STUDENTS PERCEPTIONS ABOUT THE RELEVANCE OF MATHEMATICS IN AN ETHIOPIAN PREPARATORY SCHOOL

Andualem Tamiru Gebremichael, Simon Goodchild and Olav Nygaard
University of Agder, Norway

This paper presents results from a pilot study into students’ perceptions of the relevance of mathematics. Cultural historical activity theory is used as an analytical perspective. Data are collected through interviews supported by classroom observation. Convenience and purposive sampling were used to select the school and students. Findings indicate that students perceive that only basic mathematics is used in their everyday activities whereas the mathematics they are learning at the moment: has an indirect relevance through other subjects or used by professionals; has use in their future studies; has an exchange value in the market place of joining the university and getting job; and in mathematics they experience a sense of identity, empowerment, spirituality, and trust in the curriculum and their teacher.

INTRODUCTION

The students in this study are preparing for higher learning institutions (hence the school designation ‘preparatory’). The first author’s experience as a mathematics teacher has revealed that there are many who consider mathematics as an academic exercise rather than a social activity; he has observed that even some teachers are challenged when they encounter real-life problems that could be solved using mathematics. Literature indicates that mathematics with real world connections makes learning mathematics more effective (e.g. Gainsburg, 2008, Heibert & Carpenter, 1992, Mason & Spence cited in Even & Tirosh, 2008, Goldin, 2008). Other studies show that the perception of students about the learning of mathematics is important for success (e.g. Dossey, 1992, Even & Tirosh, 2008, Moreno-Armela & Santos-Trigo, 2008, Mulat and Arcavi, 2009).

A key term in this study is perception, but there are other terms used in contemporary works such as belief, and conception which appear to be related to perception. Thus, it is worth describing these concepts as they differ from perception in this study. According to Merriam Webster’s dictionary, conception is “a complex product of abstract or reflective thinking” (‘Merriam Webster’, n.d.). Goodchild (2001) uses the word conception and defines it “as a collection of schemata, or knowledge representation structures that is evoked by a particular task and subsequently directs a student’s activity” (p. 72). The other competing word ‘belief’ is defined in the Merriam Webster’s dictionary as “a state or habit of mind in which trust or confidence is placed in some person or thing. …conviction of the truth of some statement or the reality of some being or phenomenon especially when based on examination of evidence” (‘Merriam Webster’, n.d.). Similarly, Goldin (2002) explains that beliefs are “multiply-encoded, internal cognitive/affective configurations, to which the holder attributes truth value of some kind (e.g. empirical
truth, validity, or applicability)” (p. 59). The definition for perception in Merriam Webster’s dictionary is, “a result of perceiving” where to perceive means “to attain awareness or understanding of … to regard as being such” (‘Merriam Webster’, n.d.). Since the study seeks to expose the meaning the student attaches or her/his understanding of the relevance of mathematics the student is learning, the term that fits the purpose here is perception. Mulat and Arcavi (2009) also studied the perception of high achieving students about what fosters “their mathematics and academic trajectory” (p.77). In their study ‘perception’ referred to the students’ understanding of the factors that enable or constrain learning and achievement of mathematics. The purpose of this paper is to report a characterization of Ethiopian students’ perception of the relevance of mathematics with respect to their learning goals as well as about the relevance of mathematics to the society and their real life situation, which we believe exposes the perception in a peculiar context and help to improve the learning of mathematics in Ethiopia. The principal research question addressed in this paper is ‘what are Ethiopian students’ perceptions of the relevance of mathematics and how are they characterized’. The paper is structured in such a way that the theoretical perspective and methodology are discussed first, followed by the analysis which is presented within eight themes that emerged through the analytic process.

