Learning Theories: Constructivism

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Introduction

Although not supported by everyone, constructivism is one of the most influential educational theories of our time. It is one of several important learning theories that have influenced teaching approaches. A brief summary of constructivist learning principles is provided here, along with some corresponding recommendations for educational practice and links to relevant resources.

Constructivist Learning Theory

As its name may imply, constructivism emphasizes building (i.e., constructing) that occurs in people’s minds when they learn. A simple way to summarize this idea is to refer to Gestalt theory (e.g., ‘The whole is different [maybe greater] than the sum of its parts). For example, when different people ‘observe’ the black-and-white image in Figure 1, some people ‘see’ a geographical location, others say it looks like the side of a cow, and others claim the image depicts a bearded man. Apparently, what each person ‘sees’ (or ‘observes’) depends more on what is already stored in that person’s brain than on light being emitted (or not) from the image. This suggests that learning from our environment (through our senses) is an active, rather than a passive, process. We seem to project onto phenomena what we already know about them. We each construct a unique mental image by combining information in our heads with information we receive from our sense organs (e.g., eyes). In many ways, this is self-reinforcing. Each of us is an individual, viewing the world in ways like no other person.

While many theorists emphasize each person’s right and tendency to construct unique meanings, many people also believe that these are not completely unique. Because we share common languages and think largely through language and other communal symbols, many agree that knowledge is socially constructed, even while an individual is thinking. In a sense, a person’s thoughts never are his or her own. Knowledge also may be considered socially constructed because public knowledge — that is, ideas and information stored and made available for the public — usually goes through debate. Groups of scientists, for example, read each other’s articles, write for the same journals and
often attend the same conferences. After they have debated ideas about their inquiries, etc., their collective conclusions may get published in school texts and other records available to the public. This is related to the idea of community of practice (CoP); that is, a group of people with a shared history that gives them — among other things — a common identity, a repertoire of related practices and a similar knowledge set. In other words, each of us must admit, ‘I am apart of all of whom I have met’ (Tennyson).

Constructivist learning theory suggests a number of points about teaching and learning, brief notes about which are provided below:

**Learners have ideas!**
Educational research advises that students begin their study of topics with pre-conceived notions about concepts teachers want them to learn. They are not, as is said, ‘blank slates’ on which new information can be simply written. That students begin learning sessions already possessing attitudes, skills and knowledge (ASK) applies to science education, for instance, since students have had prior experiences about many topics in science; for example, they have experienced forces (e.g., magnetism), living things (e.g., pets and houseplants), solar systems effects (e.g., day & night and eclipses), chemical change (e.g., burning), etc.

**Learners’ ideas often contradict those of teachers!**
Students’ ‘current ideas’ (also called ‘prior’, ‘alternative’ or ‘children’s conceptions) often contradict mainstream Western science & technology. For example, many 14 year-olds believe:
- weeds are not ‘plants’ because plants have to be nurtured;
- steam turns into ‘air’ once it disappears into the air;
- light beams travel farther at night than in daytime;
- electric current is used-up by light bulbs;
- objects can only move if there is a force directly on them;
- cold water freezes faster than does hot water;
- the sun revolves around the Earth.
Learners are not, in other words, passive. Rather, they often are quite active in learning.

**Learners like their ideas!**
Interestingly, just like scientists, students are very reluctant to give up their favoured ideas! For example, when people try to convince others that what they see in the above black-and-white image is the ‘right’ way to look at it (e.g., a man is visible), they often fail. Once a person sees it one way, however, it’s difficult for them to see it any other way! Indeed, students often are emotionally attached to their ideas; they don’t even want to hear that someone may have a ‘better’ explanation. That might threaten their self-esteem. As a consequence, they may not even want to deal with what others (e.g., teachers’) recommend!

**Learners see what they want to see!**
It has been said that ‘observing something tells you more about the observer than what is being observed.’ The black-and-white image above is, therefore, meaningless without a preconceived notion about it. Observing is, consequently, an active, rather than a passive, process. To a great extent, people project what they already have in their heads onto phenomena to be observed. They see what they ‘want’ to see.

**Learners often are not aware of what they know!**
Students are frequently not consciously aware of reasons (e.g., laws and theories) for their actions; they just ‘innately’ know why they do things a certain way. For example, few stop to think how gravity, wind, surface friction, etc. affect how they walk. For such reasons, teaching and learning should begin by encouraging learners to express and clarify their pre-instructional (and ongoing) conceptions.

