

## Attributes of Mathematics Enculturation: Sarah's Experiences in the Mathematics Classroom

Dimakatjo Muthelo <sup>1\*</sup>, Benard Chigonga <sup>1</sup>

<sup>1</sup> *University of Limpopo*, Polokwane, SOUTH AFRICA

\*Corresponding Author: [dimakatso.muthelo@ul.ac.za](mailto:dimakatso.muthelo@ul.ac.za)

**Citation:** Muthelo, D. and Chigonga, B. (2018). Attributes of Mathematics Enculturation: Sarah's Experiences in the Mathematics Classroom. *Pedagogical Research*, 3(1), 05. <https://doi.org/10.20897/pr/87019>

**Published:** May 1, 2018

### ABSTRACT

The paper presents a case study of the mathematics enculturation of a Grade 5 learner, (Sarah), at a school in Limpopo Province of South Africa. The case study sought to explore the attributes of mathematics enculturation in social interaction as a process of learning. A qualitative approach was adopted in collecting and analysing data. Data were constructed by capturing critical incidents and keeping a chronological account in a researcher journal of the discussion observed in Sarah's group during lessons. Qualitative data from Sarah's group, working together on activities, reveal the following constructs as key to understanding mathematics enculturation in the classroom: language, shaping of learners' ideas, and negotiation of meaning. The implication is that oral communication, which includes feedback, plays a major role in making social encounters into learning events that facilitate sense-making and understanding.

**Keywords:** enculturation, mathematical culture, mathematics enculturation, teaching experiment

### INTRODUCTION

Mathematics is seen as a culture and value-free discipline (Knijnik, 2002). Failures and difficulties regarding mathematics at school are usually ascribed to the learners' cognitive attributes or to the quality of the teaching to which learners are subjected (Knijnik, 2002). Thus, social aspects, and especially cultural aspects, have received insufficient consideration in the teaching and learning of mathematics. Bishop (1988) shows how the social dimension has affected mathematics education research, and consequently clarifies the cultural nature of being mathematical or of mathematics. According to Bishop (1988), such a dimension stimulates research at five main levels: a) individual level, which is concerned with the personal learning both in and out of classrooms; b) pedagogical level, which is concerned with the social interactions in the mathematics classroom; c) institutional level, which is concerned with the social norms and interactions within schools, which in turn influence the teaching of mathematics in classrooms; d) societal level, which is concerned with the relationships between mathematics education and society; and e) cultural level, which is concerned with the relationships between mathematics education and the historical-cultural context of the society. In relation to the individual level, which is concerned with the personal learning both in and out of classrooms, we argue that situations of cultural conflict in the classroom setting involve emotional reactions and reactions that affect the learners. This led to an interest in exploring what constitutes mathematics enculturation in the classroom.

From the above premises, we report on a study aimed at identifying the constructs that are key to understanding mathematics enculturation in the classroom. In undertaking the study, we collaborated with a practicing primary school mathematics teacher in terms of: planning of teaching experiment lessons; experimentation in the classroom; and retrospective analysis. The teaching experiment shows various interactions between learners and the class, with special focus on Sarah's enculturation as a new learner at this school. The background to the study,

statement of the problem, theoretical framework, methodology and data analysis are presented first. This is followed by the results and discussion. We conclude by highlighting the implication of the constructs that emerge from the study.

## **BACKGROUND TO THE STUDY**

Culture has become a household word in research circles. Bauersfeld (1998) sees culture as a relative word. How one defines it is relative to what one wants to achieve. However, what offers hope in the greater debate is the fact that there is consensus that culture evolves. Mathematics learning can be used to explain or describe culture and enculturation. Thus, social aspects should receive consideration in the teaching and learning of mathematics. The fact that mathematical knowledge can be acquired out of school by diverse cultural groups, brings important contributions to the analysis of the process of teaching and learning mathematics at schools (Nunes, 1992). Bishop (1988) introduced the concept of enculturation in mathematics education and suggests that mathematics education can rely on experiences of enculturation. Cultural groups and formal schooling are not distinguishable in what concerns the modes of learning (Nunes, 1992). However, learning, viewed as changes in participation and formation of identities within communities of practice, still represents, in our view, a real educational challenge with regard to school mathematics.

