EDUCATIONAL PSYCHOLOGY

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Session 8

Discovery learning

Discovery learning is a technique of inquiry-based instruction and is considered a constructivist based approach to education. It is supported by the work of learning theorists and psychologists Jean Piaget, Jerome Bruner, and Seymour Papert. Although this form of instruction has great popularity, there is some debate in the literature concerning its efficacy (Mayer, 2004).

Jerome Bruner is often credited with originating discovery learning in the 1960s, but his ideas are very similar to those of earlier writers (e.g. John Dewey). Bruner argues that "Practice in discovering for oneself teaches one to acquire information in a way that makes that information more readily viable in problem solving" (Bruner, 1961, p. 26). This philosophy later became the discovery learning movement of the 1960s. The mantra of this philosophical movement suggests that we should 'learn by doing'. In 1991, The Grauer School, a private secondary school in Encinitas, California, was founded with the motto, "Learn by Discovery", and integrated a series of world-wide expeditions into their program for high school graduation. (See Expeditionary Learning.)

The label of discovery learning can cover a variety of instructional techniques. According to a meta-analytic review conducted by Alfieri, Brooks, Aldrich, and Tenenbaum (2011), a discovery learning task can range from implicit pattern detection, to the elicitation of explanations and working through manuals to conducting simulations. Discovery learning can occur whenever the student is not provided with an exact answer but rather the materials in order to find the answer themselves.

Discovery learning takes place in problem solving situations where the learner draws on his own experience and prior knowledge and is a method of instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments.

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Discovery learning in special needs education

With the push for special needs students to take part in the general education curriculum, prominent researchers in this field doubt if general education classes rooted in discovery based learning can provide an adequate learning environment for special needs students. Kauffman has related his concerns over the use of discovery based learning as opposed to direct instruction. Kauffman comments, to be highly successful in learning the facts and skills they need, these facts and skills are taught directly rather than indirectly. That is the teacher is in control of instruction, not the student, and information is given to students (2002).

This view is exceptionally strong when focusing on students with math disabilities and math instruction. Fuchs *et al.* (2008) comment,

Typically developing students profit from the general education mathematics program, which relies, at least in part, on a constructivist, inductive instructional style. Students who accrue serious mathematics deficits, however, fail to profit from those programs in a way that produces understanding of the structure, meaning, and operational requirements of mathematics… Effective intervention for students with a math disability requires an explicit, didactic form of instruction…

Fuchs *et al.* go on to note that explicit or direct instruction should be followed up with instruction that anticipates misunderstanding and counters it with precise explanations.

However, few studies focus on the long-term results for direct instruction. Long-term studies may find that direct instruction is not superior to other instructional methods. For instance, a study found that in a group of fourth graders that were instructed for 10 weeks and measured for 17 weeks direct instruction did not lead to any stronger results in the long term than did practice alone (Dean & Kuhn, 2006). Other researchers note that there is promising work being done in the field to incorporate constructivism and cooperative grouping so that curriculum and pedagogy can meet the needs of diverse learners in an inclusion setting (Brantlinger, 1997).

However, it is questionable how successful these developed strategies are for student outcomes both initially and in the long term.

Criticism of pure discovery learning

A debate in the instructional community now questions the effectiveness of this model of instruction (Kirschner, Sweller, & Clark, 2006). The debate dates back to the 1950s when researchers first began to compare the results of discovery learning to other forms of instruction (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011).

In support of the fundamental concept of discovery learning, Bruner (1961) suggested that students are more likely to remember concepts if they discover them on their own as opposed to those that are taught directly. This is the basis of discovery learning.

In pure discovery learning, the learner is required to discover new content through conducting investigations or carrying out procedures while receiving little, if any, assistance. "For example, a science teacher might provide students with a brief demonstration of how perceptions of color change depending on the intensity of the light source and then ask them to design their own experiment to further examine this relationship" (Marzano, 2011, p. 86). In this example the student is left to discover the content on his/her own. Because students are left to self-discovery of topics, researchers worry that learning taking place may have errors, misconceptions or be confusing or frustrating to the learner (Alfieri et al., 2011).

