Introduction

During the past several years, educators have been researching how to improve teaching and learning, but there are many differences in opinion as to what changes should be made and how changes will get implemented. The trend in changing the educational experiences for students is the transformation from a teacher-centered to learner-centered approach (Jonassen & Land, 2000). The learner-centered approach provides more control of learning by the student, and the role of the teacher becomes one of a facilitator rather than the primary source of content. In the learner-centered approach, students utilize a variety of instructional resources for learning content.

Associated with the learner-centered approach is the constructivist learning theory. The constructivist theory maintains that students should learn to build their own knowledge rather than having knowledge given to them by a teacher or other outside source. This author has designed an instructional method referred to as the Probe Method in which the learner-centered and constructivist approach can be implemented at any grade level or subject area. A research study conducted by the author indicated that critical thinking skills were significantly improved when fourth and fifth grade students used the Probe Method compared to students who did not use it (Shepherd, 1998).

This article will provide a rationale for the Probe Method, instructions in implementing the Probe Method, and a specific example as to how the Probe Method can fit into the curriculum. Emphasis will be placed on using the Probe Method in the middle grades and in integrating technology.

Constructivist Learning Approach

Jonassen's (1999) theory, Constructivist Learning Environments (CLEs), states that learning occurs from ill-designed assignments and projects. Ill-designed means that some information has been omitted in the assignment or project, so the students are to complete the assignment or project by constructing knowledge. Jonassen says that his theory involves interaction between the teacher and the students that enhance opportunities for being successful in completing the assignment or project.

Jonassen (1999) further explains that the essence of meaningful learning is the ownership of the problem or learning goal by the student. There are many benefits to a constructivist approach in which students take ownership of their learning. Encouraging students to achieve results they welcome and are proud of helps foster their confidence and self-sufficiency. It further encourages emotional and intellectual discovery, which guides the learner toward lifelong learning (Brewster & Fager, 2000). A learner-centered design can improve a learner’s problem solving skills, build their self-esteem, and improve their ability to think clearly (Behrens, 2007). The learner-centered design has many benefits impacting student motivation as well. These benefits include motivating the learner to work independently, to think critically, to become self-sufficient in learning, and to become a high achiever (Brown, 2008).

Additional elements of a constructivist learning environment consist of problem-based learning (PBL) and cooperative learning. Problem-based learning provides students with opportunities to solve problems that are authentic and meaningful to them. The inclusion of problem-solving skills (i.e., reasoning, reflection, critical thinking, analysis, and synthesis) in our schools has been advocated by many researchers and educators in several subject areas (Cronin,
Cooperative learning gives students the chance to interact with peers as they solve problems and to learn and understand new content. The designer of constructivist interventions must develop an interactive learning environment, which includes simulations, collaborative activities, and problem-based learning that requires learners to work together to identify solutions to ill-defined problems (Jonassen, 1999). Similarly, Driscoll (2005) also suggests such constructivist instructional strategies as collaborative learning, goal-based scenarios, and problem-based learning.

Sims and Stork (2007) recommend that instruction be designed to allow learners to integrate their own personal and cultural characteristics into the learning experience. In their model, the designer of instruction does not make assumptions about the learner but rather asks how the learner could use course content and activities to achieve course objectives and his/her personal educational goals (Sims & Stork).

A teacher in today’s schools is torn between the suggestions of educational researchers who advocate a learner-centered, constructivist learning environment and the administration’s and public’s demands for accountability involving the covering of the curriculum and for predetermined levels of standardized test scores on specific objectives. Some teachers believe they cannot “cover” the required curriculum by using any approach but the traditional teacher-centered one. However, it is essential that teachers learn how to use learner-centered strategies as they adhere to these prescribed mandates already in place.

The Probe Method

A specific instructional model is needed for teachers to implement a constructivist approach in their classrooms. This model should contain all the basic elements of successful problem-solving promotion and self-directed learning. The Probe Method is such an instructional method in which students thoroughly investigate a topic, question, or problem. The Probe Method can be used at any grade level, with any subject matter, or in an interdisciplinary unit of study. The Probe Method can be used for any number of classes of students. Using the Internet and mobile technologies, the Probe Method can be used to connect classes from global classrooms in an effort to solve the world’s pressing problems.