Learners may not discover experts’ conclusions!
Because students will ‘see what they want to see,’ it seems inappropriate for teachers to simply provide students with experiences of phenomena and then expect them to ‘discover’ planned conclusions. This is likely to be difficult, moreover, since it took scientists years to develop many of their conclusions. Consequently, familiar ‘inquiry,’ ‘discovery’ (and certain ‘constructivist’) practical activities (‘labs.’) are inappropriate. Students, invariably, ‘discover’ what is apparent to them; not, necessarily, what would be apparent to a professional scientist or engineer — or the teacher. Accordingly, it is important for educators to carefully present ideas, skills, attitudes, etc. to students to which they want them to have access. This policy has important ramifications for social justice. Generally, those least likely to ‘discover’ important ideas, skills, etc. from ‘inquiry’ or ‘discovery’ experiences are the most disadvantaged students. Often, this is tied to socio-economic level. Expecting students to discover important ideas through experiences, therefore, discriminates against the poorest children. Moreover, most students will have difficulties discovering ASK that often are hidden from most citizens, including in terms of not easily-accessible via the Internet; such as roles of governments and transnational entities (e.g., Organisation for Economic Co-operation and Development) in allowing free flow of materials and workers, etc. across international borders. For such reasons, educators must work to actively share societies’ ideas, skills, etc. with all students. It is right and just to do so.

Learners need ‘first-hand’ experiences!
Although expecting learners to ‘discover’ scientists’ conclusions is unreasonable, explicitly sharing ideas, skills, etc. with learners by telling or showing often is insufficient for them to deeply learn. In addition to being told/shown ideas, skills, etc., learners need to use and test ideas, skills, etc. through relevant activities. Often, this involves concrete experiences that combine with abstract ideas that have just been presented to learners. For example, while a teacher can show students on a whiteboard that various atoms can be rearranged to make new molecules in a chemical change, students often need to try such reactions with concrete materials before they fully understand the new ideas, skills, etc. Although this is superior to discovery activities, teachers also need to be careful not to expect students to verify (conclude to be true) the abstract ideas being tested. Teachers can remind students that scientists and engineers have developed their ideas after many tests, by different investigators and over large periods of time - and that, although students’ conclusions may have merit, they may require more testing by them and others over longer time periods.

Students’ and scientists’ inquiries are self-fulfilling!
Students’ current ideas can affect all procedures associated with science and technology, including: observing, classifying, measuring, hypothesizing, predicting, choosing variables to change or monitor, controlling variables, analyzing tests, and drawing data-based conclusions. All of these ‘science skills’ (and more) are, therefore, theory-based; i.e., how a person conducts the ‘skill’ depends on what ideas s/he already holds. How a person classifies, for instance, depends on what categories he/she already has in mind. This means, therefore, that whole science investigations often are theory-based or, more crucially, theory-limited. It is like they are ‘self-fulfilling prophecies.’ Consequently, it is difficult for a student (or a scientist!) to plan, conduct and conclude a science test about which he/she does not already have prior notions. Therefore, science inquiries tend to be conservative; i.e., support ideas scientists and engineers already hold.

Learners need other people!
Students can’t change their thinking on their own, even if they wanted to; they lack knowledge and understanding of other laws, theories, and inventions, etc. that could be available to them. For students to learn, therefore, experiences alone are not enough; they need to receive different ‘lenses’ — e.g., different laws and theories — through which to view objects and events, design tests and interpret data. Teachers must, therefore, take purposeful steps to get students to see
things in new ways. For example, teachers may have to isolate certain areas in the black-and-white photograph in Figure 1 in order to help students to ‘see’ particular shapes within it. Likewise, it is about getting them to ‘see’ that, as a candle burns, a prevalent explanation is that wax is combining with oxygen to make carbon dioxide and water. Because knowledge is so communally-based, moreover, learners deserve access to knowledge of different communities. Learning should not be so conservative as to ignore knowledge and ways of knowing of different races, cultures and societies. In other words, learning must be pluralist — rather than conformist. Teachers could, for example, introduce students to Aboriginal ways of knowing, as well as those of ‘Western’ science and technology. A good example of this is provided at: Rekindling Traditions (education.usask.ca/ecstu/main_menu.html).