**THEORETICAL PERSPECTIVE**

The theoretical perspective that guides this study is cultural historical activity theory (CHAT), which is one strand of sociocultural theory. Sociocultural theory is about people’s active involvement in cultural practices and the inherently social nature of mental processes (Cobb, 2007; Confrey, 1995; Lerman, 1996). Proponents of sociocultural theory contend that there are many things that will remain obscure if the focus is only on the individual (Lerman, 1996; Wundt, in Cole & Engstrom, 1993). A basic tenet of cultural historical activity theory is that knowledge appropriation is a social process mediated by cultural tools such as language, with human activity as the unit of analysis (Lerman, 1996). The individual can continually change her/his environment including the social environment as she/he is shaped by it (Mellin-Olsen 1987; Roth & Lee 2007). Moreover, the experience of the first author indicates that whereas the students were all learning in English and interacting with each other in Amharic, they had different mother tongues, and it is believed that these students attach a variety of meanings to what they learn in mathematics depending on their cultural and social backgrounds. Thus, to launch a study into students’ perceptions of the relevance of mathematics, CHAT provides a useful analytic tool. The model that can describe the situation is Engström’s expanded mediational triangle (Cole & Engstrom, 1993), which models individual’s activity within which perception is mediated by the tools, rules, division of labour, and the community.

The students have been involved in the activity of learning mathematics long before they were enrolled in preparatory schools. In this activity which has a historical
dimension independent of the individual student, i.e. it has no definite beginning nor an end, with the ultimate motivation of survival of the society and the individual in the society (Roth & Lee, 2007), students are involved in a variety of activity systems, for instance, the school and the local community. The school rules enforce the curriculum and exams, and the textbooks are mediating artefacts which may or may not set learning experiences in a context that exposes the use value of mathematics. On the other hand, the textbooks and the lessons are presented through the medium of the English which the student uses at school only. The students’ perceptions are mediated by all these elements. It is in such a framework that such behaviours could be interpreted (Roth & Lee, 2007).

METHOD AND METHODOLOGICAL REFLECTIONS

The study is situated in the interpretivist paradigm. The intention is to understand students’ perceptions. The research question and the theoretical framework lead to the development of a qualitative research methodology because perceptions are behaviours that “can only be understood within [their] environment, which needs to be explored and explained” (Burton, 2002, p. 8), and it allows the investigation of the situation from the perspective of the participants. It is a case study design recognising that the knowledge gained is influenced by the peculiar culture of the setting. The data are collected through interview of students from one chosen school which has its own peculiar features although ‘typical’ of Ethiopian preparatory schools. Since the purpose is to see the relevance of mathematics through students’ eyes the appropriate way to do it was holding an interview because it enables one to hear their own account. Particularly focus group discussion was used where students were provided discussion points to expose their opinions, and probe them with further questions to enrich the data. This was intended to create a situation where the students feel secure among their own classmates, and probe each other as well as to engage with more informants in the time available. Classroom observation supported probing during the interviews and exposing features of the mathematics classroom. The first author had taught for more than three years in the selected school and there are former colleagues who helped the selection of students. The topics and students’ experiences might vary across gender, streams, grade levels, and achievement level. The department head selected 4 classes – 2 from social science and 2 from natural science (i.e. one from each of 11th and 12th grades) – where the mathematics teachers were homeroom teachers (the teachers having first line of responsibility for the students in a class) because they have better experience of the students and their academic standing. Then each teacher selected 3 female and 3 male students who were identified as low, medium, and high achievers. A total of 24 students were selected. Students of same sex from the same class were interviewed in the same group which was intended to create a situation where the students felt more comfortable and the relative freedom to express their ideas and probe each other. Themes emerged from the analytic process, and each theme is analysed using CHAT as a framework for identifying key features.
DATA ANALYSIS

In this section the data analysis is presented as a descriptive account of students’ perceptions of relevance, under eight themes which are ‘grounded’ in the analysis.

Mathematics is relevant because it is used in every day activity

The students are engaged in the activity of learning mathematics and they are also participating in the day to day activities of the society. Some students perceive that mathematics is relevant to every day activity Azenegash says, “how far I am coming from home. ... Those who work in the Edir [1] should know mathematics”. Her perception is mediated by the artefact (the road) and the community in the local activity. Their mathematical knowledge is valued by their community. Ruth says, “When my mother wants to calculate something she calls me to do it for her; if she was educated she could have done it herself [2]”. Her perception is mediated by her role in the local activity – she is involved in the budgeting of the family’s expenditure. However, Ibrahim perceives that the knowledge being used in every day activity is that which they learnt at primary school because the society is “not a developed society” but he mentions that, “the ball should be spherical so that it can roll”. His perception is mediated by the local community and the cultural artefacts.