While his article is cited as the fundamental framework for discovery learning, Bruner also cautioned that such discovery could not be made prior to or without at least some base of knowledge in the topic (Alfieri et al., 2011). Today's research, like that of Kirschner, Sweller, and Clark (2006) reports that there is little empirical evidence to support pure discovery learning. Specifically, Kirschner et al. suggest that fifty years of empirical data do not support those using these unguided methods of instruction. The meta-analyses conducted by Alfieri and colleagues reconfirmed such warnings.

Mayer (2004) argues that unassisted discovery learning tasks do not help learners discover problem-solving rules, conservation strategies, or programming concepts. He does acknowledge, however that while under some circumstances constructivist-based approaches may be beneficial, pure discovery learning lacks structure in nature and hence will not be beneficial for the learner.

Mayer also points out that interest in discovery learning has waxed and waned since the 1960s. He argues that in each case the empirical literature has shown that the use of pure discovery methods is not suggested, yet time and time again researchers have renamed their instructional methods only to be discredited again, to rename their movement again.

Additionally, several groups of educators have found evidence that pure discovery learning is less effective as an instructional strategy for novices, than more direct forms of instruction (e.g. Tuovinen & Sweller, 1999). Mayer asked the question "Should There Be a Three-Strikes Rule

Against Pure Discovery Learning?" While discovery for oneself may be an engaging form of learning, it may also be frustrating.

The main idea behind these critiques is that learners need guidance (Kirschner et al., 2006), but later as they gain confidence and become competent then they may learn through discovery.

The effects of Discovery Learning on the Cognitive Load

Research has been conducted over years (Mayer, 2001; Paas, Renkl, & Sweller, 1999, 2004; Winn, 2003) to prove the unfavorable effects of Discovery Learning, specifically with beginning learners. "Cognitive load theory suggests that the free exploration of a highly complex environment may generate a heavy working memory load that is detrimental to learning" (Kirschner, Sweller, Clark, 2006). Beginning learners do not have the necessary skills to integrate the new information with information they have learned in the past. Sweller reported that a better alternative to Discovery Learning was Guided Instruction. Guided Instruction produced more immediate recall of facts than unguided approaches along with longer term transfer and problem-solving skills (Kirschner, Sweller, Clark, 2006).

Enhanced Discovery Learning

Robert J. Marzano (2011) describes enhanced discovery learning as a process that involves preparing the learner for the discovery learning task by providing the necessary knowledge needed to successfully complete said task. In this approach, the teacher not only provides the necessary knowledge required to complete the task, but also provides assistance during the task. This preparation of the learner and assistance may require some direct instruction. "For example, before asking students to consider how best to stretch the hamstring muscle in cold weather, the teacher might present a series of lessons that clarify basic facts about muscles and their reaction to changes in temperature" (Marzano, 2011, p. 87).

Another aspect of enhanced discovery learning is allowing the learner to generate ideas about a topic along the way and then having students explain their thinking (Marzano, 2011). A teacher who asks the students to generate their own strategy for solving a problem may be provided with examples in how to solve similar problems ahead of the discovery learning task. "A student might come up to the front of the room to work through the first problem, sharing his or her thinking out loud. The teacher might question students and help them formulate their thinking into general guidelines for estimation, such as "start by estimating the sum of the highest place-value numbers." As others come to the front of the room to work their way through problems out loud, students can generate and test more rules" (Marzano, 2011, p. 87).

Experiential learning is the process of making meaning from direct experience, i.e., "learning from experience".[1]

The experience can be staged or left open. Aristotle once said, "For the things we have to learn before we can do them, we learn by doing them".[2] David A. Kolb helped to popularize the idea of experiential learning drawing heavily on the work of John Dewey, Kurt Lewin, and Jean

Piaget. His work on experiential learning has contributed greatly to expanding the philosophy of experiential education.

