

3- أن يكتشف الطالب عملياً صفات الأخيلة المتكوّنة في المرايا المحدبة.

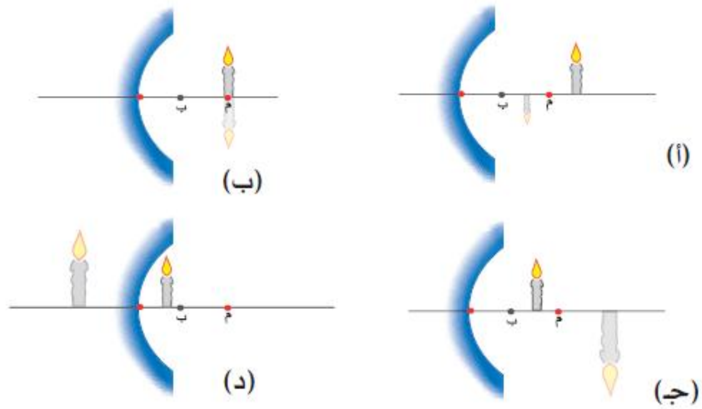
4- أن يعطي الطالب أمثلة على استخدامات المرايا الكروية والمرايا المستوية في حياته.

المواد والأدوات: مرآة محدبة, وشمعة, وستارة, وبرمجية من الانترنت لمحاكاة تغير صفات الخيال مع موقع الجسم الموضوع أمام مرآة مقعرة، وجهاز العرض لعرض الشكل (8-21) صفات الأخيلة في المرايا المقعرة.

استراتيجية الكتابة من أجل التعلم:

يقسم المعلم الطلبة إلى مجموعات غير متجانسة ويعرض الشكل الآتي على جهاز العرض :

تبين الأشكال الآتية الحالات الأربع التي وردت في النشاط السابق، قارنها بالأشكال التي قمت برسمها.



الشكل (٢١): صفات الأخيلة في المرايا المقعرة

يوجه المعلم الطلبة للتأمل في الشكل وفي مقارنته مع الأربع حالات لبعد الجسم عن المرآة المقعرة، ويوجه الطلبة لقراءة نص الكتاب أسفل الرسمة، ثم يقسم الصف إلى قسمين : يتم تكليف القسم الأول بكتابة أسئلة ، والقسم الثاني بكتابة ملاحظات .

يستمع المعلم لإجابات الطلبة ويناقشهم في صحتها.

يعرض المعلم البرمجية التي تحاكي تغير صفات الخيال مع تغير موقع الجسم الموضوع أمام المرآة المقعرة، ويكلف بعدها الطلبة بكتابة ملاحظات على شكل جمل و على شكل رسومات.

لحساب مسائل على بعد الخيال المتكوّن في المرآة المقعرة وعلى قوة التكبير :

مرآة مقعرة بعدها البؤري 20 سم وضع أمامها جسم فتكوّن له خيال على بعد 30 سم، أوجد بعد الجسم وصفات الخيال؟

للتعرف على صفات الأخيلة المتكوّنة في المرايا المحدبة:

يوجه المعلم الطلبة لجسلة الاستقصاء :

للتأكد من صحة الإدعاءات يوجه المعلم المجموعات لتنفيذ نشاط(12): صفات الأخيلة في المرايا المحدبة.

يوجه المعلم الطلبة إلى تصميم خارطة مفاهيمية صحيحة تضم أنواع المرايا وصفات الأخيلة المتكوّنة لها.

يناقش المعلم الطلبة في أهمية المرايا المحدبة والمقعرة في حياتنا اليومية.

