A Guided Inquiry Learning Approach in a Web Environment: Theory and Application

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Abstract

The advancement of Internet technology has provided a platform for educators to introduce web-based learning as a new approach of instruction. Although thousands of web based learning environments have been developed, most of them are linear and sequential in nature. In this linear, tutorial approach, the information is presented to the learner and is followed by practices or quizzes and some form of feedback. Another alternative to this approach is inquiry learning, which may exist in several levels including open inquiry, structured inquiry, or guided inquiry. Unlike tutorial, the inquiry approach suggests information seeking from the learner by allowing exploration and concept application rather than a mere content presentation. This non-linear, discovery approach of inquiry learning will assist the learner to better comprehend the issue or topic presented.

This paper will discuss the basic learning theory underpinning the guided inquiry approach and its application in a web-based learning environment. Constructivist theory asserts that meaningful learning will only occur if the learners construct their own knowledge and understanding through active involvement, such as inquiry or discovery approach. Two relevant models of the guided inquiry approach will also be discussed, i.e., the Collins and Stevens’ Theory of Inquiry Teaching (1983) and Lawson’s Learning Cycle Model (1995). In addition, an example of the application of the guided inquiry approach in a web-based learning environment will also be discussed.

INTRODUCTION

Internet technology has become an integral part of our society. Rapid advancement of this technology has brought a huge impact to our education system. As an important component of this technology, World Wide Web (also known as the Web) provides an alternative for the teaching and learning processes. The Web is viewed as the biggest library that stores perhaps the largest collection of information in which its users can access the information at anytime, from anywhere, and at a very fast rate. Lately, with the introduction of wireless technology, this process of accessing the information from the Web has becoming much easier and faster.
Today, millions of web pages designed for several purposes are stored in computer servers around the world. Although there are so many web sites designed for instructional purposes, most of them are tutorial-based, i.e., linear, sequential, and conventional in nature. As the Web offers non-linear and interactive features of multimedia, instructional designers should take advantage of these Web capabilities when preparing instructional web-based learning (WBL) environment to promote inquiry learning.

**Inquiry Learning**

Inquiry has been defined in many different contexts, and it generally refers to the art and science of asking questions that are accessible, can be answered in part or in whole, and ones that lead to meaningful tests and explorations (Hebrank, 2004). The inquiry technique usually involves careful observation and measurement, hypothesizing and interpreting, and theorizing. It requires experimentation, reflection, and recognition of the strengths and weaknesses of its own methods. In education, while much thought and research have been spent on the role of inquiry in science education, this approach can be applied to many disciplines, including social sciences, humanities, or even arts.

Inquiry-based learning is defined as a way of acquiring knowledge through the process of inquiry. In this approach, the learners generate their own question or are posed with a question by the teacher, or by the computer. Regardless of the source of the question, this approach requires a more active role of the learners in answering the given questions or problems through discovery, investigation or experimentation.
The Inquiry based Learning is also a highly recommended approach in the Malaysian school system. This approach has been the focus of our national curricular, both at the primary and secondary school levels, and it is especially applicable in the Science Curriculum. For example, according to the Curriculum Development Centre (1993), the focuses of learning in our science education are towards inquiry approach, the development of scientific thinking and skills, research and problem solving, the application of principles of science, as well as the assimilation of scientific attitude and moral values. This statement clearly indicates the importance of our students to develop their own learning experience through inquiry and problem solving in acquiring the scientific processes. It is hoped that this exposure will assist them to better understand the world.

There are several types of inquiry-based learning approach, such as Structured Inquiry, Guided Inquiry, as well as Open Inquiry (Herron, 1971). In a Structured Inquiry (Level 1), the learners will conduct an investigation and discovery based on the questions and procedures provided by the teacher. In the Guided Inquiry approach (Level 2), although the learners will investigate based on the questions posed by the teacher, they will determine the discovery procedures. In an Open Inquiry (Level 3), the learners will investigate and explore based on the questions and procedures that they have to construct. These three levels of inquiry as suggested by Herron (1971) rely on the degree of commitment from the learners; the more commitment they put in their learning process indicate a higher level of inquiry learning.
Some prominent researchers of the Guided Inquiry Learning Approach are Schulman and Tamir (1973), as well as Collins and Stevens (1983). Schulman and Tamir (1973) view guided inquiry as a learning process in which the teacher (or WBL) provides the basic elements during the learning process, while the learners make a generalization. The teacher acts as a facilitator who poses questions to stimulate the learners to continue their discovery process. Later, Collins and Stevens (1983) have proposed the Theory of Inquiry Teaching to assist the learners develop their own theories based on the procedures that they have learned.

