Theories about How Children Learn

Contents

Many researchers have thought hard about how children learn and in particular about how children learn mathematics. It is possible that you will be familiar with some of them from your initial teacher training however some teacher training courses (e.g. GTP) do not require study of theories of learning. This document deals briefly with some of the current theories of learning and why they may be important when thinking about how children learn mathematics. It also gives suggestions for further reading if you are interested in knowing more.

1. Transmission Theory

This theory appears to have been widely accepted by teachers over many years without any research basis. The idea seems to have developed that teachers could somehow, unproblematically, transfer or transmit information to their pupils. This has let to common statements on school reports such as “if only he listened better he might learn more”. It also leads pupils to suggest that they need their teachers to “explain better”.

This theory has been largely discredited although it has not disappeared from our language.

2. Behaviourist Theories

Skinner, B. F. 1976. *About Behaviorism*. New York: Vintage.

Behaviourism aims to explain human behaviour in terms of external physical stimuli, responses, learning histories, and reinforcements. Behaviourism is present in the work of Ivan Pavlov (1849-1936) and Edward Thorndike (1874-1949). Its fullest and most influential expression is B. F. Skinner's (1904-90) work on schedules of reinforcement.

> “*behaviour which is followed by reward or success will tend to be repeated whereas behaviour which is not rewarded will tend to die away”*
>
> *“reward desirable connections and make undesirable connections produce discomfort”*

To illustrate, consider a food-deprived rat in an experimental chamber. If a particular movement, such as pressing a lever when a light is on, is followed by the presentation of food, then the likelihood of the rat's pressing the lever when hungry, again, and the light is on, is increased. Such presentations are reinforcements, such lights are (discriminative) stimuli, such lever pressings are responses, and such trials or associations are learning histories.

Thorndike used behaviourist ideas when he explained that mathematics consisted of countless sets of bonds or connections and it is the teacher’s role to enable pupils to know these bonds. Whilst the connections necessary to facilitate learning are the same for each learner, the rate at which the connections may be assimilated may be different for different learners.

Again these theories have been largely discredited as deep learning cannot be seen as a simplistic response to stimuli.

3. Constructivism

Von Glaserfeld, E. 1984. An introduction to radical constructivism. In *The Invented Reality*, edited by P. Watzlawick. London: W.W.Naughton & Co.

Cobb, P. 1988. The tension between theories of learning and instruction. *Educational Psychologist* 23 (2):87-103.

> Radical constructivism, thus, is radical because it breaks with convention and develops a theory of knowledge in which knowledge does not reflect an 'objective' ontological reality, but exclusively an ordering and organisation of a world by our experience" P.24 (von Glaserfeld 1984)

Constructivism takes the view that children construct their learning themselves. Learning is the process by which human beings adapt to their experienced world. The development of new concepts or modification of existing ones occurs when the student's view of the world is challenged in some way so that their existing web or schema of concepts cannot accommodate the new experience and some modification in their concept structure must occur. Therefore learning can be seen as an adaptive response to a problematic situation. Conflict with existing concepts promotes learning and it may be that in peer communication this cognitive conflict is more likely to occur. Children exploring situations linguistically with others and attempting to use language to explain their own understanding promotes the reflection process. Within this reflection process, cognitive conflict may occur in a way that will promote learning

Each student brings to every mathematics lesson a unique interconnecting set of experiences. Constructivism demands the recognition that each student will develop their own idiosyncratic set of understandings of whatever is presented, in part due to the unique set of experiences that each student brings to the lesson. From a constructivist point of view there is no way of knowing whether someone's developed concept matches an objective reality. A concept 'works' or is viable to the extent that it does what it needs to do.

Radical Constructivists contend that understandings that can only be accessed very partially by others. When communication appears to occur between two subjects then there may be said to be a fit between the two understandings but no match can be assumed. The fact that communication is difficult is explained well by the constructivist philosophy

> Because teachers and children each construct their own meanings for words and events in the context of the on-going interaction, it is readily apparent why communication often breaks down, why teachers and children frequently talk past each other. The constructivist's problem is to account for successful communication (Cobb 1988)

Constructivism indicates that it is important that a teacher is constantly on the lookout for misconceptions or alternative ways of conceptualising the work in hand. It requires that the discourse in the classroom is one of exploration and challenge, it stimulates teachers and pupils to work hard towards a greater understanding of one another.

4. Social Culturists

Wertsch, J.V., and Toma, C. 1995. Discourse and Learning in the Classroom: A Sociocultural Approach. In *Constructivism in Education*, edited by L. P. Steffe and J. Gale. Hove, UK: Lawrence Erlbaum Associates.
Vygotsky, L.S. 1962. *Thought and Language*. Cambridge, Mass.: MIT Press New York

Some theorists, particularly Vygotsky, see learning as a purely social process where learning is seen as becoming more able to act within a culture or enculturation. Social culturalists suggest that higher mental processes are stimulated by social interaction.

Vygotsky saw this development as the purpose of instruction and of social interaction. He considered the social as vital in the development of concepts or of higher mental functioning.

> It is necessary that everything internal in higher forms was external, that is, for others it was what it now is for oneself. Any higher mental function necessarily goes through an external stage in its development because it is initially a social function. ….. Any higher mental function was external because it was social at some point before becoming an internal, truly mental function. P. 162 (Vygotsky 1981)

Vygotsky's insight into the relationship between social and individual processes has a major contribution to make in modern thought. Each person is the product of their previous experiences or cultural history. The development of the individual is in terms of the various social interactions that they take part in and these are different for each person. When an individual comes to the social interaction of the classroom they bring with them their own individual social history and therefore they will be more or less able, in terms of the development of their higher mental functions, to engage with what is presented there.