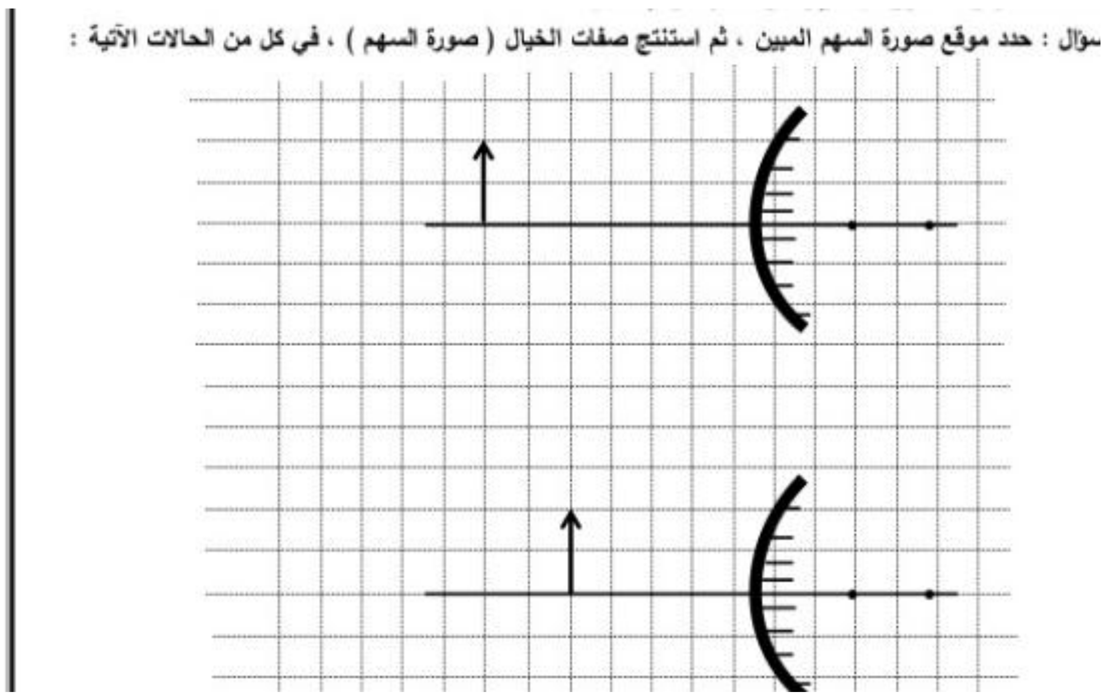
حصة لحل أسئلة الدرس.

التقويم :

1- اكتب رسالة لزميلك توضح فيها بالرسم والكتابة صفات الأخيلة المتكوّنة في المرايا المحدبة**.**

2- ماذا تعني لك إشارات الكميات التالية عند تطبيق قانون المرايا العام في حل مسائل عددية ؟ +ع ، +ص، - ع ، -ص ؟

3- وضح صفات الأخيلة المتكونة لجسم ما عند وضعه أمام المرآة المحدبة.



الواجب البيتي : يكلف المعلم الطلبة بكتابة تقرير تأملي للحصة يشمل التقرير ما تعلموه في الحصة مع إظهار أهميته بحياتهم اليومية وكتابة الأفكار التي يريدون الحصول على معرفة إضافية فيها ، وكيف ساعدتهم جلسات الاستقصاء في تطوير وتعميق الفهم وتحمل المسؤولية الذاتية في التعلم.

الدرس الثالث : انكسار الضوء

الحصة الأولى

الأهداف:

1- أن يوضح الطالب المقصود بانكسار الضوء.

2- أن يفسر الطالب بعض المشاهدات المتعلقة بانكسار الضوء في وسطين شفافين في ضوء فهمه لانكسار الضوء.

3- أن يبرهن الطالب عملياً انكسار الضوء عند انتقاله من وسط شفاف إلى آخر.

4- أن يفسر الطالب اختلاف مقدار زاويتي السقوط والانكسار بعد تنفيذه لأنشطة الكتاب.

المواد والأدوات : ملعقة، وكأس ماء، وحوض زجاجي مملوء بالماء، ومصدر ضوئي (قلم ليزر إن وجد) ، وقطعة ورق مقوى تغطي الحوض، ومسحوق الطباشير، ومتوازي مستطيلات من الزجاج أو البلاستيك.