In developing the concept of mathematics enculturation, Bishop (1988) argues that a child does not receive the culture as if it is an abstract entity; cultural learning at school is not a mere unilateral process that goes from the teacher to the learner or from learner to learner. According to him, mathematics enculturation in a classroom should have as its target the initiation of the learners into the conceptualisation, symbolisation and values of mathematics culture. This process is interpersonal; it is interactive between learners. In this sense, says Bishop, mathematics enculturation is not different from any other enculturation, and mathematics classrooms should be a propitious environment for mathematics enculturation. Therefore, mathematical enculturation is a shaping process – a process whereby concepts, meanings, processes and values of mathematics are shaped in trying to develop in each individual learner a way of knowing (Bishop, 1991). Thus, teachers should not see themselves as transmitters of knowledge (concepts from mathematical culture) but rather as active participants during the enculturation to shape learners' ideas. Concepts, meanings, processes and values are what are being shaped, and these belong to the learner, are owned by the learner, and are shaped by the learner (Bishop, 1991).

Enculturation is the actual process of learning as it takes place in a specific culture (Mead, 1963). There are five constructs that are key to understanding enculturation. These are: role play; shaping of learners' ideas; learning (what it means to learn); negotiation of meaning; and the intentional process (Mead, 1963).

What do these five constructs mean in the process of teaching and learning mathematics? The first construct has to do with the roles that teachers are expected to play. The teacher is responsible for creating an environment that allows for learning to take place. The type of environment created depends largely on the beliefs that the teacher has in terms of what it means to learn. The other role of the teacher is that of representing the mathematical culture. This role involves coming up with intentional activities that are meant to initiate the learning process. The teacher is expected, through questioning, to help learners to shape their mathematical ideas. Learners, on the other hand, are expected to respond to the environment created and positively contribute to the emerging classroom culture.

The second construct is the shaping of learners' ideas. This results from learners sharing ideas and analysing them. It is believed that during this process, learners are able to develop mathematical meaning. It is the learner who does the shaping, not the teacher.

The third construct is about what it means to learn. This serves as the basis for what teachers intend to do in the classroom. It is the teachers' understanding or perception of what it means to learn that guides: how they prepare the activities they give to learners; how they engage learners in discussions during the negotiation of the meaning process (this includes the shaping process); and the learning activities that they create during the learning process.

The fourth construct refers to the importance of the process of negotiation of meaning in a constructivist classroom. Though the meaning developed during this process remains at a social level, it plays a significant role in helping learners when they individually interrogate issues as they shape their ideas.

The fifth construct is more concerned with how teachers plan for their lessons. It is the intentions of the teacher that give shape to the kind of issues that are brought forward by learners during the interactions. However, constructivists are concerned with construction of mathematical meaning and how that becomes knowledge to individual learners. It is a theory of knowing that explains the development of learners' cognitive structures (Pirie and Kieren, 1992). Therefore, it is the role of the teacher to create an environment that allows for the development of learners' cognitive structures (Pirie and Kieren, 1992). The two have suggested tenets or beliefs that should be

held by teachers if they are to create a constructivist environment for mathematical learning and understanding, as follows:

- Although a teacher may intend to move learners towards particular mathematics learning goals, s/he will be aware that such progress may not be achieved by some of the learners.
- In creating an environment for learners to modify their mathematical understanding, the teacher holds the belief that there are different pathways to similar mathematical understanding.
- The teacher cannot think that his or her own understanding and the learners' understanding will all be the same for a particular mathematical topic.
- The teacher will know that for any topic there are different levels of understanding, but that these are never achieved once and for all.

Pirie and Kieren's (1992) argument is based on the belief that a constructivist environment for mathematics learning is not a product of a particular programme of classroom or individual activity (Pirie and Kieren, 1992). Such an environment is created by a teacher through a set of constructivist beliefs in action, including the four tenets mentioned above. It is believed that it is the teacher's intention, together with the learners' response to the environment created, that constitutes the evolving classroom culture.