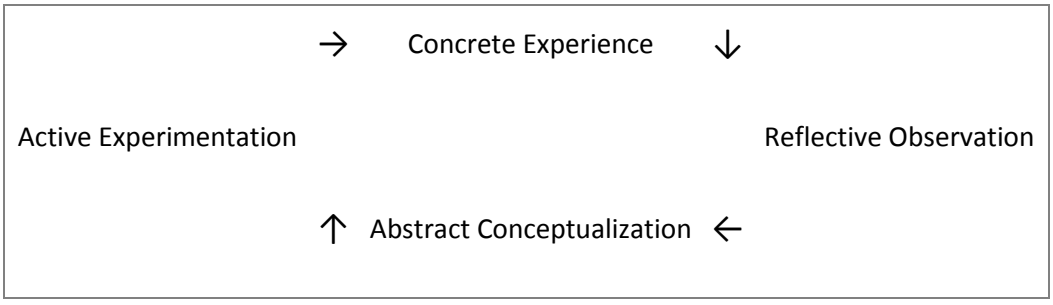
Overview[

Experiential learning is learning through reflection on doing, which is often contrasted[by whom?] with rote or didactic learning. Experiential learning is related to, but not synonymous with, experiential education, action learning, adventure learning, free choice learning, cooperative learning, and service learning. While there are relationships and connections between all these theories of education, importantly they are also separate terms with separate meanings.[1]

Experiential learning focuses on the learning process for the individual. It is often used synonymously with the phrase "experiential education", however, while experiential learning considers the individual learning process, experiential education should be considered a broader philosophy of education.[citation needed] As such, it is concerned with issues such as the relationship of teacher and student, as well as broader issues of educational structure and objectives.[1] An example of experiential learning is going to the zoo and learning through observation and interaction with the zoo environment, as opposed to reading about animals from a book. Thus, one makes discoveries and experiments with knowledge firsthand, instead of hearing or reading about others' experiences. In business school, internship, and job-shadowing, opportunities in a student's field of interest are elevated[by whom?] as examples of valuable experiential learning which contribute significantly to the student's overall understanding of the real-time environment.[3]

A third example of experiential learning involves learning how to ride a bike,[4] a process which can illustrate the widely known four-step experiential learning model (ELM) as purported by Kolb[5] and outlined in Figure 1 below. Following this example, in the "concrete experience" stage, the learner physically experiences the bike in the "here-and-now".[6] This experience forms "the basis for observation and reflection" and the learner has the opportunity to consider what is working or failing (reflective observation), and to think about ways to improve on the next attempt made at riding (abstract conceptualization). Every new attempt to ride is informed by a cyclical pattern of previous experience, thought and reflection (active experimentation).[6]

Figure 1 – David Kolb's Experiential Learning Model (ELM) [7]



Experiential learning can exist without a teacher and relates solely to the meaning-making process of the individual's direct experience. However, though the gaining of knowledge is an inherent process that occurs naturally, for a genuine learning experience to occur, there must

exist certain elements.[1] According to David A. Kolb, an American educational theorist, knowledge is continuously gained through both personal and environmental experiences.[8] Kolb states that in order to gain genuine knowledge from an experience, certain abilities are required:

- The learner must be willing to be actively involved in the experience;
- The learner must be able to reflect on the experience;
- The learner must possess and use analytical skills to conceptualize the experience; and
- The learner must possess decision making and problem solving skills in order to use the new ideas gained from the experience.

Implementation

Experiential activities are among the most powerful teaching and learning tools available.[9] Experiential learning requires self-initiative, an "intention to learn" and an "active phase of learning".[10] Kolb's cycle of experiential learning can be used as a framework for considering the different stages involved.[11] Jennifer A. Moon has elaborated on this cycle to argue that experiential learning is most effective when it involves: 1) a "reflective learning phase" 2) a phase of learning resulting from the actions inherent to experiential learning, and 3) "a further phase of learning from feedback".[10] This process of learning can result in "changes in judgment, feeling or skills" for the individual[12] and can provide direction for the "making of judgments as a guide to choice and action".[13]

Most educators understand the important role experience plays in the learning process. The role of emotion and feelings in learning from experience has been recognised as an important part of experiential learning.[10] While those factors may improve the likelihood of experiential learning occurring, it can occur without them. Rather, what is vital in experiential learning is that the individual is encouraged to directly involve themselves in the experience, and then to reflect on their experiences using analytic skills, in order that they gain a better understanding of the new knowledge and retain the information for a longer time.