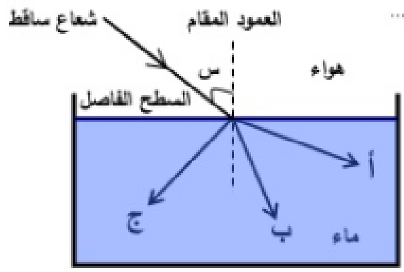
التمهيد : المعلم : عرفت سابقاً أن الضوء المار في وسط معين متجانس يسير في خطوط مستقيمة، وعند سقوطه على سطوح معينة ينعكس عنها ويبقى في الوسط نفسه. ولكن ماذا يحدث للضوء عندما ينتقل من وسط ما إلى وسط آخر يختلف عنه ؟ قبل الإجابة عن هذا السؤال دعونا نضع هذه الملعقة في كأس يوجد بها ماء إلى منتصفها وننظر إليها، ماذا نلاحظ ؟ وإذا نظرنا لسمكة موجودة في بركة ماء كما في شكل الكتاب ماذا نلاحظ ؟. يناقش المعلم الطلبة في إجاباتهم ويتوصل معهم لمفهوم الانكسار. ويطلب من الطلبة التعبير عن هذا المفهوم بالرسم وبالكتابة بلغتهم الخاصة على دفاترهم.

يوجه المعلم الطلبة للقيام بنشاط(13): انكسار الضوء عند انتقاله من وسط شفاف إلى آخر ، ويطلب منهم كتابة الملاحظات التي يحصلون عليها بعد تنفيذ النشاط ورسمها ويناقشهم فيها. ويكلفهم بعمل ثلاثة صناديق ، صندوق يتم فيه كتابة أسئلة ، وصندوق يتم وضع فيه إجابات للأسئلة، والصندوق الأخير تكتب فيه جملة تأملية لما تعلمه الطالب من هذا النشاط أو من النشاط

البديل نشاط(14).   **التقويم:**

س١) **الشكل المجاور يوضح مسار شعاع ضوئي سقط من الهواء (وهو وسط خفيف) ، إلى الماء (وهو وسط كثيف) ، أي المسارات (أ ، ب ، ج) يبين كيفية الانكسار ؟ ولماذا ؟** ٢

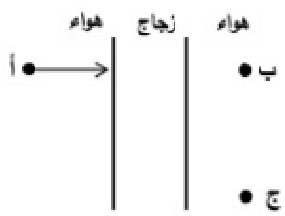
....



س٢) **في الشكل المجاور ، ارسم مسار الشعاع :**

١. بين النقطتين (أ) و (ب) .

٢ . بين النقطتين (أ) و (ج) .



الواجب البيتي : تخيل أنك شعاع ضوئي وأردت الانتقال من الهواء إلى ماء البحر، اكتب مقالة في مجلة توضح فيها للقارئ الطريق الذي تسلكه موضحاً مصيرك مع الرسم.

الدرس الثالث: انكسار الضوء

الحصة الثانية

الأهداف:

1- أن يوضح الطالب المقصود بالكثافة الضوئية.

2- أن يستدل الطالب على العلاقة بين الكثافة الضوئية وزاوية الانكسار للوسط الواحد.

3- أن يقارن الطالب بين زاوية السقوط وزاوية الانكسار عند انتقال الشعاع الضوئي من الهواء إلى الماء والعكس.

4- أن يرسم الطالب انكسار شعاع ضوئي عند سقوطه من الهواء للماء ثم للزجاج.

المواد والأدوات: جهاز العرض.

التمهيد : المعلم: هل تختلف سرعة الضوء باختلاف صفات الوسط المار فيه ؟ وما علاقة انكسار الضوء بذلك ؟

هل ينكسر الضوء بالمقدار نفسه في جميع الأوساط ؟ ولماذا ؟ وعلى ماذا يعتمد مقدار الانكسار في الوسط الشفاف ؟

يناقش المعلم الطلبة في إجاباتهم ويتوصلون لمفهوم الكثافة الضوئية.

المعلم : هل تتوقع أن تكون سرعة الضوء هي نفسها في جميع الأوساط الصلبة والسائلة والغازية ؟ إذن دعونا نرتب هذه الأوساط تنازلياً من حيث سرعة الضوء فيها؟

المعلم : ما العلاقة برأيك بين الكثافة الضوئية للوسط ومقدار زاوية الانكسار فيه ؟ (حاول الاستعانة بتعريف الكثافة الضوئية للوصول للإجابة).