Students need to know how to learn!
Students may not know, even if they have access to ideas and an urge to change, how to change their thinking. They may lack skills necessary to re-consider their ideas. They may not know how to think about their own ideas, how to learn new ones or how to decide what they believe. Therefore, as with conceptual change, students need others (often teachers) to introduce them to new learning skills; e.g., how to develop concept maps to exhibit ideas.

Teachers need to portray scientific and technological knowledge as ‘constructed!’
Just as students are unlikely to discover, through their own experiences, all products and processes that have been developed by science and engineering, they are unlikely to discover characteristics of practices and products of these fields. Students need, therefore, to be taught particular conceptions about the nature of science and technology (NoST), such as that science inquiries are, typically, not linear, often involving dead ends, changes in direction and/or reversals, and in terms of relationships among fields of science and technology and societies and environments (STSE), including how powerful people (e.g., financiers) and organizations (e.g., corporations) may influence scientists and engineers to compromise topic choices, methods and sharing of findings to favour private profit over general wellbeing. From a social constructivist perspective on knowledge generation, all of these characteristics and relationships are constructed! Having said that, not everyone agrees with them. Accordingly, presenting ‘realistic’ conceptions about NoST and STSE are complex undertakings; but, nevertheless, extremely necessary to promote democracy in societies.

Students deserve the right to determine their beliefs!
Scientists are never, because of the theory-limited nature of knowledge development, absolutely certain that explanations are correct. There always is a possibility for change. The same can be said for inventions, which can have negative side-effects on individuals, societies and environments. Although it is apparent that most changes in ideas, approaches, etc. of scientists and engineers have gradually changed over time, there also have been major (paradigmatic) shifts in history (e.g., believing in a flat vs. round Earth). Furthermore, scientists have been known to be influenced by personal and group biases (e.g., an interest in fame). Similarly, products of science and technology — such as various inventions — have had negative side-effects on societies and environments. Breakdown of nuclear reactors is just one of many examples. Perhaps most importantly, much common knowledge is biased and, most worrisome, controlled by the most powerful societal members and groups. Consequently, we could ask whether or not society (through teachers) has the right (or, even, ability!) to change a student’s beliefs. While getting students to understand new ideas may be (is) society’s right and responsibility, forcing them to accept certain beliefs may be problematic. Should education be about convincing others or about enlightening others? Perhaps students deserve the right to determine their own beliefs in school settings and beyond. That may occur if students have opportunities to conduct science inquiry and technology design projects under their control. In line with principles of social constructivism, such decision making should — likely — be made by groups of students.

Individuals, societies and environments can benefit from students’ research-informed actions!
Products of science and technology (S&T) have benefited, in many ways, individuals, societies and environments. Medical science and technology, for instance, has significantly prolonged human longevity over about the last century.
Nevertheless, many people and groups are concerned about adverse effects of products of S&T on wellbeing of living and nonliving things on Earth (and, perhaps, beyond!). Perhaps most worrisome in this regard are devastating effects already experienced and predicted due to climate change caused by humans’ uses of petroleum-fueled technologies. Because governments have often assisted financiers and corporations in influencing S&T in ways that have led to such harms, it is apparent that community members must be ever-vigilant in evaluating processes and products of S&T and, where they determine harms, develop and implement actions to try to eliminate them. Accordingly, although it can be very helpful for students to understand and be able to use ASK from S&T for personal choices, many scholars and others suggest they also need to use at least some of their literacy in S&T to address harms in STSE relationships of interest to them. Although teaching students about harms, such as poor working conditions of people who mine minerals (e.g., cobalt to make circuits in cell phones) for electronic devices (see the documentary, Blood in the Mobile), they may become more motivated to do so if they have designed and conducted research (e.g., studies of peers’ knowledge of harms in STSE relationships) that they then use to inform social actions (e.g., petitions, YouTube™ videos and Twitter™ campaigns) to educate others about such problems and/or encourage government officials to change laws in ways that eliminate such problems. Such research-informed and negotiated action (RiNA) experiences are constructivist, in the sense that — as noted above — each decision in RiNA activities inevitably involves combinations of ASK in students’ heads (and bodies) and that from others. Teachers wanting to encourage and enable students to develop expertise, confidence and motivation for eventually self-directing RiNA projects to address harms they identify in STSE relationships may find helpful constructivism-informed approaches inherent to the STEPWISE framework for S&T education; which are found at: www.stepwiser.ca.

Relevant Internet-based Resources
An earlier version of the above notes on constructivism are provided at goo.gl/OF9LYk, where you also can find some links to internet-based resources related to this topic.