Our initial intention was to assist a Grade 5 mathematics teacher in creating a constructivist learning environment in the classroom (teacher development of a teaching approach that uses constructivism as a referent). The main idea was to have learners working in groups as they responded to learning activities. It was during the process of collecting data that the focus changed, after noticing that Sarah, who had joined the school and grade at the beginning of the year, was struggling to be part of the group. Joining learners who have been together for four years prior to being in Grade 5, Sarah was always quiet and would appear to be scared whenever we approached her group. This aroused our interest in knowing more about her behaviour. As a result, most of the data collected revolved around what Sarah's group was doing. Hence the discussion is on how she struggled to be part of the classroom culture and ultimately how she struggled to negotiate for meaning, shape her ideas and share her thoughts with her group.

## STATEMENT OF THE PROBLEM

Sarah joined a new school at the beginning of the year. For the whole of the first term, she experienced problems in integrating with the Grade 5 learners. Sarah was quiet, reserved and performed badly in mathematics and other subjects. Her teacher, at some point during the first term, asked Lazarus to work with her during classroom activities for the entire quarter. The teacher was not satisfied with their interaction because Sarah showed no improvement in her performance. The teacher discovered that Sarah was struggling to fit into a group of learners who had been together for four years. According to the teacher, three learners, Merlyne, Anneline and Helen, then volunteered to help Sarah, specifically with mathematics. Sadly, there was still no marked improvement in her performance. Given Sarah's predicament, what constitutes enculturation in a mathematics classroom?

## THEORETICAL FRAMEWORK FOR THE STUDY

Matthews (2000:161) contends that "constructivism is undoubtedly a major influence in contemporary science and mathematics education". In essence, constructivism is described as a learning theory that claims that: "knowledge is not passively received, but is actively built up by the cognising subject"; and "the function of cognition is adaptive and serves the organisation of the experimental world" (Matthews, 2000:175). Constructivism is viewed as an alternative learning theory to behaviourism; and according to Atherton (2003:1), it fits in "somewhere between the cognitive and humanistic views". Atherton's (2003:1) explanation of what constructivism entails emphasises the roles of the social and communicative dimensions of learning. This emphasis on the social aspect points towards a more active role by the learner "in a joint enterprise with the teacher of creating new meanings" and ties in well with Vygotsky's view on the importance of "interpersonal exchange" in the learning process (Sfard, 1998:489). A distinction is thus made between cognitive constructivism, which deals with understanding and making sense; and social constructivism, which emphasises "how meanings and understandings grow out of social encounters" (Atherton, 2003:1). It should therefore be noted that oral communication, which includes feedback, plays a major role in making social encounters into learning events that facilitate sense-making and understanding. Hence, the purpose of this study was to explore the constructs that are key to understanding mathematics enculturation in the classroom through the constructivist lens of learning mathematics. The emergent research question that guided the way we looked at data and the analysis thereof was: *What constitutes mathematics enculturation in the classroom?*

## **METHODOLOGY**

### **Research Design**

Since exploring the processes of mathematics enculturation in the classroom constitutes the core of our study, a qualitative research approach, employing case study design, was adopted to conduct the study. The assumption was that an understanding of the inner perspective of Sarah could only be achieved by participating in her world and gaining as much insight as possible. To capture what happened in Sarah's world in the mathematics classroom, the study design had to provide for direct information about Sarah's actual participation in class activities. The information would help describe and explain how she learned while learners (or we) engaged in learning activities.

### **Participant**

The participant in this study was a Grade 5 learner at a school in Limpopo Province of South Africa.

### **Instrument**

Video-taping while the learners were engaged in learning activities, participant observation (Budhal, 2000) and analysis of learners' written class work were used to collect data. The three techniques for data collection were used in the search for convergence among multiple and different sources of information to form themes or categories in the study (Creswell et al., 1998). The purpose of the video-taped data was to provide information about the actual activities of Sarah and the other learners. It was important to know, for instance, the time learners spent doing recitation activities, group work, learner participation and so forth. Analysis of the learners' written work was done not only to locate mistakes, but also to explore the content of the learners' procedural knowledge and their conceptual understanding during the lessons. The analysis was done during balanced participant observation where one researcher observed and participated in some activities but did not participate fully in all activities, while the second researcher filmed the video. Therefore, the participating researcher had to maintain a balance between being an insider and being an outsider. This entailed engaging in careful, systematic experiencing and conscious recording of details regarding many aspects of the teaching and learning situations.