يوجه الطلبة بهذا السؤال للبدء بجلسات الاستقصاء مع التأكيد على ضرورة الرسم.

بعد استماع المعلم لاستنتاج المجموعات الذي يكون موضحاً بالرسم وبالكتابة، يؤكد المعلم على صحة ما توصل إليه الطلبة، ويعرض أشكال الكتاب على جهاز العرض: الشكل(8-30) الذي يوضح أن زاوية انكسار الشعاع الضوئي في الماء تكون أقل من زاوية سقوطه في الهواء، والشكل:(8-31) الذي يوضح أن زاوية انكسار الشعاع الضوئي في الهواء تكون أكبر من زاوية سقوطه في الماء.

التقويم :

1- يحل الطلبة سؤال الكتاب ص80 باستخدام نشاط(فكر\زاوج\شارك) حيث يبدأ الطالب بشكل فردي ثم يقارن كل فرد مع زميله وبعدها يقارن مع مجموعته.

2-ورقة الدقيقة الواحدة: يكلف المعلم الطلبة بإغلاق الكتب ودفاتر الملاحظات، ويقوم الطلبة بتلخيص أهم النقاط الواردة في الدرس، ويكتبون أسئلة، ويستغرق هذا من (2-3) دقائق.

الدرس الثالث: انكسار الضوء

الحصة الثالثة

الأهداف:

1- أن يفسر الطالب سبب ظهور ألوان قوس قزح في يوم ماطر.

2- أن يوضح الطالب المقصود بالعدسة.

3- أن يميز الطالب بالرسم الفرق بين صفات العدسات المحدبة والعدسات المقعرة.

4- أن يتعرف الطالب على بعض المصطلحات المتعلقة بالعدسات مثل مركز تكوّر العدسة،و المحور الرئيس للعدسة، والمركز البصري،والبؤرة، والبعد البؤري.

المواد والأدوات: منشور ثلاثي زجاجي أو بلاستيكي، ستار(حاجز)، مصدر ضوء أبيض.

المعلم: لعلك لاحظت يوماً ظهور ألوان قوس قزح في يوم مشمس ماطر. كيف تفسر ذلك ؟

يوجه المعلم الطلبة للبدء بجلسات الاستقصاء المبني على أساس الدليل والحجة وبعدها يقوم الطلبة بتنفيذ نشاط الكتاب: نشاط(15): انكسار الضوء في منشور ثلاثي. ويفسر الطلبة ما شاهدوه ويتوصلون إلى استنتاج كتابي.

المعلم: ما المقصود بالعدسة ؟ وما أنواعها ؟ وما الفرق بين النوعين ؟

يوجه المعلم الطلبة لاسترجاع معلوماتهم السابقة بالكتابة في مجموعات ثنائية. ويناقش معهم ما توصلوا إليه ويوضح الفرق برسم العدسات على اللوح والدفتر.

للتعرف على بعض المصطلحات المتعلقة بالعدسات يوجه المعلم الطلبة لقراءة هذه المصطلحات والتعرف عليها بشكل فردي مع كتابتها ورسمها، ثم يطلب من كل زميلين مناقشة ما توصلوا إليه معا، ثم يطلب من المجموعة مناقشة المصطلحات الجديدة التي تعرفوا عليها، بعدها يكلف المعلم أحد الطلبة بتوضيح المصطلحات الجديدة مع رسمها على اللوح أمام الطلبة والمعلم.

التقويم: الاختبارات الوهمية: يقوم الطلبة في نهاية الحصة بإغلاق الكتب ودفاتر الملاحظات وصياغة اختبار على ما تم تعلمه في غرفة الصف، ثم يقومون بمناقشة أسئلة الاختبار مع أقرانهم، وهذا لا يساعد الطلبة فقط على المراجعة والتفكير قبل الاختبار وإنما يساعدهم أيضاً على التعبير عما تعلموه من مفاهيم وإدراك العلاقات بين أجزاء محتوى المادة التعليمية.