The Probe Method includes the following elements:

- Thorough investigation of a topic, question, or problem
- Student-centered technique
- Integrated, interdisciplinary learning
- Problem-based learning with real-world topics and problems
- Relevant learning
- Individualized learning
- Mastery learning
- Cooperative learning
- Higher-order thinking skills
- Self-responsibility
- Self-esteem
- Like to learn and learn how to learn
- Life-long learning
- Successful learning

A unit of study might begin with a set of “regular” classroom assignments, such as readings, exercises, and written assignments in order to promote interest and motivation as well as providing a basic background of the area to be "probed." A teacher might invite a guest speaker to introduce the unit, show a video, take students on a field trip, or a number of other activities to arouse interest in the general topic. Then, a question or real-world problem is identified that is associated with the unit of study. A topic, question, or real-world problem can be either teacher-originated, or, to be truly constructivist, student-generated. A teacher can use student-generated ideas and then select the questions that best fit into the curriculum they need to address. This ensures that the required curriculum guidelines and objectives are being met. It is suggested that teachers consult their governing curriculum map or guidelines for the subject and grade level to look up the specific objectives that need to be covered in a particular unit of study. Then the teacher can write the objectives for the Probe Method unit of study to match the objectives required for the course. In this way, specific course objectives will be met in the process of implementing the Probe Method unit. An example will be provided later as to how to align state objectives with a Probe Method unit.

Further detail regarding The Probe Method is outlined below. Teachers should vary the steps and technologies used, as deemed necessary. The steps describe a unit involving a real-world problem. The same steps can be used with a
topic or question rather than an actual problem to be solved. Following the outline of the Probe Method, there will be an example of using the Probe Method in a social studies unit.

Outline of Steps in the Probe Method

I. Provide students with a set of information about the unit. Students should be given the objectives of the unit along with a list of required readings, exercises, and assignments that relate to the unit of study.

II. Identify a real-world problem that relates to the unit of study and present an introduction on issues related to the problem to the whole class. Some suggestions are:

   A. Introduce issues of the problem via short lecture presentation or online presentation.
   B. Show a video or other visuals to expand on the introduction of the problem.
   C. Have a guest lecturer or online expert to present issues. Have students discuss topic and define problem.
   D. Have students discuss topic and define problem.

III. Examine the problem as a whole class in a teacher-led discussion. Discussions can be face-to-face or electronic communications.

   A. Large group discussion
      1. Verbalize the problem.
      2. Discuss different sides of the problem.
      3. Consider the complexity of the problem.
      4. Develop a few possible solutions to the problem.
      5. Develop a plan of action to solve the problem.
         a. Decide on the types of information (areas) needed to better understand the problem.
         b. Establish small groups of students (2 to 4). If distance learning groups are involved, divide each site into small groups as well so that students work in virtual study groups.
         c. Determine what area each small group will research.

IV. Gather data and put appropriate data in a presentation format.

   A. Each group collects data on their chosen area.
      1. Use CD-ROM databases, electronic encyclopedias, atlases, and other computer software programs containing related information.
      2. Use Internet and World Wide Web to conduct searches on the topic to find a variety of sources of related information. Provide several very good sites with resources, if needed.
      3. Use conventional library skills (card catalogs, periodical guides, encyclopedias, books, magazines, films) to find other sources.
      4. Compile information individually as assigned by the small group.
   B. Small group decides what data is most relevant, weeds out some data not pertinent to the problem after discussing their "new" understanding of the given problem and how the data might help in solving the problem, and then summarizes the most important data.
C. The "key" data is entered into electronic form (using word processors, desk-top publishing, databases, spreadsheets, authoring or presentation programs, and graphic programs). Graphic programs can be used to create illustrations, maps, and graphs and then these graphics can be imported into other software programs. Some data might be put online as web pages or links to them online.

V. Small groups present data.

A. Each small group presents their data to the larger group. Information is presented in electronic format using web-authoring or presentation programs.

B. Small groups also discuss their interpretation of the problem and how the data might help in solving the problem.

VI. Large group discussion, teacher-led

A. Smaller groups and individuals verbalize their understanding of the other groups’ data and interpretations.

B. Verbalize criticisms of others’ interpretations.

C. Distance cooperative groups can discuss the issues by using Internet. Have one group at a distant site communicate to a specified group at another site about their ideas. Several classrooms could be working together on one probe method project at locations around the world to refine ideas. Wiki spaces can be set up for students to communicate, share ideas, and work. Blogs can be used for discussion of the topic with others at a distance.

VII. Simulation and/or CBI (computer-based instruction) program, if available, either software or online. This would be optional if such software was found to be appropriate.

A. Students work on a CBI program geared to their topic/problem.

B. Students work on the program in a small cooperative group.

C. Small group discusses the game and its relationship to solving the problem.

VIII. Solutions to the problem

A. Small groups discuss and brainstorm solutions to the topic/problem.

B. Small groups summarize their solutions, using electronic means. Students might create a website, if appropriate. They might also build physical models, if appropriate.