Using participant observation enabled the researcher to interact with Sarah and the learners, participate in the classroom activities and clarify the learner's doubts when requested by them. Participant observation was also adequate for dealing with behaviours that Sarah was unable to verbalise (Krathwohl, 2004).

### **Procedure**

A constructivist learning environment was created in the classroom, such that each learner was seen to re-create mathematics with the constraint of social interaction as the medium for the development and limitation of those personal creations. The culture created in the classroom was such that learners worked on the activities in their groups and later had a class discussion where an attempt was made to negotiate for a common understanding. We did this whilst acknowledging the fact that each learner would develop his/her own constructs.

All the lessons were initiated and focused through learning activities that were pre-planned as part of the day-to-day mathematics teaching and learning programme. The activities were prepared with the aim of achieving specific learning outcomes on multiplication as prescribed by content teaching policy – content validity. This adherence to policy ensured that the research agenda did not tamper with the content taught or compromise the learners. We collaborated with the practicing teacher in terms of: planning teaching experiment lessons; experimentation in the classroom; and retrospective analysis. We were co-facilitators during the learning sessions. In planning for the teaching experiment lessons, we followed the activities as they appear in the Grade 5 learners' guide textbook but provided additional activities where we felt that the concepts to be developed were not well understood.

Data were constructed by writing critical incidents in researchers' journals during the teaching experiment. The incidents came from lessons based on the activities on multiplication. However, as the learners were engaged in activities, we listened to teacher-learner interactions and learner-learner interactions. Sarah's body language and reactions to situations and challenges encountered in the classroom were also observed and noted. A sample of Sarah's responses to classroom teaching and learning activities was also collected. These included Sarah's challenges, which emerged during the time we tried to establish ways to make her feel and be part of the group.

## **DATA ANALYSIS**

Data analysis involved zooming into Sarah's group to illustrate a chronological account of observed discussion by the group. Polkinghorne's (1995) narrative analysis of eventful data for analysis was used. With narrative analysis, instead of separating data into discrete parts, data are synthesised into a coherent developmental account.

Interpretations of the data are arrived at in their immediate, rather than in their possible future developments. Evidence of findings is provided by using vignettes from related excerpts of discussions and incidents that are found substantive to the narrative. Finally, the choice of significant excerpts is made in consultation with the research questions and purpose of the study.

## RESULTS

### The Teaching Experiment

The teaching experiment shows various interactions between learners, with special focus on Sarah's enculturation as a new learner at the school and in the class.

#### Lesson 1:

The activity given to learners was a follow-up on one that they had done on counting and addition, and encompassed the introduction of multiplication. The idea was for learners to use their prior knowledge on counting and addition to carry out this activity. The activity was taken from the basic textbook: *Maths for All*, Grade 5.

#### Activity 2: Buying Herbs

1. For their new herb garden, Mr and Mrs Gordon bought the following: 3 boxes of rosemary, 6 boxes of thyme, 8 boxes of origanum and 10 boxes of coriander.
  - (a) How much did they pay for the rosemary?  
Complete:  $R4 \times 3 = \square$
  - (b) How much did they pay for the thyme?  
Complete:  $R8 \times 6 = \square$
  - (c) Now work out how much they paid for the coriander and origanum. Write number sentences for your answers
2. Their neighbour, Ouma Mentoor, bought 4 boxes of thyme and 7 boxes of origanum. Ouma had R80 before buying her plants. How much money did she have left?

#### Excerpt 1:

(Recorded by the researcher involved in the interaction)

This is what happened in the classroom:

*Teacher:* Do the activity on page 27 from your textbook *Maths for All* on buying herbs.  
(About five minutes after learners started working on the activity the teacher looked a bit frustrated.)

*Teacher:* Hey, you need to write down what you are doing. We need to see that on paper.

*Learner A:* Madam, do you mean that I should write down what I was explaining to you.

*Teacher:* Exactly, you need to present those ideas using numbers.