الدرس الثالث: انكسار الضوء

الحصة الرابعة

الأهداف:

1- أن يقدر الطالب عملياً البعد البؤري لعدسة محدبة.

2- أن يرسم الطالب الأشعة المتوازية عند سقوطها على عدسات محدبة ومقعرة.

3- أن يستنتج الطالب صفات العدسات المحدبة والعدسات المقعرة.

4- أن يحدد الطالب موقع خيال جسم موضوع أمام عدسة محدبة بطريقة رسم الأشعة.

المعلم: ماذا تتوقع أن يحصل للأشعة الضوئية عند سقوطها على عدسة محدبة ؟؟

يوجه الطلبة لجسات الاستقصاء ثم تنفيذ نشاط(16): تقدير البعد البؤري لعدسة محدبة، واستخلاص النتائج وكتابتها ورسمها.

مسودات ملاحظة الزملاء: في هذا النشاط يقدم الطلبة مسودات قبل نهائية من عمل مكتوب لتقرير مخبري بعد تنفيذ النشاط السابق، وهذه المسودات لا توفر للطلبة تغذية راجعة وانية فقط ، وإنما تساعدهم أيضاً على تطوير التواصل والتفكير الناقد والعمل التعاوني واكتساب مهارات التعلم الحياتية.

المعلم: ماذا تتوقع أن يحصل للأشعة الضوئية عند سقوطها على عدسة مقعرة ؟ هل تتجمع في بؤرة العدسة ؟ وهل لها بؤرة حقيقية ؟ يرسم المعلم الشكل (8-36): عدسة مقعرة على اللوح، ويكلف الطلبة باستنتاج الإجابة.

لتحديد موقع خيال جسم موضوع أمام عدسة محدبة بطريقة رسم الأشعة يكلف المعلم الطلبة بدراسة هذه الصفحة من خلال خطوات استراتيجية الكتابة من أجل التعلم الموضحة كالآتي:

1- التلخيص: يلخص الطالب النص بعد قراءته بشكل فردي بلغته الخاصة مع التمثيل بالرسم والأشكال.

2- المقارنة: يقارن الطالب ما سجله مع زميله لملاحظة نقاط الاختلاف والتشابه. (يمكن الاستعانة بالمعلم في حال كان هناك اختلافات كبيرة).

3- التنقيح: إنشاء نسخة كاملة ومنقحة لما تم تسجيله من الزميلين بعد الاتفاق فيما بينهما.

4- الجمع: يناقش الزميلان مع باقي المجموعة ما توصلوا إليه ويعطون صورة كاملة عن التعميمات الجديدة.

5- الاستعراض: تعرض أحد المجموعات ما توصلت إليه على اللوح أمام المعلم والطلبة.

6- التقييم: يقيم المعلم عمل المجموعة من خلال صحة ما توصلوا إليه ويؤكد على أهم التفاصيل والتعميمات.

التقويم: الاختبارات الوهمية: يقوم الطلبة في نهاية الحصة بإغلاق الكتب ودفاتر الملاحظات وصياغة اختبار على ما تم تعلمه في غرفة الصف، ثم يقومون بمناقشة أسئلة الاختبار مع أقرانهم، وهذا لا يساعد الطلبة فقط على المراجعة والتفكير قبل الاختبار وإنما يساعدهم أيضاً على التعبير عما تعلموه من مفاهيم وإدراك العلاقات بين أجزاء محتوى المادة التعليمية.

الدرس الثالث: انكسار الضوء

الحصة الخامسة

الأهداف:

1- أن يستدل الطالب عملياً على خصائص الأخيلة في العدسات المحدبة والمقعرة.

2- أن يلخص الطالب المعلومات التي درسها عن العدسات في خارطة مفاهيمية صحيحة.

3- أن يحل الطالب مسائل على بعد الخيال وصفاته وطوله، ومقدار التكبير.

