

## Chapter 1 : Constructivist Science | FabLearn Fellows

*Constructivist teaching in science "The most conspicuous psychological influence on curriculum thinking in science since has been the constructivist view of learning." (Fensham, , p) Tobin () remarked that as "constructivism has become increasingly popular in the past ten years. it represents a paradigm change in science.*

Many educators may or may not be familiar with the term "constructivism," but probably recognize it as something to do with learning. The main tenet of constructivist learning is that people construct their own understanding of the world, and in turn their own knowledge. However, any theory of learning has ramifications beyond the scope of learning itself. Simply put, subscribing to a constructivist view of learning affects teaching, classroom practices, and student classroom behavior. Von Glaserfeld calls constructivism a theory of knowing, as opposed to a theory of knowledge. From his view it is easy to see how constructivism can be thought of as a perspective or a lens with which to understand or know the world; meaning that reality, knowledge, and learning are considered to be constructed by individuals See von Glaserfeld, for more philosophical issues regarding constructivism. So what does this mean for educational settings like the typical classroom? It seems as though a belief in a constructivist approach to knowledge or learning is contrary to the fields of mathematics and science, where knowledge is viewed as true facts, principles, theorems, and laws. In literature, however, it makes sense that the reader constructs her own meaning of the works of William Shakespeare or Maya Angelou because she is interpreting the writings and intentions of the authors. There is a danger in trying to apply that logic with mathematics and science because constructivism is not questioning the interpretation of simple arithmetic or the notion of gravity; rather it is saying that each person comes to construct their own conclusions and conceptions. These individually constructed conceptions are personally valued whether they are consistent with what the field deems acceptable or not. A belief that the world is flat is just one particular view. It was once accepted by society, but now is not. Bodies of knowledge including mathematics and science change, and what is claimed to be known in the fields is either a logical derivation from the available conventions, or "the best way of conceiving the situation because, at the moment, it is the most effective way of dealing with it" von Glaserfeld, , p. In fact, some constructivists do not acknowledge that there is a single truth to be known. Instead what is traditionally "true" can be thought of as what is viable von Glaserfeld, Good, Wandersee, and St. Julien offer 15 different adjectives to place in front of constructivism to clarify its meaning: While many of these terms relate to overlapping concepts and assumptions, others have distinctions worth mentioning. All forms of constructivism incorporate the notion of individually constructed knowledge. Weak constructivism, as Paul Ernest describes it, assumes that individuals construct their own knowledge a local notion , while accepting the existence of objective knowledge a global notion. Radical constructivism additionally assumes that individual knowledge is in a state of flux, or constant reevaluation by adapting and evolving. In this view, the mind is characterized as problematizing knowledge. Finally, social constructivism is based on the assumption that individual knowledge and social knowledge are one in the same. That is to say that the knowledge an individual constructs is that which he or she constructs with society. This evokes a "shared" metaphor of knowledge, and the "social construction of meaning" Ernest, , p. There are some commonalities, however. According to Paul Ernest the forms of constructivism identified above all lead to the following pedagogical implications: Using cognitive conflict techniques to remedy misconceptions. Engaging in practices like this allow students to trouble their own thinking, and it is through this conflict that they will develop their own meanings, or at least seek to rectify the conflict. Attention to metacognition and strategic self-regulation. This follows from the previous suggestion when students think about their thinking, and become responsible for their learning. Use of multiple representations. Awareness of the importance of goals for the learner. This awareness of goals refers to the difference between teacher and learner goals, and the need for learners to understand and value the intended goals. Awareness of the importance of social contexts. Various types of knowledge occur in various social settings for instance informal street knowledge versus formal school knowledge. The first principle is posing problems of emerging relevance to students. The relevant questions posed to the students