IX. Summary of solutions

A. Small groups present their solutions to the larger group. Again, they should use electronic web-authoring or presentation software.

B. Large group critically discusses others’ solutions and try to come to some agreements.

C. Individuals write a short essay in which they explain what solutions to the problem they most support and why. Individuals could choose to publish their personal thoughts on a web site as an optional activity.

X. Final assessment of unit. Assessment of the unit should come from work in the problem-solving assignments, end-of-unit tests (if any), and any other assignments associated with the unit of study. Self-assessment measures would be quite appropriate in a constructivist approach such as this one.

Example of the Probe Method
The Probe Method can be used at any grade level or subject area. This section highlights the use of the Probe Method in the middle grades and provides an example in one subject area - social studies. However, the Probe Method is a very effective interdisciplinary instructional strategy because when one solves problems and thoroughly investigates a topic, more than one subject area is usually included in the process. Teachers are encouraged to modify the steps outlined in the Probe Method to make this instructional strategy work for any specific unit. Teachers are also encouraged to collaborate with a team of teachers so more than one class of students works on a Probe Method project. In this way, a team of teachers (two to four teachers) can design an interdisciplinary unit to integrate multiple subject areas. Teachers can also team with teachers from other schools, either local or in another country, using Internet features, such as chat rooms, videoconferencing, wikis, etc. In a middle school, the language arts teacher, social studies teacher, science teacher, and math teacher can design a very substantial unit using the Probe Method and ensure each of the subjects’ objectives are met.

The Probe Method was used in a fourth and fifth grade social studies class in a study that examined critical thinking skills when using the Probe Method (Shepherd, 1998). Students who used the Probe Method significantly improved their critical thinking skills as compared to students who did not use this method. Shepherd (1998) reported the control group and the experimental groups were given a pre- and post-test called the Cornell Critical Thinking Skills Test. The mean scores of the difference between the pre- and post-test for the control group who did not use the Probe Method was not significant (p = 0.77) while the difference in the mean scores between the pre- and post-test for the experimental group who used the Probe Method was significant (p < 0.0001). Qualitative data in this study included interviews with students and teachers as well as researcher observation and notes. The qualitative data supported the hypothesis that students and teachers found the Probe Method to be an interesting and effective method by which to learn.

Some objections to a constructivist or PBL methodology have been made in which researchers feel students need more guidance than what is normally provided with such an instructional approach (Kirschner, Sweller, & Clark, 2006). Qualitative data collected during the study on the Probe Method would support that some students, particularly younger students such as the fourth and fifth graders in the study, need guidance and assistance in tackling difficult and complex problems (Shepherd, 1998). In this study, students were asked to investigate the problem of homelessness throughout the world. Six groups of students were formed and each group investigated the homeless problem in different countries. Feedback from the teacher indicated students were having trouble knowing how to get started and in finding the information they needed to thoroughly investigate this complex problem. The researcher and the teacher made adjustments during the unit of study and provided students with a sheet of guiding questions on the homeless problem and a web site with several sources of information. This additional guidance and support made a big difference for students and they later reported they very much enjoyed using the Probe Method to investigate the homeless problem but they were frustrated in the beginning. The teacher also reported that such a complex problem was too difficult for children of this age without guidance and teacher support (Shepherd, 1998).

Now, I will examine how the Probe Method could be utilized in a social studies unit. The social studies curriculum is often divided into several topics, events, or time periods. The teacher could have students thoroughly investigate any topic within the chapter or time period and/or begin the Probe Method unit with a problem found within the time period. A unit on the Great Depression utilizing the Probe Method will be used as the example. Again, each state has specific curriculum objectives for Social Studies in each grade level and teachers would need to access their respective curriculum guidelines. The author lives in Arizona so Arizona’s curriculum for seventh grade will be used in this example. Arizona’s objectives for the Great Depression period include:

**PO 1.** Identify economic policies and factors (e.g., unequal distribution of income, weaknesses in the farm sector, buying on margin, stock market crash) that led to the Great Depression.

**PO 2.** Determine the impact of natural and manmade crises (e.g., unemployment, food lines, the Dust Bowl, and the western migration of Midwest farmers) of the Great Depression. (Arizona Department of Education, Standard Based Teaching and Learning, 2005, pp 40-41.)