They continued working on the activity. During the process, I would go to Sarah's group (Merlyne, Anneline and Helen) to see how she was interacting with other learners and to find out if she was working on the activity. As I observed Sarah's group from a distance I could see her nodding her head. This prompted me to get closer to make sense of her participation. On closer inspection, I noticed that the group had responded to question 1(a) and 1(b) as follows:

$$\begin{aligned} \text{a) } R4 \times 3 &= R4 + R4 + R4 \\ &= R12 \end{aligned}$$

$$\begin{aligned} \text{b) } R8 \times 6 &= R8 + R8 + R8 + R8 + R8 + R8 \\ R8 + R8 &= R16 \\ R8 + R8 &= R16 \\ R8 + R8 &= R16 \end{aligned}$$

$$\begin{aligned} \text{Then } R16 + R16 &= R32 \\ R32 + R16 &= R48 \end{aligned}$$

But the responses did not give a picture of Sarah's understanding. In my attempts to probe Sarah's understanding, this is what happened:

*Researcher:* Sarah, explain to me what you did here – referring to 1(a)  
(She kept quiet and looked scared.)

*Helen:* I can explain sir. Here we are multiplying R4 by 3, this is the same as when we add 4 and 4 and 4, and we get R12.

*Researcher:* What if you have R4 × 100?

*Helen:* I am going to write R4 a hundred times and add them one by one. Potsiso ya bobedi le yona ke e dirile ka wona mokgwa wo (I did the second question in this way).

*Researcher:* Do you think this method will always work for any multiplication problem?

*Helen:* Yes, it will work (looking very confident).

*Researcher:* Explain what you did to Sarah on the first two problems.

From the extract, it is clear that Helen did the questions on her own. Sarah did not utter a word to me. Instead of pestering her with questions, I decided to let Helen explain the responses to her. The confidence shown by Helen forced me to let her explain. I wanted her to continue working hard.

### **Lesson 2:**

This was a continuation of the activity the class was engaged in the previous day (Lesson 1). We asked them to complete the activity at home so that when they came to class they could start with the group discussion. During discussion, we realised that they were comfortable using repeated addition when given a multiplication exercise. We gave them three further multiplication questions, a small number, a relatively large number and a much larger number, to see if they would still find repeated addition the only way to do multiplication. We asked them to do the following products:

(a)  $20 \times 8 =$

(b)  $19 \times 12 =$

(c)  $100 \times 70 =$

As we expected, all the groups used repeated addition for all the questions.

### **Excerpt 2:**

This is how almost all the groups wrote question (a):

$$\begin{array}{r} 20 \\ 20 \end{array} \} 40$$

$$\begin{array}{r} 20 \\ 20 \end{array} \} 40$$

$$\begin{array}{r} 20 \\ 20 \end{array} \} 40$$

$$\begin{array}{r} 20 \\ 20 \end{array} \} 40$$

$$40 + 40 + 40 + 40 = 160$$

It was interesting to see how happy they were and asking for more questions. We decided to give them larger numbers just to see what would happen.

*Question:* Find the product:  $100 \times 100$

As they were working on the question, I went to check if Sarah was able to respond to the first set of questions. This time I did not involve other members of her group. I was prepared to go to some length to figure out her thoughts. This is what transpired:

*Researcher:* Show me how you would multiply 20 by 8.

(She kept quiet and did not look as if she was even thinking about my question. I resorted to using her mother tongue.)

*Researcher:* *Ok, Sarah o na le bagotsi ba bakae mo sekolong?* (How many friends do you have here at school?)

*Sarah:* *Ba four.*

*Researcher:* *Ge ele gore o mongwe le o mongwe wa bagotsi ba gago ba go fa R10, go ra gore ba go file bokae ka moka ga yona?* (If each one of them gives you R10, how much will you have in total?)

*Sarah:* *Ke R40.*

*Researcher:* *O ebweditse bjang?* (How did you get that?)

*Sarah:* *Ke a tseba gore di R10 tse four ke R40* (I know that four R10 equals to R40).

At least Sarah was talking although still reluctant to give details. In the interaction that follows, I was trying to establish how she arrived at R40 but in a way she just knew that four R10 equals R40.

*Researcher:* *Ge nka go botsisa gore 10 multiply by 4 ke bokae o tla reng?* (If I ask you what the product of 10 and 4 is, what would you say?)

*Sarah:* *Ga ke tsebe* (I do not know).