will force them to ponder and question their thoughts and conceptions. Another guiding principle is structuring learning around primary concepts. This refers to building lessons around main ideas or concepts, instead of exposing students to segmented and disjoint topics that may or may not relate to each other. To accomplish this, however, the teacher must be willing to listen to students, and to provide opportunities for this to occur. The final principle is assessing student learning in the context of teaching. Authentic assessment is best achieved through teaching; interactions between both teacher and student, and student and student; and observing students in meaningful tasks. Brooks and Brooks offered these guiding principles to serve as over-arching themes for educational settings that are consistent with constructivist learning. They also identify 12 practices that distinguish constructivist teachers. These practices apply to any subject or academic setting. Encourage and accept student autonomy and initiative. Use raw data and primary sources, along with manipulative, interactive, and physical materials. Use cognitive terminology such "classify," "analyze," "predict," and "create" when framing tasks. Allow student responses to drive lessons, shift instructional strategies, and alter content. Encourage students to engage in dialogue, both with the teacher and with one another. Encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other. Engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion. Allow significant wait time after posing questions. Provide time for students to construct relationships and create metaphors. Teachers who embrace the constructivist view of learning are encouraged to compare their classroom practices with those listed above, for they are the indicators that practice matches theory. To most effectively find relevant items in the ERIC database, it is recommended that standard indexing terms, called ERIC Descriptors, be used whenever possible to search the database. The term constructivism is an ERIC descriptors, so this term could be combined with other Descriptors, such as science education or mathematics education, in constructing an ERIC search. Such a general search would yield over items. Constructivism in the Classroom The Math Forum [http:](http://)

## Chapter 2 : Constructivism (philosophy of education) - Wikipedia

*Constructivism has been considered as a dominant paradigm, or research programme, in the field of science blog.quintoapp.com term constructivism is widely used in many fields, and not always with quite the same intention.*

The constructivist view of learning argues that students do not come to the science classroom empty-headed but arrive with lots of strongly formed ideas about how the natural world works. In the view of constructivists, pupils should no longer be passive recipients of knowledge supplied by teachers and teachers should no longer be purveyors of knowledge and classroom managers Fosnot, From this perspective, learning is a process of acquiring new knowledge, which is active and complex. It is also an active interaction between teachers and learners, and learners try to make sense of what is taught by trying to fit these with their own experience. Constructivist views also emphasize generative learning, questioning or inquiry strategies Slavin, Wildy and Wallace believed that good science teachers are those who teach for deep understanding: The classrooms of such teachers are learner-centered places where group discussion, exploration and problem solving are common place. The following are practices derived from cognitive psychology that can help students understand, recall and apply essential information, concepts and skills. Important concepts from this perspective are Slavin, , p. To achieve this, teachers should have a clear idea of what students have already known and understood so that they can engage students in activities that help them construct new meanings von Glaserfeld, Moreover, the opportunities for pupils to talk about their ideas concerning particular concepts or issues are prominent in the learning process. Teachers who employ constructivist teaching try to help pupils to learn meaningfully. They should encourage pupils to accept the invitation to learn and to take action on what they have learnt, and to provide pupils with opportunities to explore, discover and create, as well as to propose explanations and solutions. The collaborative effort among researchers and teachers on constructivist teaching is to encourage teaching which takes account of the prior ideas and understanding of children in the development of specific concepts in science, and to stress the need to provide prospective science teachers with a model for constructivist learning situations. Pupils are exposed to scientific concepts at a much earlier stage in their education; and, acknowledge the diversity of learners. Current teaching of science Glynn, Yeany and Britton stated that school science curricula are commonly placed on a continuum from "textbook-centered" to "teacher-centered" and that the textbook is the vehicle that drives the teaching. The textbook is usually accompanied by a large bulk of resource materials, such as additional information, overhead transparencies, wall charts, cassette tapes, teaching kits, worksheets, exercises, suggested activities and experiments, and the activity cards. The problem of the heavy reliance on textbooks during science lessons was addressed in the American Association for the Advancement of Science Report , noting that the present science textbooks and methods of instruction emphasized the learning of answers more than the exploration of questions, memory at the expense of critical thoughts, bits and pieces of information instead of understanding in context, recitation over argument, reading in lieu of doing. Morris in discussing the pedagogy in classrooms claimed that the major resource used by teachers and pupils in Hong Kong is the textbook. It often provides the content of the lesson and many of its learning activities. Further to this, in examining the nature of the more pupil-centered tasks used in the classrooms, such as group work, problem solving and discovery learning, Morris found that these tasks are often characterized by a high degree of teacher control and a low level of pupil involvement. Volume 3, Issue 1, Article 1 June,