The teacher should conduct the Probe Method unit in a way that meets the state objectives. The teacher can provide a variety of scenarios related to the causes and results of the United States of America’s economic turmoil. An analogy could be made during the introduction of this unit to the present day recession. The initial introduction of a unit is where the teacher grabs the attention of the students and gets them hooked. This stage is vital because without student interest in a topic or problem it may become an issue during the unit. There are a number of activities a teacher could use to get students interested in a topic. A guest speaker could be invited to share some of his/her experiences and first-hand knowledge about the Great Depression period. The teacher could show a video of the period or use an overhead projector to show a PowerPoint presentation with pictures and information about this time period. Student involvement and engagement is the key to a constructivist learning environment. Students must feel they have some ownership and personal investment in the unit to be investigated.
A teacher can set parameters to ensure objectives are being met. However, a teacher giving students choices and options that fit their needs and interests will result in more motivated students, ready to get involved with the unit of study. The teacher might also want to develop a web site containing information about the Great Depression, links for students to explore, and several powerful images. The web site could be used as part of the presentation and as a resource for students to use throughout the project.

Once the teacher provides a powerful and engaging initial presentation of our present economic situation and relates it to the Great Depression period, students should be given the opportunity to explore the concepts and issues involved with a recession or depression. In this way, students begin to understand the full scope of problems caused by such economic downturns in our country. Recessions and depressions are very complicated and how to solve these economic problems have been debated by many experts, so students need time to discuss all the possible factors that might contribute to the causes of a depression. They also need to have time to discuss possible solutions to a depression. This initial discussion phase provides time for students to voice their own opinions and to seek clarification from the teacher. The teacher should guide the discussion carefully and try to get as many students as possible involved in this discussion. This discussion could be part of a brainstorming session in which the teacher writes out factors related to the Great Depression on the blackboard, Smartboard, or software program, such as Kidspiration or Inspiration. The factors could be written in bubbles connected together to illustrate related factors. Technologies, such as a Smartboard or Inspiration, have the advantage of a save feature allowing teacher to print them out for students to refer to at a later date.

Next, the teacher should divide students into small groups and they will begin to develop a strategy for working together. The teacher will need to assign specific areas for each group to explore. The large group discussion should have produced a list of several major factors that impact the economy, so each group could concentrate on one of these factors. Students decide what they need to learn about this factor and how they will learn about it. For instance, one factor to be explored might be unemployment, so one group would be assigned this problem. They would decide who will do what and how they will proceed. The teacher should assist each group in this decision making process in order to prevent students from getting stuck and frustrated. Resources, both traditional and web-based, should be provided by the teacher. The media center specialist for the school can help supply those resources and they are invaluable when implementing the Probe Method. Appropriate resources for finding information on factors are essential for the constructivist approach. Students can do searches and find their own resources, but the media specialist can provide direction and guidance as to where to start looking. The technology teacher or regular classroom teacher could develop a web site for the Great Depression, as discussed earlier, and provide many resources for students to use. Additional resources could be added to the web site as they are found throughout the project. Students might find web sites to add to the classroom web site for others to use and to use the following year. Students should not be left alone to find information as they might get frustrated and give up, or they might not find the quality and full scope of information they need to understand the problem as they should.

While each member of the group is gathering information, they should document what is discovered. Word processing would be one of the better ways for students to document their notes. In this way, students will have a reason to use word processing and in turn will develop word processing skills in an authentic manner. Students can be shown how convenient word processing is to save and to edit their work. Students need help from the teacher in deciding what information is important in order to summarize the most relevant information and not just write down everything they find on the topic, such as unemployment.

If students write notes and summaries in a word processing program they can go through all their data and decide what information should be included in their group report and how the report will be presented when they return to the group. For instance, the group could do a PowerPoint presentation or create their own web pages about unemployment, which means they need to reduce all their information into clear and precise summaries. They should be encouraged to include several images in their presentation and not just bulleted text. Images can speak louder than words and powerful images can portray a message that words cannot express.

Small groups will present their findings to the larger group. Once all the presentations are given, the teacher should lead a whole class discussion to help them sort out what all the presentations mean to the main problem being explored, causes, and implications of a depression. Students need help in putting all these ideas together to understand how they are all related to the problem. The teacher could introduce a video, a simulation or software program, web-based material, or other appropriate media that would relate to the topic of the depression. After the large group work, then students should go back to the small groups.

