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A Learning Cycle Approach for Inquiry-Based Teaching 5E Instructional Model

ABSTRACT

The implementation of inquiry-based teaching is a major theme in national science education reform documents. Science for All Americans (Rutherford & Alhgren, 1990) and the National Science Education Standards (NRC, 1996). This research argue that inquiry needs to be a central strategy of all science curricula. Using a learning cycle approach in the classroom helps to facilitate inquiry practices because learning cycles focus on constructivist principles and emphasize the explanation and investigation of phenomena, the use of evidence to back up conclusions, and experimental design. Although there are several variations of learning cycles, the one that is highlighted in this research as a method to support inquiry-based teaching is the 5E Instructional Model (Bybee & Landes, 1990). The use of this model in several science education professional development programs is also addressed.

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مبدأ التعلم المستمر القائم على التدريس باستخدام النموذج التعليمي

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الخلاصة:

يعد تنفيذ التدريس القائم على التحقيق موضوعاً رئيسياً في وثائق إصلاح تعليم العلوم الوطنية. يعرض هذا البحث أن التحقيق يجب أن يكون استراتيجية مركزية لجميع مناهج العلوم. يساعد استخدام نهج دورة التعلم في الفصل الدراسي على تسهيل ممارسات الاستفسار لأن دورات التعلم التي تركز على المبادئ البنائية وتؤكد على تفسير الظواهر والتحقيق فيها، واستخدام الأدلة لدعم الاستنتاجات، والتصميم التجريبي. على

الرغم من وجود العديد من الاختلافات في دورات التعلم، إلا أن تلك التي تم تسليط الضوء عليها في هذا البحث تعتبر طريقة لدعم التدريس والقائم على الاستفسار والبحث. كما يتم تناول استخدام النموذج في العديد من برامج التطوير المهني لتعليم مختلف العلوم.

الكلمات المفتاحية: التعلم, المبدأ الدوري, القائم على الاستفسار, التعليم, النموذج التعليمي

Introduction:

1. Inquiry-Based Teaching

Inquiry may be referred to as a technique that encourages students to discover or construct information by themselves instead of having teachers directly reveal the information (Uno, 1999). The implementation of inquiry has had a place in science classrooms for less than a century. Before 1900, most educators viewed science as a body of facts that students were to learn through memorization and direct instruction . Students also learn to think critically using an inquiry approach. These critical thinking skills enable students to generalize what they have learned and apply it to other topics . Inquiry is an approach that enables students to discover or develop information on their own rather than having teachers give it to them directly . Inquiry-based learning has been used in English lessons for less than a century. Prior to 1900, most educators saw science as a collection of facts that students were expected to memorize and understand through direct instruction. (Uno, 1999). It emphasize the inclusion of inquiry-based lessons in the science classroom as part of the process by which new knowledge is acquired. Specifically, *The Standards* describe the inquiry process as follows:

Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. However, the shift to inquiry-based pedagogical practices in the classroom may necessitate a transition from textbook-dependency as the main resource of science information to a more hands-on approach, where students are central to the learning episodes. Recent research findings have shown that an inquiry-based approach is beneficial to students and that even young children can learn through inquiry processes. A recent publication from the National Research Council (Branford et al,1999) .

It should have to recognize the important of motivating students for learning by adopting new models and update strategies (Al Azzawi and Adnan, 2023). Illustrate a broad consensus about learning processes. Even though inquiry-based reform efforts are widespread around the country, many educators may be uncomfortable or unaware of ways to design science lessons that support inquiry learning. However, the transfer and application of inquiry-based practices in the classroom can be accomplished by using practical tools or templates for instructional design. For instance, one strategy that can be helpful to teachers, as they embark on the development of inquiry-based lessons, involves the use of a learning cycle approach (Abraham, 1997).

The history of the learning cycle method dates back to the Science Curriculum Improvement Study (SCIS), an elementary school science curriculum project during the 1950's (Atkin and Karplus, 1962).