**Chapter 3 : Constructivist Views of Learning in Science and Mathematics. ERIC Digest.**

*Constructivism is a theory in education that holds a few central ideas about learning. In "Science Education: An International Course Companion" by Keith Taber and Ben Akpan, the big ideas in constructivism are laid out as follows, 1 .*

Individual[ edit ] The formalization of constructivism from a within-the-human perspective is generally attributed to Jean Piaget, who articulated mechanisms by which information from the environment and ideas from the individual interact and result in internalized structures developed by learners. He identified processes of assimilation and accommodation that are key in this interaction as individuals construct new knowledge from their experiences. When individuals assimilate new information, they incorporate it into an already existing framework without changing that framework. Accommodation can be understood as the mechanism by which failure leads to learning: It is important to note that constructivism is not a particular pedagogy. In fact, constructivism is a theory describing how learning happens, regardless of whether learners are using their experiences to understand a lecture or following the instructions for building a model airplane. In both cases, the theory of constructivism suggests that learners construct knowledge out of their experiences. However, constructivism is often associated with pedagogic approaches that promote active learning , or learning by doing. There are many critics of "learning by doing" a. Without the social interaction with other more knowledgeable people, it is impossible to acquire social meaning of important symbol systems and learn how to utilize them. Young children develop their thinking abilities by interacting with other children, adults and the physical world. From the social constructivist viewpoint, it is thus important to take into account the background and culture of the learner throughout the learning process, as this background also helps to shape the knowledge and truth that the learner creates, discovers and attains in the learning process. Social constructivism thus emphasizes the importance of the learner being actively involved in the learning process, unlike previous educational viewpoints where the responsibility rested with the instructor to teach and where the learner played a passive, receptive role. Von Glasersfeld emphasized that learners construct their own understanding and that they do not simply mirror and reflect what they read. Learners look for meaning and will try to find regularity and order in the events of the world even in the absence of full or complete information. This is also named after the Harkness table and involves students seated in a circle, motivating and controlling their own discussion. The teacher acts as little as possible. The students get it rolling, direct it, and focus it. They act as a team, cooperatively, to make it work. They all participate, but not in a competitive way. Rather, they all share in the responsibility and the goals, much as any members share in any team sport. Discussion skills are important. Everyone must be aware of how to get this discussion rolling and keep it rolling and interesting. Just as in any sport, a number of skills are necessary to work on and use at appropriate times. Everyone is expected to contribute by using these skills. The motivation for learning[ edit ] Another crucial assumption regarding the nature of the learner concerns the level and source of motivation for learning. By experiencing the successful completion of challenging tasks, learners gain confidence and motivation to embark on more complex challenges. In the former scenario the learner plays a passive role and in the latter scenario the learner plays an active role in the learning process. The emphasis thus turns away from the instructor and the content, and towards the learner. The critical goal is to support the learner in becoming an effective thinker. This can be achieved by assuming multiple roles, such as consultant and coach. A few strategies for cooperative learning include Reciprocal Questioning: Kukla argues that reality is constructed by our own activities and that people, together as members of a society, invent the properties of the world. Other constructivist scholars agree with this and emphasize that individuals make meanings through the interactions with each other and with the environment they live in. Knowledge is thus a product of humans and is socially and culturally constructed. He further states that learning is not a process that only takes place inside our minds, nor is it a passive development of our behaviors that is shaped by external forces and that meaningful learning occurs when individuals are engaged in social activities. Learners compare their version of the truth with that of the instructor and fellow learners to get to a new, socially tested version of truth Kukla The task