**Theoretical Background**

The field of instructional technology has seen some changes in its paradigm, from behaviorism to cognitivism, and now to constructivism. Constructivist proponents argue that individuals actively construct knowledge by working to solve realistic problems, usually in collaboration with others (Duffy, Lowyck & Jonassen, 1993). Constructivist theory encourages students to use active techniques such as experiments and problem solving to build more knowledge.

Besides being constructive, learning should also be reflective, collaborative, inquiry-based, and evolving (Thirteen Ed Online, 2004). In creating a new knowledge and understanding, they should be active participants by asking questions, creating hypotheses, conducting experiment, analyzing and making conclusion. They should also reflect on, and talk about their activities. In addition, they should collaborate with their peers so that they can learn from others. The main activity in a constructivist session is solving problems, and the inquiry method is the best way to achieve this goal. The inquiry approach is used to ask questions, investigate an issue or a topic, and use a variety of resources to find the solution. The learners will draw the conclusions and they usually need to revisit those conclusions as the exploration will lead to more questions.
Through these processes, they will integrate their new knowledge with the previous one, which in turn will assist them in building their current conceptions. Therefore, Constructivism is seen as the underpinning theory for the development of the Guided Inquiry Approach.

Lawson (1995) has suggested a Learning Cycle Model in a constructivist environment. In this Learning Cycle, Lawson has introduced *exploration, term introduction, and concept application* as the three core elements (Figure 1).

![Figure 1: Lawson’s Learning Cycle](image)

In a constructivist environment, the learners will begin their learning process by *exploring* a given issue, question, or problem that is related to the content. At this stage, the teacher (or the computer) will provide guidance to the learners to observe, measure, and record data or information. They are encouraged to collaborate with their peers to conduct this analysis. Then, at the next stage; *term introduction*, they will be introduced to the terms and concepts related to the topic. Here, the teacher (or the computer) will explain the concepts and terms. It is at this stage (also called guided discovery stage) that the concepts should be clarified, and any misconceptions be corrected. The third stage, the *concept application* stage, the learners will apply the concepts that they have learned to a new, different situation. These cycle will continue until the learner understands the concepts and experiences meaningful learning.
The Cognitive Theory of Inquiry Teaching (Collins & Stevens, 1983) is also relevant to the development of Guided Inquiry Learning approach. In this theory, Collins and Stevens have identified two goals: teaching learners particular rules or theories, and teaching learners how to derive rules and theories. In achieving these goals, they have suggested several instructional techniques and strategies that can be applied in an inquiry learning environment: (1) selecting positive and negative exemplars, (2) varying cases systematically, (3) selecting counterexamples, (4) generating hypothetical cases, (5) forming hypotheses, (6) testing hypotheses, (7) considering alternative predictions, (8) entrapping students, and (9) tracing consequences to a contradiction.

Although Lawson’s Learning Cycle Model as well as Collins and Stevens’ Theory of Inquiry Teaching are designed for classroom activities, both ideas are applicable for any web-based inquiry learning environment. In a WBL environment, the web interface and its interactive elements can replace the instructor’s facilitative role. While Lawson’s Learning Cycle Model can be applied to prepare the learning sequences, Collins and Stevens’ Theory can provide a guideline in planning the inquiry learning activities in a web-based environment.