Reflection is a crucial part of the experiential learning process, and like experiential learning itself, it can be facilitated or independent. Dewey wrote that "successive portions of reflective thought grow out of one another and support one another", creating a scaffold for further learning, and allowing for further experiences and reflection.[14] This reinforces the fact that experiential learning and reflective learning are iterative processes, and the learning builds and develops with further reflection and experience. Facilitation of experiential learning and reflection is challenging, but "a skilled facilitator, asking the right questions and guiding reflective conversation before, during, and after an experience, can help open a gateway to powerful new thinking and learning".[15] Jacobson and Ruddy, building on Kolb's four-stage Experiential Learning Model[6] and Pfeiffer and Jones's five stage Experiential Learning Cycle,[16] took these theoretical frameworks and created a simple, practical questioning model for facilitators to use in promoting critical reflection in experiential learning. Their "5 Questions" model is as follows:[15]

- Did you notice...?
- Why did that happen?

- Does that happen in life?
- Why does that happen?
- How can you use that?

These questions are posed by the facilitator after an experience, and gradually lead the group towards a critical reflection on their experience, and an understanding of how they can apply the learning to their own life.[15] Although the questions are simple, they allow a relatively inexperienced facilitator to apply the theories of Kolb, Pfeiffer, and Jones, and deepen the learning of the group.

While it is the learner's experience that is most important to the learning process, it is also important not to forget the wealth of experience a good facilitator also brings to the situation. However, while a "facilitator", traditionally called a "teacher", may improve the likelihood of experiential learning occurring, a "facilitator" is not essential to experiential learning. Rather, the mechanism of experiential learning is the learner's reflection on experiences using analytic skills. This can occur without the presence of a facilitator, meaning that experiential learning is not defined by the presence of a facilitator. Yet, by considering experiential learning in developing course or program content, it provides an opportunity to develop a framework for adapting varying teaching/learning techniques into the classroom.[17]

Experiential learning in schools

- Think Global School is a four-year traveling high school that holds classes in a new country each term. Students engage in experiential learning through activities such as workshops, cultural exchanges, museum tours, and nature expeditions.
- The Dawson School in Boulder, Colorado, devotes two weeks of each school year to experiential learning, with students visiting surrounding states to engage in community service, visit museums and scientific institutions, and engage in activities such as mountain biking, backpacking, and canoeing.

Experiential learning in business education

As higher education continues to adapt to new expectations from students, experiential learning in business and accounting programs has become more important. For example, Clark & White (2010) point out that "a quality university business education program must include an experiential learning component".[18] With reference to this study, employers note that graduating students need to build skills in “professionalism” – which can be taught via experiential learning. Students also value this learning as much as industry.

Learning styles also impact business education in the classroom. Kolb transposes four learning styles, *Diverger*, *Assimilator*, *Accommodator* and *Converger*, atop the Experiential Learning Model, using the four experiential learning stages to carve out "four quadrants", one for each learning style. An individual’s dominant learning style can be identified by taking Kolb’s Learning Style Inventory (LSI). Robert Loo (2002) undertook a meta-analysis of 8 studies which revealed that Kolb’s learning styles were not equally distributed among business majors in the sample.[19] More specifically, results indicated that there appears to be a high proportion of

assimilators and a lower proportion of accommodators than expected for business majors. Not surprisingly, within the accounting sub-sample there was a higher proportion of convergers and a lower proportion of accommodators. Similarly, in the finance sub-sample, a higher proportion of assimilators and lower proportion of divergers was apparent. Within the marketing sub-sample there was an equal distribution of styles. This would provide some evidence to suggest that while it is useful for educators to be aware of common learning styles within business and accounting programs, they should be encouraging students to use all four learning styles appropriately and students should use a wide range of learning methods.[19]

Professional education applications, also known as management training or organizational development, apply experiential learning techniques in training employees at all levels within the business and professional environment. Interactive, role-play based customer service training is often used in large retail chains. [20]Training board games simulating business and professional situations such as the Beer Distribution Game used to teach supply chain management, and the Friday Night at the ER game used to teach systems thinking, are used in business training efforts.[21]

Comparisons

Experiential learning is most easily compared with academic learning, the process of acquiring information through the study of a subject without the necessity for direct experience. While the dimensions of experiential learning are analysis, initiative, and immersion, the dimensions of academic learning are constructive learning and reproductive learning.[22] Though both methods aim at instilling new knowledge in the learner, academic learning does so through more abstract, classroom-based techniques, whereas experiential learning actively involves the learner in a concrete experience.