or problem is thus the interface between the instructor and the learner. Some learning approaches that could harbour this interactive learning include reciprocal teaching, peer collaboration, cognitive apprenticeship, problem-based instruction, web quests, Anchored Instruction and other approaches that involve learning with others. Collaboration among learners[ edit ] Main article: Learning by teaching Learners with different skills and backgrounds should collaborate in tasks and discussions to arrive at a shared understanding of the truth in a specific field. The importance of context[ edit ] The social constructivist paradigm views the context in which the learning occurs as central to the learning itself. Here the essentially interactive nature of learning is extended to the process of assessment. Rather than viewing assessment as a process carried out by one person, such as an instructor, it is seen as a two-way process involving interaction between both instructor and learner. The role of the assessor becomes one of entering into dialogue with the persons being assessed to find out their current level of performance on any task and sharing with them possible ways in which that performance might be improved on a subsequent occasion. Thus, assessment and learning are seen as inextricably linked and not separate processes. The feedback created by the assessment process serves as a direct foundation for further development. The selection, scope, and sequencing of the subject matter[ edit ] Knowledge should be discovered as an integrated whole[ edit ] Knowledge should not be divided into different subjects or compartments, but should be discovered as an integrated whole. This captures their motivation and builds on previous successes to enhance learner confidence. Then it awakens and rouses to life an entire set of functions in the stage of maturing, which lie in the zone of proximal development. It is in this way that instruction plays an extremely important role in development. Learners must not only have ownership of the learning or problem-solving process, but of the problem itself. This notion has been extensively used in curricula. It is important for instructors to realize that although a curriculum may be set down for them, it inevitably becomes shaped by them into something personal that reflects their own belief systems, their thoughts and feelings about both the content of their instruction and their learners. The emotions and life contexts of those involved in the learning process must therefore be considered as an integral part of learning. The goal of the learner is central in considering what is learned. Savery contends that the more structured the learning environment, the harder it is for the learners to construct meaning based on their conceptual understandings. A facilitator should structure the learning experience just enough to make sure that the students get clear guidance and parameters within which to achieve the learning objectives, yet the learning experience should be open and free enough to allow for the learners to discover, enjoy, interact and arrive at their own, socially verified version of truth. Current trends in higher education push for more "active learning" teaching approaches which are often based on constructivist views. Approaches based on constructivism stress the importance of mechanisms for mutual planning, diagnosis of learner needs and interests, cooperative learning climate, sequential activities for achieving the objectives, formulation of learning objectives based on the diagnosed needs and interests. While adult learning often stresses the importance of personal relevance of the content, involvement of the learner in the process, and deeper understanding of underlying concepts, all of these are principles that may benefit learners of all ages as even children connect their every day experiences to what they learn. Pedagogies based on constructivism[ edit ] Main article: Constructivist teaching methods Various approaches in pedagogy derive from constructivist theory. They usually suggest that learning is accomplished best using a hands-on approach. Learners learn by experimentation, and not by being told what will happen, and are left to make their own inferences, discoveries and conclusions. For example, they describe a project called GenScope, an inquiry-based science software application. Students using the GenScope software showed significant gains over the control groups, with the largest gains shown in students from basic courses. This study also found that inquiry-based teaching methods greatly reduced the achievement gap for African-American students. The constructivist approach, called CORI Concept-Oriented Reading Instruction, resulted in better student reading comprehension, cognitive strategies, and motivation. This study also found that students preferred constructivist methods over traditional ones. However, Kim did not find any difference in student self-concept or learning strategies between those taught by constructivist or traditional methods. In their initial test of student performance immediately following the lessons, they found no significant difference between traditional and constructivist methods. However, in the follow-up assessment 15 days later, students who