A learning cycle model divides instruction into various phases based upon an established planning method, and is consistent with contemporary theories about how individuals learn, constructivist ideas of the nature of science, and the developmental theory of Jean Piaget (Piaget, 1970). A compelling case for implementing a learning cycle as a strategy to design inquiry-based science lessons is illustrated by Abraham (1997). This report synthesizes the findings from several research studies such as Abraham and Renner (1986), Ivins (1986), McComas III (1992), Raghbir (1979), and Renner, Abraham, and Birnie (1985) and suggests that, in comparison with traditional pedagogy, the learning cycle can result in better retention of science concepts, higher achievement in science, superior process skills, improved attitudes toward science and science learning, and improved reasoning abilities.

The use of a learning cycle approach in the classroom differs greatly from traditional teaching methodologies. For example, learning cycles focus on constructivist principles and emphasize the explanation and investigation of phenomena, the use of evidence to back up conclusions, and experimental design. In contrast, traditional pedagogical approaches stress the progression of skills and techniques, the delivery of ready-made information, and knowledge of the outcome of an investigation prior to it being conducted. Although there may be several variations of learning cycles, the one that will be highlighted here as a method to support inquiry based teaching is the 5E Instructional Model (Abraham, 1997).

1. The Constructivist Theory

Constructivism is one of the intellectual doctrines that emerged in the modern era at the hands of its first theorist, Jean Piaget, and revolutionized human and social studies, and ways of dealing with knowledge, in addition for its great influence in the field of education. Some constructivist theorists have attempted to define it as the philosophy related to the learner, which imposes the learners' need to build their own understanding on new ideas, or it is a reception process that involves learners reconstructing new meanings within the context of their immediate knowledge with their previous experience and learning environment (Bybee & Landes, 1990).

2. The Teacher's Role in Constructivist Learning

There are a few difficulties worth mentioning: the teacher's attitude toward self-conscious behavior, the unpleasant situation in an intensive learning environment, and unpleasant behavior caused by huge classrooms. The most critical issue is teachers' lack of confidence in their ability to focus on each individual. Completing the specified course contents to aid learners' intellectual development and comprehension is difficult. The traditional "Lecture-based mainly Method" focuses primarily on the teachers, while students find it ineffective. Learners try to acquire content by cramming during test times since they need to pass their papers and achieve good grades because English is a required subject. The roles of the teacher are:

- 1- Encourages and accepts learners' independence and initiative
 - 2 -Uses raw data, primary sources and tools during processing.
 - 3 Formulate tasks around terms and cognitive activities such as analysis, interpretation, prediction, and classification structure.
 - 4 allows learners' answers to guide the lesson and alter and alter teaching strategies and content.
 - 5 -Examines the extent to which learners understand the concepts.
 - 6 -He encourages learners to participate in dialogue with him and with each other.
 - 7 -It helps learners to research and investigate by asking thinking questions and open-ended questions and encouraging them to ask questions.
- (Zaytoun, 2007).

4. Traditional Methods of Science Instruction

Open the textbook, read the passage, and answer questions. This is the primary method of how traditional science instruction is delivered. The teacher is the center of the lesson. The students receive the instruction and may do some supporting activities along the way .The next stage may be to perform an investigation. The students open the lab manual, read the instructions, and perform the “experiment.” However, unless the students comes up with a hypothesis and perform an investigation that controls for variables, this is not truly an experiment. It is an activity that asks the students to make observations of some scientific experience. The traditional method of science instruction is not a bad way to teach science. The traditional method, after all, is the way many students have been learning for centuries. But research is showing that there is a more effective way to deliver lessons. In fact, when we think of the historic geniuses of science, many of them taught themselves science through this inquiry-based method, outside of the traditional classroom .In the traditional method, students are passive recipients of information delivered by their teachers. Studies show that when students are fully engaged in defining the problem and coming to a solution, their knowledge deepens. They are able to understand the many facets of the topic much more fully (Sabri, 2000) .