Back in the small groups, students are to discuss possible solutions to a recession/depression. Students should decide how they think a recession or depression could be avoided. What can the government do? What can citizens do? What can corporations do? The teacher should assist as needed so students stay on task and come to a consensus to
solving the problem. Small groups compile their ideas and present their suggestions to the whole class. Students will learn from other groups as well as from their own efforts. The teacher should follow up small group presentations with a whole class discussion that helps students to review all the various ideas in solving the problem and to critically analyze the validity of the proposed solutions. The teacher can also relate their solutions to the actions taken by our government under President Roosevelt. Why some of these measures worked and why some of these measures did not work could be explored. If the teacher has created a classroom web site on the Great Depression, the students' solutions could be uploaded onto the site so there is a record of their work for others to see. Students could also assist in making the site even more appealing by adding images, graphs, and links to other related material. Parents would probably be very pleased to go to a web site that provides evidence of their children’s efforts in school.

The teacher can decide how best to evaluate individuals throughout this learning experience. Students could be asked to individually write a two page reflection on what they learned, what they contributed, and which solution seems to them to be most successful. The teacher could also give a test with open ended questions that require individual assessment. Individual accountability of understanding the major concepts of the Great Depression can be determined by the teacher in the way that seems most fitting.

The above example of using the Probe Method in a unit on the Great Depression in a social studies class provides the teacher with a more thorough explanation of how the Probe Method can be implemented into a regular middle grades classroom. This example can also be used by teachers in language arts, science, math, or any subject area. Some disciplines, such as language arts and math, find the Probe Method more difficult to use. In some instances, it takes creativity and collaboration to see how select subject matter and objectives for a course can be divided into topics that can be thoroughly investigated using the Probe Method. The Probe Method can be adapted for any topic, question, or problem.

An interdisciplinary unit is one way to integrate multiple content areas into a single Probe Method unit. Taking the previous example on the Great Depression, the language arts teacher could add literature from that time period or other writings about the economy and unemployment. This would substantially improve the unit and introduce richer ideas to help students more thoroughly investigate and understand the complex problem. In addition, the science teacher could introduce environmental factors that might impact the economy, employment, or the government’s budget and the math teacher could assist students in understanding statistics, percentages, and other mathematical data. Students could incorporate creating their own graphs and statistical charts to enhance their presentations. The math teacher could partner with the social studies teacher in helping students understand economic data, budgets, and inflation. This type of collaboration can be done on most any topic, question, or problem allowing students to become more fully engaged in thoroughly understanding complex problems. Complex problems and issues require more than a single viewpoint. Teachers can map course required objectives to ensure these objectives are being met during a Probe Method unit of study.

Many technology-related skills can be seamlessly incorporated into a Probe Method unit. Students would not have to learn technology skills in a regular technology class but they could learn these skills as part of their regular classroom learning. The technology teacher/coordinator could work with the classroom teacher much the same way as the media specialist does. They can provide ongoing training and assistance in a just-in-time learning manner, helping students use the technology when it is needed. They can also assist the teacher and students to develop a web site showcasing their work. Students can begin to see technology as an integral part of our lives and not just an entertainment vehicle. Technology has a seamless integration with the Probe Method.

Conclusion

In the 21st century, the expectations for educators are that they provide students with skills that include independent thinking, higher level thinking skills, and abilities to cooperate and communicate with others. Reigeluth (1999) suggests that corporations are organizing their employees into teams that are given considerable autonomy to manage themselves within the corporate vision, rather than being directed from above. Reigeluth suggests a paradigm of instruction that has to change from standardization to customization. The paradigm requires the definition of instruction include construction. Construction is a process of helping learners to build their own knowledge, as opposed to a process in which information is merely conveyed to the learner.

The adult learner of today must be able to learn independently and to work in teams with peers. So the education in the K-12 setting must begin to promote the skills needed by the 21st century adult in the community and in the workforce. As educators, we have to ensure our teaching strategies promote these 21st century skills. Learner-centered, constructivist instructional strategies, such as the Probe Method, are important to move education forward so all students are given opportunities to develop the skills they will need as successful adults. The Probe Method is an instructional strategy adaptable to any grade level or any subject area in order to provide learners with the opportunities to learn and to develop these 21st century skills.
References


Glenn Shepherd is a graduate of N.C. State University where he earned his Ed.D. in Curriculum & Instruction with a concentration in Instructional Technology in 1998. He designed and implemented a constructivist, problem-based learning strategy that he called the Probe Method. Results of his research indicated that use of the Probe Method significantly improve critical thinking skills. He has also taught several years at the middle grades level and used the Probe Method in his own teaching. During the last four years, he has been teaching online graduate level courses with the University of Maryland University College (UMUC), Walden University, and Capella University. He teaches courses in educational technology and mentors several students as chair of their dissertation committees. He has over 25 years experience in the teacher/training field. His experience includes teaching at the middle grades level, teaching at the university level, and instructional design with business and government agencies.

Email: gandsaz@yahoo.com