المواد والأدوات: عدسة محدبة بعدها البؤري معروف، وحامل عدسة، ومسطرة،وشمعة، وستارة، وعدسة مقعرة، وحامل عدسات، وأوراق عمل لأسئلة مختلفة تشمل حساب البعد البؤري ومقدار التكبير وبعد الخيال وصفاته(يمكن عملها على شكل بطاقات).

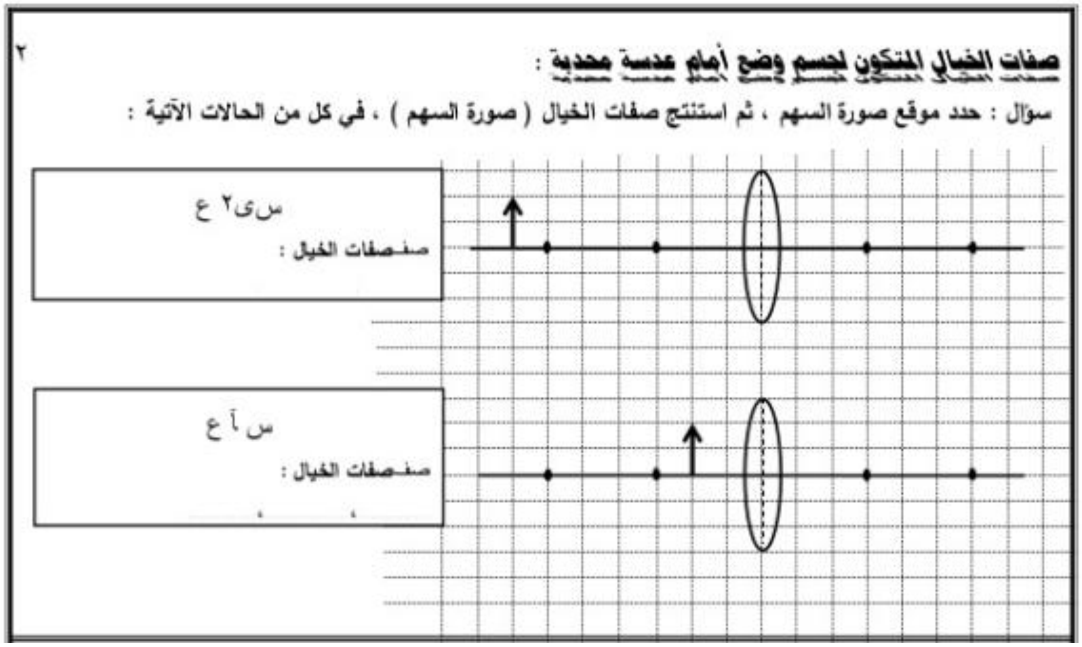
المعلم: ما الذي يحدد خصائص الأخيلة المتكوّنة في العدسات ؟

يوجه المعلم الطلبة لتنفيذ نشاط(17): خصائص الأخيلة في العدسات المحدبة، ونشاط(18): خصائص الأخيلة في العدسات المقعرة في مجموعات وعمل تقرير مخبري بعد تنفيذ كل نشاط والإجابة على الأسئلة في الكتاب وإلى استنتاج خصائص الأخيلة المتكوّنة في كلا النوعين من العدسات باستخدام استراتيجية الكتابة من أجل التعلم الموضحة سابقاً والتي تنمي من قدرة الطالب على التعلم الذاتي وتزيد من مهاراته في القدرة على توظيف أشكال الكتاب للوصول إلى فهم عميق.

التقويم:

1- صمم رسماً توضيحياً لصفات الأخيلة المتكونة في العدسات بنوعيها.

2- صمم خارطة مفاهيمية للعدسات.



يوزع المعلم أوراق العمل على المجموعات ويطلب منهم التعاون في حلها، ويمكن أن يحل المعلم معهم أحد الأسئلة كنموذج لتوضيح خطوات الحل.

تطبيقات عملية على استخدام العدسات:

الحصة الأولى: العين البشرية

الأهداف:

1- أن يذكر الطالب أجزاء العين البشرية ووظائفها.

2- أن يوضح الطالب المقصود بظاهرة تكيف العين.

3- أن يوضح الطالب المقصود بقصر النظر وطول النظر.