5.The constructivist theory's general Basis for learning

Planning by the teacher to invite students and their participation in an activity or solve a specific problem effectively. Relying on students' ideas and perceptions to find solutions to the problems they face giving the opportunity to test students' ideas even if they were wrong during the learning process. Giving the students the opportunity to work collectively in the spirit of cooperation in order to discuss what has been reached of proposals and explanations regarding the problem at hand . Preparing a set of questions that the teacher poses in order to motivate the students to search and refer to the various sources of information and try to find evidence that supports what they mention (Abdul-Fattah,2015). Giving students enough opportunity to research, think and retrieve their previous experiences and competition among themselves. Accepting all the students' opinions, even if they are wrong, bearing in mind that the teacher directs the students' ideas to the right path without notifying them that the ideas they presented are not valid. The necessity of listening to the students' predictions of the results of the problem at hand before they delve into the solution (ibid).

6.The 5E Instructional Model

The 5E Instructional Model (Bybee & Landes, 1990) can be used to design a science lesson, and is based upon cognitive psychology, constructivist-learning theory, and best practices in science teaching. The cycle appears in Figure 1 and consists of cognitive stages of learning that comprise *engage, explore, explain, elaborate, and evaluate*. Bybee (1997) declares that “using this approach, students redefine, reorganize, elaborate, and change their initial concepts through self-reflection and interaction with their peers and their environment. Learners interpret objects and phenomena, and internalize those interpretations in terms of their current conceptual understanding. Science teachers and curriculum developers may integrate or apply the model at several levels. The model can be the organizing pattern of a sequence of daily lessons, individual units, or yearly plans. Each phase of the 5E Instructional Learning Cycle, as it has been modified from Bybee, is now described:

Engagement. In this first phase of the cycle, the teacher aims to assess student prior knowledge and/or identify possible misconceptions. Bybee and Landes(1990) state that " The teacher or a curriculum task accesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities . At this stage, students' attention is attracted and invited to learn, by asking the teacher questions that include new knowledge of concepts, generalizations, skills, and issues, and encouraging them to think by involving them in solving problems and activities that motivate them, and push them to find a solution, and these problems are related to the students' activities

Exploration. Following an engagement phase that promotes a mental focus on the concept, the exploration phase now provides the students with a common, concrete learning experience. This phase is also student-centered and incorporates active exploration. Students are encouraged to apply process skills, such as observing, questioning, investigating, testing predictions, hypothesizing, and communicating, with other peers. This phase of the learning cycle tends to incorporate the main inquiry-based activity or experience, which encourages students to develop skills and concepts. The teacher's role is one of facilitator or consultant. In addition, students are encouraged to work in a cooperative

learning environment without direct instruction from the teacher. This phase is also unique because the students are given a “hands-on” experience before any formal explanation of terms, definitions, or concepts are discussed or explained by the teacher (Raghubir, 1979).

Explanation. A “minds-on” phase follows the exploration phase, and this is more teacher-directed and guided by the students’ prior experience during the exploration phase. The explanation phase enables students to describe their understanding and pose questions about the concepts they have been exploring. It is likely that new questions will be generated. The explanation phase is an essential, minds-on part of the 5Es lesson. Before the teacher attempts to provide an explanation, the students must first have the opportunity to express their own explanations and ideas. Thus, the initial part of the explanation phase is a time for the teacher to serve as a facilitator and ask the students to describe and discuss their exploration learning experiences. After the students have had the opportunity to share their own explanations, the teacher introduces scientific and technical information in a direct manner. This phase includes clarification of student misconceptions that may have emerged during the engagement or exploration phases. Formal definitions, notes, and labels are provided. The teacher may also decide to integrate video, computer software programs, or other visual aides to help with student understanding. The students should then be able to clearly explain the important concepts to the teacher and to their peers (Raghubir, 1979).