learned through constructivist methods showed better retention of knowledge than those who learned through traditional methods. It is argued that constructivist theories are misleading or contradict known findings. That is, it is maintained that if the requirements of the concept to be understood exceeds the available processing efficiency and working memory resources then the concept is by definition not learnable. This attitude toward learning impedes the learning from understanding essential theoretical concepts or, in other words, reasoning. If this condition is not met, construction goes astray. He describes this inappropriate use of constructivism as the "constructivist teaching fallacy". Slezak states that constructivism "is an example of fashionable but thoroughly problematic doctrines that can have little benefit for practical pedagogy or teacher education. Evidence for learning by studying worked-examples, is known as the worked-example effect and has been found to be useful in many domains e. The reasoning for this grouping is because each learning theory promotes the same constructivist teaching technique" "learning by doing. Mayer states that it promotes behavioral activity too early in the learning process, when learners should be cognitively active. This continuum of faded guidance has been tested empirically to produce a series of learning effects: In so far as there is any evidence from controlled studies, it almost uniformly supports direct, strong instructional guidance rather constructivist-based minimal guidance during the instruction of novice to intermediate learners. Even for students with considerable prior knowledge, strong guidance while learning is most often found to be equally effective as unguided approaches. Not only is unguided instruction normally less effective; there is also evidence that it may have negative results when students acquire misconceptions or incomplete or disorganized knowledge " Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching by Kirschner, Sweller, Clark [7] Mayer argues against discovery-based teaching techniques and provides an extensive review to support this argument. The main conclusion I draw from the three research literatures I have reviewed is that it would be a mistake to interpret the current constructivist view of learning as a rationale for reviving pure discovery as a method of instruction. He provides empirical research as evidence that discovery-based teaching techniques are inadequate. Here he cites this literature and makes his point "For example, a recent replication is research showing that students learn to become better at solving mathematics problems when they study worked-out examples rather than when they solely engage in hands-on problem solving. Yet a dispassionate review of the relevant research literature shows that discovery-based practice is not as effective as guided discovery. He proposes that the instructional design recommendations of constructivism are too often aimed at discovery-based practice. See the preceding two sections of this article. The math wars and discovery-based teaching techniques[ edit ] Main article: Math Wars The math wars controversy in the United States is an example of the type of heated debate that sometimes follows the implementation of constructivist-inspired curricula in schools. In the s, mathematics textbooks based on new standards largely informed by constructivism were developed and promoted with government support. Although constructivist theory does not require eliminating instruction entirely, some textbooks seemed to recommend this extreme. Some parents and mathematicians protested the design of textbooks that omitted or de-emphasized instruction of standard mathematical methods. Supporters responded that the methods were to be eventually discovered under direction by the teacher, but since this was missing or unclear, many insisted the textbooks were designed to deliberately eliminate instruction of standard methods.

## Chapter 4 : Constructivist Teaching Model - Constructivist Science Teaching

*An attempt is made to prepare a lesson plan for science teachers based on 5E's model (one of the model of constructivism) on the topic 'Images formed by concave lenses'.*

This is blog 2 of 3 to construct my own knowledge on the topics of making in schools and the two learning theories constructivism and constructionism. Pestalozzi was a constructivist and a constructionist. I went gladly, for I hoped to offer these innocent little ones some compensation for the loss they had sustained, and to find in their wretchedness a basis for their gratitude. In my zeal to put my hands to the task which had been the great dream of my life, I should have been ready to begin even in the highest Alps and without fire and water, so to speak, had I only been allowed. As early as Dr. Montessori was advocating for the use of the scientific method to inform curriculum design. As a result of the push for standardization during the industrial era, new ways of thinking about learning and consuming were growing up into areas as wide as the Bauhaus school of art and architecture to the Arts and Crafts movement, to the works of American philosopher and educational reformer John Dewey. Himself influenced by Rousseau and Plato, Dewey would advocate for the role of education in protecting democracy in such works as *Democracy and Education*. Even though they were describing the idea of constructivism the term would not be coined until Swiss psychologist Jean Piaget would study young children, beginning with his own. Piaget noticed that children construct an understanding of their world via sensorimotor interactions with their environment. Piaget was highly influenced by Dr. Montessori as well as the Montessori method. Piaget used the terms assimilation and accommodation to explain the twin processes of constructing new knowledge or understanding. Assimilation happens when the input children take in from their environment becomes part of their schema, or tool box of knowledge. For anyone to learn complex models and abstract ideas in science, there must first be fertile foundations to latch onto these new models. If fertile ground is absent the new idea may be ignored or rejected outright. Take for instance how popular science fiction is as a temporary break from our boring old schemas. Next, how constructionism gives us the most useful mode for practicing constructivism in school. The science behind the genius. Zone of proximal development. The development of higher psychological processes,

## Chapter 5 : Constructivist Teaching in Primary Science

*Matthews () attempts to sketch the influence of constructivism in current mathematics and science education, aiming to indicate how pervasive Aristotle's empiricist epistemology is within it and what problems constructivism faces on that account.*

## Chapter 6 : Constructivism in science education - Wikipedia

*Constructivism is one of the most influential theories in contemporary education and learning theory. It has had great influence in science education. The papers in this collection represent, arguably, the most sustained examination of the theoretical and philosophical foundations of constructivism yet published.*

## Chapter 7 : Constructivism in Science Education: A Philosophical Examination - Google Books

*The role of the teacher within a constructivist classroom is that of a facilitator of learning rather than a dispenser of knowledge. The teacher helps students learn by "encouraging (them) to look at problems critically and with fervour" (Schreiber & Valle, , pp3).*