4- أن يميز الطالب بين طول النظر وقصر النظر من حيث الأسباب والعلاج.

المواد والأدوات: فيلم تعليمي عن عيوب الإبصار، وجهاز العرض.

الاستراتيجية : KWL

يطلب المعلم من الطلبة التأمل في عنوان الدرس وفي العناوين الفرعية ، ثم يكلفهم المعلم بعمل ثلاثة أعمدة على دفاترهم، يمثل العمود الأول يكتب فيه الطالب **ماذا يعرف عن الدرس ، والعمود الثاني يمثل ماذا يريد أن يتعلم الطالب من الدرس، والعمود الثالث ما الذي تعلمه بالفعل، وإذا ما كانت لديه خطة لتعميق فهمه للدرس.** ويتم تعبئة العمودين في بداية الحصة، أما العمود الثالث يتم تعبئته في نهايتها.

يناقش المعلم الطلبة بما كتبوه في العمود الأول ليكشف عن معلوماتهم السابقة وليتأكد من صحتها.

يعرض المعلم الفيلم التعليمي (عيوب الإبصار) وبعدها يكلف الطلبة باستخدام خطوات استراتيجية الكتابة من أجل التعلم الموضحة سابقاً وفق الخطوات التالية:

1- التلخيص:

2- المقارنة:

3- التنقيح:

4- الجمع:

5- الاستعراض:

6- تقييم المعلم للمجموعة التي عرضت والتأكيد على صحة أو عدم صحة ما توصلوا إليه ، وشرح وتوضيح أشكال الكتاب ص91.

بعد انتهاء المعلم من الخطوة (6)، يكلف المعلم الطلبة بتعبئة العمود الثالث.

التقويم:

1- صمم رسماً توضيحياً للخيال الذي يتكون أمام شبكية شخص مصاب بقصر نظر وآخر مصاب بطول نظر.

2- زميلك يخلط بين مفهومي قصر النظر وطول النظر، اكتب له رسالة تساعده على التمييز بينهما مع توضيح الأسباب والعلاج لكل منهما.

تطبيقات عملية على استخدام العدسات:

الحصة الثانية: الآلات البصرية

الأهداف:

1- أن يوضح الطالب المقصود بالآلات البصرية.

2- أن يعدد الطالب أمثلة على آلات بصرية.

3- أن يوضح الطالب مبدأ عمل كل من المجهر البسيط ، والمجهر المركب، والمقراب(التلسكوب)، وآلة التصوير.

المواد والأدوات: عدسة محدبة، مجهر مركب.

الاستراتيجية: الكتابة من أجل التعلم.

التمهيد: يقدم المعلم مقدمة عن الآلات البصرية ويعطي أمثلة عليها.

يوزع المعلم على كل مجموعة مهمة: وهي قراءة وفهم وتلخيص كل آلة من الآلات البصرية، يوزع أربعة آلات بصرية على 4 مجموعات وفي حال وجود أكثر من 4 مجموعات يمكن تكليف مجموعتين بنفس المهمة.

يكلف الطلبة باستخدام خطوات استراتيجية الكتابة من أجل التعلم الموضحة سابقاً وفق الخطوات التالية:

1- التلخيص:

2- المقارنة:

3- التنقيح:

4- الجمع:

5- الاستعراض:

6- تقييم المعلم للمجموعة التي عرضت والتأكيد على صحة أو عدم صحة ما توصلوا إليه، وربطها بأهمية كل آلة من الآلات السابقة في حياتنا العملية.

التقويم:

1- كوّن أسئلة عن جميع الآلات البصرية واكتبها على بطاقة لتسألها لزميلك.

2- اكتب بطاقة معايدة لصديقك في عيد ميلاده تشرح له فيها عن تركيب واستخدام المقراب الفلكي(التلسكوب).