Elaboration. The activities in this phase of the learning cycle should encourage students to apply their new understanding of concepts, while reinforcing new skills. Students are encouraged to check for understanding with their peers, or to design new experiments or models based on the new skills or concepts they have acquired. The goal of this phase is to help develop deeper and broader understandings of the concepts. Students may conduct additional investigations, develop products, share information and ideas, or apply their knowledge and skills to other disciplines. This is a great opportunity to integrate science with other content areas. Elaboration activities may also integrate technology, such as web-based research or Web Quests (Atkin and Karplus, 1993).

Evaluation. Assessment in an inquiry-based setting is very different to that in traditional science lessons. Both formal and informal assessment approaches are appropriate, and should be included. For instance, the use of non-traditional

forms of assessment, such as portfolios, performance-based assessment, concept maps, physical models, or journal logs may serve as significant evidence of student learning. During an inquiry-based lesson, assessment should be viewed as an ongoing process, with teachers making observations of their students as they apply new concepts and skills and looking for evidence that the students have changed or modified their thinking. Students may also have the opportunity to conduct self-assessment or peer-assessment.

However, the evaluation may also include a summative experience such as a quiz, exam, or writing assignment. Although the 5E Model has just been explained in serial order, it is often necessary to reverse back into the cycle before again going forward. For instance, numerous explore/explain rotations may need to occur before the students are ready to transition to the elaboration phase. The teacher may move back and forth several times within the Es, or may include an additional engagement prior to starting an elaboration phase. The cycle is very flexible and dynamic. It may take many days to complete the lesson or unit. It is not necessary to complete one learning cycle each day that science is taught. The model is designed to facilitate conceptual change and contribute to more consistent and coherent science instruction (Bybee, 1997). Duran (2003) contains a lesson that engages students in inquiry following a 5E design.

7. Effectiveness of 5E Model

Using the 5E Model will help me to be sure of designing meaningful, purposeful lessons for my students each time I teach science. 5Es model is most effective when students are encountering new concepts for the very first time because there is opportunity for a complete learning cycle. According to co-creator Rodger W. Bybee, the 5Es model is best used in a unit of two to three weeks in which each phase is the basis for one or more distinct lessons. Using of 5Es Model as the basis for a single lesson decreases the effectiveness of the individual phases due to shortening the time and opportunities for challenging and restructuring of concepts and abilities for learning. The 5E planning guide enables teachers to personalize lessons according to student needs. Educators often teach chapters or units from the order that is presented in the book. However, various and flexible teaching enables children with attention problems to stay focused. The 5E Model is a tool for teachers to engage the students with topics they may not have much interest in or prior knowledge about. 5Es Model allows educators to create a unique learning experience for

students. Teachers who can incorporate instructional models like the 5Es Model into their classrooms help students build a strong foundation of knowledge through active participation. By following the 5Es it is possible to assess the students' knowledge before the exploration activity starts so that their evaluations will be appropriate for their academic ability level . 5Es planning guide enables teachers to personalize lessons according to student needs (Anil and Batdi,2015) .

5Es Model is used to notice that the students are more motivated to learn the topic after engaging them in the beginning. The extend phase allows them to relate science to other subject areas so they see the purpose of what's being taught .A prolonged engagement period draws in the students who are more reserved--or just disinterested--into sharing their ideas and opinions. (Ambo and Khamis Al Balushi ,2011) .These students are more likely to stay with the lesson once they've invested something in it. Exploring scientific applications with hands-on activities helps the students immediately realize that these topics are relevant to their lives and perhaps connected to something they have observed or have wondered about. Teachers also argue that they are more comfortable teaching science after their participation in the projects (Tinker : 2001).

8. Conclusions

A national vision of science teaching and learning is being promoted that accentuates the need to restructure science education. Several national reform documents illustrate the need to make science classrooms across the country active and inquiry based environments. With much research to support inquiry-based teaching and learning, many teachers are opting for this non-traditional teaching approach. s. The 5E Instructional Model serves as a flexible learning cycle that assists curriculum developers and classroom teachers create science lessons that illustrate constructivist, reform-based, best teaching practices.

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