Representation of Mathematical learning: A short discourse

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Bal Chandra Luitel

Curtin University of Technology

There are four main ideas in order to conceptualise the notion of *representation*. Firstly, within the domain of mathematics, representation may be regarded as internal- abstraction of mathematical ideas or cognitive schemata that are constructed by the learner (Pape & Tchoshanov, 2001) . Secondly, representation can be explicated as mental reproduction of a former mental sate. Thirdly a structurally equivalent presentation through pictures, symbols and signs (seeger, cited in Pape & Tchoshanov, 2001) also resembles to the concept of representation. Lastly, it is also known as something in place of something.

There is no unanimity in depicting the notion of representation. Goldin and Shteingold (2001) try to explicate it as hypothesised mental constructs and material-notations. The former is an internal representation while the second is external one. Cifarrelli seems to use the word “representation” exclusively as mental representation whereas Evan used this word as material representation (cited in Kaput, 1999) . Similarly *fusion* is referred to emphasise on maintaining structure and orientation in time and in the space of actions and possibilities surrounded by a symbol rich experience (Kaput, 1999)—internalisation of external representations. Representational capacity of early men has been believed to begin about 1.5 million years ago in the form of *mimetic* (Donald,

1991) .

In the broad sense, the notions of representation can be constructed from the three perspectives: constructivism, constructionism and ethnomathematics. The notion of constructivism (cf. *trivial*, *radical*, *cultural*, *social* and *critical* constructivism) regards the idea of representation as a central process of the construction of knowledge. According to von Glasersfeld (1995) , for the constructivism, the most important is that the common conception of truth as the correct representation of states or events of an external worlds replaced by the notion of *viability.* According to the constructionist perspective, the role of representation is to mediate between the two worldly perspectives of representation of knowledge: *exogenic* and *endogenic* (Gergen, 1995) . In the context of Ethnomathematics, the notion of representation is to regard the natural (cf. *non-standard*, *informal*, *subjective* and *non-canonical*) and context-based representation of mathematical concepts.

Basically, representational systems can be classified into three categories: *external, shared (*cf. *negotiated)* and *internal.* Epistemological link of external representation is with the school of behaviourism. The external representations are, for instance, mathematical symbols, signs, characters, and signals (Goldin & Shteingold, 2001) . Despite the portrayal of formal mathematics as a static representation of mathematics, the use of microcomputer and graphing calculator has made the external and formal representational systems dynamic (Kaput, 1989) . The shared representations exist during the process of interaction. Moreover, this types of representation deals with such representation that are shared between the teachers and the learners (Goldin & Shteingold, 2001) . There are various forms of internal representation including

verbal/syntactic, imagistic, formal notational, and affective (Goldin & Shteingold, 2001) .

Broadly speaking, there are two types of representation that affect children's understanding of and solution to, mathematics problems: 1) instructional representations (definitions, examples and models) that used by teachers to impart the knowledge to students and 2) cognitive representations that are constructed by the students themselves as they try to make sense of a mathematical concept or attempt to find a solution to a problem (Miura, 2001) . Furthermore, there are many important roles of representation in school mathematics such as to help communicate, solve mathematical problems, and identify attitudes of learners towards mathematics.

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