- Researcher:* *Ge re re ba go fa R13, o tla ba le bokae?* (If each one of them gives you R13, how much will you have?)
- Sarah:* (Very quick to respond) *Di R13 tse four diswana le R10 tse four le di R3 tse four. Ke a tseba gore di R10 tse four ke R40 and di R3 tse four ke R12. Ge ke tlakantsa R40 le R12 ke hwetsa R52.* (Four R13 is the same as four R10 and four R3. I know that four R10 is equal to R40 and four R3 is equal to R12. When I add R40 and R12 I get R52).
- Researcher:* *3 multiply by 4 ke bokae?*
- Sarah:* *Ga ke tsebe* (I do not know).

Going back to check how other learners were responding to the question ( $100 \times 100$ ) we found that they still used repeated addition. Interestingly, they were complaining that it took them a lot of time to write down all the hundreds and add them one by one. We were satisfied that, though they used repeated addition, they understood what it meant to multiply. Merlyne was excited and we asked her why. This is what she presented on the board.

- Merlyne:* Sir and M'em, let's say I multiply 28 by 8. I know that 28 is the same as  $20 + 8$  and this is what I will write:
- $$\begin{aligned}(20 + 8) \times 8 &= (20 \times 8) + (8 \times 8) \\ &= 160 + 64 \\ &= 224\end{aligned}$$
- Teacher:* Merlyne why do you separate 28 into 20 and 8
- Merlyne:* It is easy for me to multiply numbers that end with zero by a single number and it is also easy to multiply a single number by a single number.

It was already time up and most learners were no longer paying attention.

## DISCUSSION

The teaching experiment was done to explore what constituted Sarah's enculturation arising from the two lessons. The following issues emerged as key to the enculturation of Sarah and others in the classroom: Language; shaping of learners' ideas; and negotiation of meaning.

### Language

It is through language that we communicate with one another and share ideas. As mentioned by Seeger, Voigt and Waschescio (1998), language is the limit of what one can express and more importantly, language is culturally specific and learned as one develops.

From the two lessons, it emerged that language plays an important role in teaching and learning. The classroom culture, as it evolved during the course of the year, was such that learning occurred through social interaction. In this case, English was used during the interactions. In a way, it meant that learners who were unable to speak English would find it difficult to cope with the flow of activities unfolding during the learning process.

An example of such a case was Sarah, who was new to the school. She had to undergo enculturation into the school culture and ultimately the classroom culture. The culture of the classroom was such that learners were free to talk to each other, share ideas, and learn through social interaction. Sarah had a problem with English. She could not construct a single sentence and it resulted in her feeling inferior. Consequently, she could not participate in the social interactions that were taking place.

In learning mathematics, sustained participation in conversations helps in generating, testing, correcting, and validating subjective representations of mathematical knowledge (Ernest, 1998). On the other hand, teachers do not have direct access to learners' understanding, since knowledge can only be identified as the individual's mental constructions. It is through, but not limited to, interactions with learners that teachers get an idea of what learners know and understand. Looking at Sarah and Helen, it is evident from the two lessons that Helen's enculturation into the mathematical culture had been a smooth one compared to Sarah's. The main reason was that Helen did not have problems with English, and the environment therefore allowed her to engage freely in classroom interactions.

### Shaping of Learners' Ideas

It is through language that we are able to communicate and share ideas with other people. In a mathematics classroom where social interactions are being encouraged, it becomes even more important for learners to be able to communicate with each other. It is through this social interaction that individual learners make sense of what is

being discussed. It becomes very difficult to find out if learners understand if they are not communicating their ideas (as we saw with Sarah).

It was evident from both lessons that Sarah found it difficult to adapt to how things were done in her classroom. The environment created or the culture of the classroom was such that learners learned by interacting with one another. Sarah found sharing ideas with other learners very difficult. She hardly contributed to group discussions at all.

Not being able to participate in the processes of a mathematical classroom is more likely to affect how one learns mathematics in a social mathematics classroom. Saying aloud what you think helps to clarify your understanding. This allows other members of the class to help in modifying and shaping those ideas. Moreover, while enculturation involves learners sharing ideas and helping each other to shape those ideas, it also provides the teacher with an opportunity to shape those ideas.