تم الدليل بحمد الله

إعداد : المعلمة الباحثة: ريهام هلال

Appendix No.6 Permission of the Faculty of Educational Science\Graduate Studies Program at Al-Quds University

بسم الله الرحمن الرحيم

Al-Quds University
Faculty of Educational Science
Graduate Studies Programs

جامعة القدس
كلية العلوم التربوية
برامج الدراسات العليا

التاريخ:2017/1/30

حضرة السادة / مدرسة بنات العيزرية الثانوية المحترمين

لمن يهمه الأمر

تحية طيبة وبعد،،

تقوم الطالبة: رهام هلال ورقمها الجامعي (21410104)، باجراء دراسة بعنوان :

" فاعلية برنامج يستند الى الدمج بين منحى الاستقصاء المبني على اساس الحجة واستراتيجية الكتابة من اجل التعلم الصف الثامن الاساسي على مهارة التنظيم الذاتي في تعلم العلوم وعلى قدرتهم في تشكيل نماذج عقلية علمية "

يرجى من حضرتكم تسهيل مهمة الطالبة المذكورة والتعاون معها باعطائها البيانات اللازمة لتطبيق الدراسة.

شاكرين لكم حسن تعاونكم

د.ايناس ناصر
منسقة برنامج ماجستير اساليب التدريس

كلية العلوم التربوية
Faculty of Educational Science

Tel 02-2799753 Fax 02-2796960 Jerusalem P.O. Box 20002

تلفون 02-2799753 فاكس 02-2796960 القدس ص.ب 20002

Appendix No.7 Permission of the Directorate of Education in Jerusalem District

بسم الله الرحمن الرحيم

State of Palestine
Ministry of Education & Higher Education
Directorate of Education\
Jerusalemm Suburbs – Alram
Tel (02-2348627/8) Fax (02-2344455)

دولة فلسطين
وزارة التربية والتعليم العالي
مديرية التربية والتعليم/ ضواحي القدس-الرام
تلفون (02-2348627/8) فاكس (02-2344455)

الرقم : 1/3/ ٧١٥
التاريخ :16 / 2 /2017 م
الموافق 19/ جماد الاولى/ 1438 هـ

حضرة مديرة مدرسة بنات العيزرية الثانوية المحترمة ،،

تحية طيبة وبعد،،

الموضوع: تسهيل مهمة

يرجى السماح للطالبة **رهام ناظم انداراوس هلال** باجراء دراسة بعنوان "فاعلية برنامج يستند الى الدمج بين منحى الاستقصاء المبني على أساس الحجة واستراتيجية الكتابة منأجل التعلم الصف الثامن الاساسي على مهارة التنظيم الذاتي في تعلم العلوم وعلى قدرتهم في تشكيل نماذج عقلية علمية"، واعطائها البيانات اللازمة ، علما بأنها ستلتزم بجميع الأنظمة والتعليمات والقوانين الصادرة عن وزارة التربية والتعليم العالي.

مع الاحترام ،،

أ.بسام مدحت طهبوب
مدير التربية والتعليم

التعليم العام/ أ.خ/ر.أ

Appendix No. 8

List of Validation Committee

No.	Name of juror	Place of work	Specialization	Self-regulation Questionnaire and Mental Model exam in Arabic	Self-regulation Questionnaire and Mental model exam in English
1.	**Dr. Ziad Qabaja**	Al Quds University	teaching methods	✔	
2.	**Dr. mohsen Adas**	Al Quds University	Curriculum and teaching	✔	
3.	**Dr. Inas Naser**	Al Quds University	teaching methods	✔	
4.	**Dr. Ghassan Sirhan**	Al Quds University	teaching methods	✔	
5.	**Dr. Afif Zeidan**	Al Quds University	teaching methods	✔	
6.	**Dr. Ibrahim Arman**	Al Quds University	teaching methods	✔	
7.	**Dr. Bushra Adawi**	Al Quds University	teaching methods	✔	
8.	**Dr. Kamel Hashem**	Al Quds University	teaching methods	✔	
9.	**Sister Martha**	Orthodox School of Bethany	English supervisor		✔
10.	**Sana'a Jaber**	Orthodox School of Bethany	Science supervisor	✔	
11.	**Sameera Erikat**	Orthodox School of Bethany	Arabic supervisor	✔	
12.	**Buthaina Jaffal**	Orthodox School of Bethany	Arabic supervisor	✔	