It is in discourse with more knowledgeable peers that learning takes place. The social view of learning and "coming to know" can be extended further into the classroom environment. This view of knowing sees knowledge residing in the culture and this culture is a system that is greater than the sum of its parts. This is important when looking at learning in the classroom. Classrooms are communities; there is knowledge that resides in the culture of the classroom. Knowledge can be viewed as taken-as-shared when members of a classroom community, having no direct access to one another's thinking, achieve a sense that that some aspects of knowledge are shared and act as though each shares this knowledge.

Vygotsky also introduced ideas about the zone of proximal development and scaffolding which are also important in thinking about learning.

Zone of proximal development: an area of learning into which a learner is able to move with the aid of a more competent peer.

Scaffolding: the external actions of a more competent peer that allow learning within the zone of proximal development that can gradually be withdrawn as the learning becomes internalised. (Jaworski, 1994)

5. Social Constructionism

Gergen, K.J. 1995. Social Construction and the Education Process. In *Constructivism in Education*, edited by L. P. Steffe and J. Gale. Hove, UK: Harel, I. &

Papert, S. 1991 ‘Situating Constructionism’, in Papert S. & Harel I. (Eds), *Constructionism*, Norwood, NJ: Ablex Publishing Corporation. Lawrence Erlbaum Associates

Social Constructionists believe that learners build knowledge through active engagement in a social setting. Some people who take this stance believe that cchildren need to work with physical materials to build a mental construction of reality which counts as knowledge.

Mathematics is a social construction, a body of knowledge that has been developed to meet certain needs within society. A major focus of social constructionism is the ways in which individuals and groups participate in the creation of their perceived social reality. Children take on the social status within a given construct by talking and acting within it. Therefore social consructionists believe that to take on the identity of a mathematician (someone who can do maths) you must be able to use language to communicate in a way that is accepted as mathematical. In the social constructionist view

> "meaning is achieved through the co-ordinated efforts of two or more persons.... It is out of community that rational articulation is achieved and without such articulation there is no means of presuming the individual self” P. 24 (Gergen 1995)

A culture's accumulation of what we take to be knowledge resides in linguistic artefacts. In our culture these are documents, journals, lectures, discussions and the like. Communities develop ways of responding and some of these responses are given the respect or authority of knowledge within the community.

> "From the constructionist standpoint, the individual is not the possessor of contents or rationalities, but rather participates in them. Knowledgeable and rational statements are not external expressions of the internal mind but are integers in the ongoing flow of communal interchange" p 33 (Gergen 1995)

Accepting this view of the way knowledge is acquired places language at the forefront of an educational situation. The implication that children must be part of the community of learners engaged within the dialogue of knowledge and participators in the meanings of a community are inevitable consequences of this view of knowledge. This adds legitimacy to a view of education where one learns, not through listening to the holder of the knowledge dispensing it in the form of a lecture but rather through engaging, incorporating and critically exploring the views of others; opening up new possibilities of interpretation through the interaction.

Mathematical knowledge can therefore be seen from the social constructionist's point of view as the construction of the community of mathematicians. In order to be said to 'know' mathematics one must occupy a discursive position that is accorded the standpoint of authority by the social community of mathematicians. "*The ideal position is not knowing that something is the case, but knowing how to produce language that will be accorded status” p*. 31(Gergen 1995)

6. Situated Cognition - Communities of practice

Lave, J., and Wenger, E. 1991. *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Theories about learning taking place situated within communities of practice as explained by Lave (Lave and Wenger 1991) put a different emphasis on what goes on in the classroom.

This theoretical perspective was developed after an anthropological study of tailors (Lave and Wenger 1991), the findings are therefore based on an apprenticeship model. Lave saw people inducted into the practice of tailoring, they learned to become tailors and to think of themselves as master tailors, taking on the status and role in that society accorded to tailors. She studied and described the acquisition of cultural practices taking place in the context of the practices themselves. The learning that Lave described was part of the practice of tailoring where novice tailors became master tailors, the learning was secondary to the task in hand, that of producing the clothes. The mathematics classroom is not constituted to develop skills in these terms, but rather to help children think mathematically or at least 'school mathematically' or to gain the best qualification possible so that they are disadvantaged as little as possible. There are several aspects to these theories that throw light on the situation in the classroom under review.

Situated cognition begins to explain the importance of the tools of learning to the learning itself. Child to child discussion of a task may be intended to enable the mathematical learning in the task and therefore be invisible. However if the rules of the mediating discussion have not yet been established the functioning of the learning group may become the visible feature and obscure the mathematical learning. This is true of many of the resources in the classroom, the children have to learn to use the tools in order to participate in the cognition that lies within them. Tools and resources may be more or less transparent and as such can enable, obstruct or deny access to the practice. Increasing access to a practice entails organisation of activities to make their meaning visible to participants in the practice, in this case the practice of learning mathematics.

Lave describes two different types of talk, that of talking 'within' and 'about' a practice. Learning mathematics involves learning to talk like a mathematician. However the distinction for Lave is of talking within and talking about and it is in becoming able to follow the conventions of talking within and talking about that knowledgability occurs. Talking within means exchanging the information necessary to the progress of ongoing activities, this may involve using the mathematics register or not, according to the needs of the activity that is going on. Talking about the children's mathematics would describe talk that explains a mathematical task that the children have been engaged on, maybe to the rest of the group or as writing on, say, a poster. Talk that is involved in learning is done by the learner (as opposed to the teacher), the learner learns to talk as a full participator in the community by engaging in the practices of the community. Therefore from this point of view, the discourse in the classroom is pre-eminent but only when it actively involves the learner.