### Negotiation of Meaning

In a classroom where social interaction is encouraged, learners come up with different ideas. The challenge becomes how to get to a point where the class agrees on the meaning of what is being discussed. By questioning during the discussions, the teacher should give direction to the process of negotiating for meaning. Negotiation of meaning from the two lessons was done during group discussions as opposed to whole class discussions. This provided the opportunity to engage learners in rigorous discussions.

## CONCLUSION

The purpose of this study was to explore what constitutes mathematics enculturation in the classroom, with particular focus on Sarah's enculturation. The following constructs emerged as key to understanding mathematics enculturation in the classroom: language, shaping of learners' ideas, and negotiation of meaning. The implication is that oral communication, which includes feedback, plays a major role in making social encounters into learning events that facilitate sense-making and understanding.

## REFERENCES

- Atherton, J. S. (2003). *Learning and teaching: Constructivism*. [Online] Available at: <http://www.dmu.ac.uk/~jamesa/learning/constructivism.html> (Accessed 11 March 2005).
- Bauersfeld, H. (1998). About the notion of culture in mathematics education. In F. Seeger, J. Voigt and U. Waschescio (eds.). *The Culture of the Mathematics Classroom* (pp. 375-389). Cambridge University Press. <https://doi.org/10.1017/CBO9780511720406.015>
- Bishop, A. J. (1988). *Mathematical Enculturation: A Cultural Perspective on Mathematics Education*. Dordrecht Kluwer A. Publishers. <https://doi.org/10.1007/978-94-009-2657-8>
- Bishop, A. J. (1991). *Mathematical Enculturation: A Cultural Perspective on Mathematics Education*. Netherlands: Kluwer Academic Publishers.
- Budhal, R. S. (2000). The impact of the principal's instructional leadership on the culture of teaching and learning in the school. MEd dissertation. Durban: Unisa.
- Creswell, J. W., Miller, D. L. and Olander, L. S. (1998). Writing and retelling multiple ethnographic tales of a soup kitchen for the homeless. *Qualitative Inquiry*, 4, 469-491. <https://doi.org/10.1177/107780049800400404>
- Ernest, P. (1998). The culture of the mathematics classroom and the relations between personal and public knowledge: An epistemological perspective. In F. Seeger, J. Voigt and U. Waschescio (eds.). *The Culture of the Mathematics Classroom* (pp. 245-268). Cambridge University Press. <https://doi.org/10.1017/CBO9780511720406.010>
- Knijnik, G. (2002). Two political facets of mathematics education in the production of social exclusion. Proceedings of the 3<sup>rd</sup> International MES Conference. Copenhagen: Centre for Research in Learning Mathematics, pp. 1-9.
- Krathwohl, D. R. (2004). *Methods of educational and science research: an integrated approach* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage.
- Matthews, M. R. (2000). Constructivism in science and mathematics education. In Phillips DC (ed.). *National Society for the Study of Education, 99<sup>th</sup> Yearbook*. Chicago: Chicago University Press, pp. 161-192.
- Mead, M. (1963). Socialization and Enculturation. *Current Anthropology*, 4(2), 184-188. University of Chicago Press. <https://doi.org/10.1086/200358>
- Nunes, T. (1992). Ethnomathematics and everyday cognition. *Handbook of Research on Mathematics Teaching and Learning*. New York: Macmillan.



- Pirie, S. and Kieren, T. (1992). Creating constructivist environments and constructing creative mathematics. *Educational Studies in Mathematics*, 23, 505-58. Netherlands: Kluwer Academic Publishers. <https://doi.org/10.1007/BF00571470>
- Polkinghorne, D. E. (1995). Narrative configuration in qualitative analysis. In J. A. Hatch and R. Wisniewski (eds.). *Life history as narrative*. London: The Falmer Press. <https://doi.org/10.1080/0951839950080103>
- Seeger, F., Voigt, J. and Waschescio, U. (1998). Introduction. In F. Seeger, J. Voigt and U. Waschescio (eds.). *The Culture of the Mathematics Classroom* (pp. 1-12). Cambridge University Press. <https://doi.org/10.1017/CBO9780511720406.001>
- Sfard, A. (1998). The many faces of mathematics: do mathematicians and researchers in mathematics education speak about the same thing? In A. Sierpiska and J. Kilpatrick (eds.). *Mathematics education as a research domain: a search for identity*. Dordrecht: Kluwer Academic Publishers, pp. 451-492.