**Applications of Guided Inquiry Learning Approach**

In designing and developing a web-based learning environment that utilizes a Guided Inquiry Learning (GIL) approach, the authors have adapted Lawson’s Learning Cycle Model. The steps or procedures suggested in the GIL approach is shown in Figure 2.
In this model designed for a WBL environment, the learning process begins with an introductory section. At this stage, the learning goals and objectives will be presented. Also, this section provides the overall structure of the WBL, which can be in the form of a concept map, an outline, or a hierarchy, as well as the instructions on how to use the WBL.

Then, several questions are posed to the learners. This very pertinent element of the Inquiry Approach functions to stimulate the learners’ discovery process or to allow them to reflect on the questions. If the learners are ready, they may respond to the questions, or they may want to explore the relevant information first. Also, if they fail to provide a correct response, they will be guided by the WBL. If the learners answer correctly, a concept or a rule will be presented. The correct response indicates that a new knowledge has been generated by the learners, and the presentation of the new concept or rule helps to strengthen the learners’ understanding of the new knowledge. This new concept or rule will then be used for the subsequent problems or questions. These whole activities indicate an inductive, exploratory process of the guided inquiry learning approach.

![Diagram](Figure 2: A Guided Inquiry Learning Approach (Sajap & Irfan, 2004))
As a comparison, the guided inquiry approach is different than the traditional, tutorial approach proposed by Alessi and Trollip (2001). This tutorial approach begins with an introductory section which informs the learner of the purpose and nature of the lesson. It is then followed by a cycle which begins with the presentation and elaboration of the information. A question is asked and the learner has to respond to this question. The program (a multimedia courseware or WBL) will judge the response and the learner is given a feedback to improve his comprehension. At the end of each cycle, the program will make a sequencing decision to determine what information should be treated during the next cycle. This cycle will continue until the lesson is terminated either by the learner or by the program. The tutorial approach is shown in Figure 3.

![Figure 3: The Tutorial Approach (Alessi & Trollip, 2001)](image)

Meanwhile, the Collins and Stevens Inquiry Approach can be applied as guidelines in planning the inquiry learning activities and strategies in a WBL environment. In order to assist learners’ understanding of the concept presented, the WBL should provide some positive and negative exemplars (Strategy 1). For example, in presenting the concepts of desktop publishing design, the WBL may provide some appropriate as well as inappropriate examples of choice of colors for selected designs. The WBL may also vary the given cases systematically (Strategy 2). For
instance, in teaching the concepts of primary, secondary and tertiary colors, the WBL may present the combination of different mixture of these colors. To reinforce the learners’ comprehension on the given task, the WBL may also want to use counterexamples (Strategy 3). An example would be in the teaching of complementary colors and analogous colors on color wheel.

The learners should also be given the opportunity to generate hypothetical cases (Strategy 4), form hypotheses (Strategy 5), evaluate hypotheses (Strategy 6), and consider alternative predictions (Strategy 7). For instance, the WBL may provide a situation whereby the learners have to create a logo that portrays an energetic, active feeling by using a mixture of two colors. Here, the learners have to generate several hypotheses and test those hypotheses in choosing and selecting the appropriate colors.

Another technique that an inquiry WBL may apply is entrapping the learners (Strategy 8) by getting them to reveal and correct misconceptions during their learning process (Collins & Stevens, 1983). This will lead to a deeper understanding of the concept or task presented. For instance, if the learners choose a combination of the three primary colors to paint their classroom to create a harmonious feeling, the WBL may have to correct this misconception by providing the appropriate examples. The inquiry based WBL should also be able to trace the consequences of this misconception (Strategy 9) generated by the learners, to correct this misconception as well as to prevent them from making similar mistakes in the future.
Summary

Although Guided Inquiry Learning is not a new approach in classroom instruction, it can always be applied in a web based learning environment. With the interactive nature of the Web, this method promotes discovery learning by allowing the learners to examine the questions or problems posed by the WBL. Also, with the guidance from the WBL environment, the learners should be able to develop the concept or rule, and then apply it to a new situation. The WBL should also provide several instructional strategies and techniques to assist the learners during their inquiry learning process. Through these activities, it is hoped that they understand the new knowledge, concepts or rules, as well as be able to apply it in future learning.

REFERENCES