On the other hand, Beza mentions an example where an outcome of the school activity was used as a tool at the workplace, “population size, proportion, death rate, average, etc. are useful in society. … My father works for the statistics authority”. Her perception is mediated by the local community, through her father. The student’s role as a mathematics learner also mediates perception of relevance, Azenegash says:

... But now I departed from my friends. ... They are in another school [3] now. …there were clever students [who] explain to us. We used to discuss while walking home. …I don’t score in it and when I miss something I don’t get back to see it again.

The change in Azenegash’s activity system had impact in her learning of mathematics. She used to pay attention to her surroundings with respect to mathematical meaning, and relevance of mathematics she mentioned before was about distance from home to school. Fisiha works in a wood work shop with his brother. He says, “For example, in my job, I measure, I should read the number; in order to cut accurately you should learn number”. His role in the activity of the local community mediates his perception.

Mathematics is relevant because it is used in other subjects

Some students perceive that mathematics is relevant to other subjects they are learning, Mekia says, “mathematics is useful for physics. ... In chemistry we have mathematics”. Beza gives a specific example. She says, “Log, we learnt, is applied in bacterial growth; so it is used in biology”. Habtu provides another example, “physics involves number e.g. vector”, but he comments that “those [they] are learning now are rarely used”. Their perceptions are mediated by the school curriculum. Debesh’s perception is mediated by the local community and the school rules; he says:
There is calculation in Geography, Business; not the [subject] mathematics but the calculation in these subjects is useful. … I think there are subjects which are related to mathematics. Those subjects have societal values. Thus, your knowledge of mathematics will help you for dealing with those subjects.

Whereas Fikru says, “In 7th or 8th our teacher said ‘mathematics is the king of all subjects’. … it has use in chemistry, rector scale in geography; it is related with all other subjects”. His perception of relevance is mediated by the school community and rules. On the other hand, Meseret’s perception of relevance is associated with her stream. She says, “We are social, we don’t use much calculation… Other subjects are to be learnt by heart; I take break with mathematics … It is … compulsory”. Her perception is mediated by the other subjects, school rules and community.

**Mathematics is relevant because it is useful in an unknown future**

The students are preparing for university studies. Hence their perception of the relevance of mathematics is mediated by their future goal. Habtu says, “I want to study astronomy and my brother told me that in addition to mathematics, physics is the base”. The local community mediates his perception of relevance. Yirdaw says:

What we are learning now, I don’t see its application. … But in offices I think they use it. … We are in the process of development. It is useful for what will learn in the future, I think. So, we must learn it.

His perception is mediated by the local community as he perceives that it is being used in the work place. On the other hand, some students explain the future based on their experience of the interdependence of the current activities of learning, Abebe says:

I don’t know the detail about astronomy and how much mathematical capacity it requires. Since mathematic is important in our every day activities, it would be the same at that level. I think it would be important.

Whereas Meseret considers a specific case and projects it to the future. She says, “[mathematics] is a mother tongue. … In economics there is slope. We learnt it in 7th or 8th. We didn’t know then that it has this use”. Hayal who wants to study Medicine or Chemistry remarks its relation with science “Science without mathematics? I don’t believe that”. Whereas, Makida says, “In books we don’t see where to apply [it]. [It] has relation with other subjects and we apply it on them… at tertiary level”. Thus, the other subjects, the school rules and the tools at school mediate their perceptions.

**Mathematics is relevant because it gives an identity**

Students appear to form their sense of identity in relation to mathematics. Debesch wants to “study Banking and Insurance because it has mathematics” and he “like[s] mathematics … it is not difficult for [him]”. He perceives himself as someone who can do mathematics well and this sense of identity that he has in relation to mathematics is a motivational factor towards making a decision about what he has to
study in the future. Essayas, on the other hand, perceives himself as someone who
doesn’t want to deal with mathematics; he says, “I want to study law because my
brother told me that it doesn’t involve mathematics … economics, but [it] has
mathematics; so I don’t like”. His perception of relevance is mediated by the local
community, and the emotion towards mathematics. His decisions about the future are
mediated by his identity in relation to mathematics. There is emotion involved in their
perception. The students’ perceptions might be related to a specific type of
mathematics. Abebe says,

I like word problems, because it involves critical thinking and analysing … it has to be
related to our society, things that we know and experience in our lives. Not in some other
society; the names when related to our situation then we do it with interest. When it talks
about some world we don’t know – names and places we don’t feel that we have any
concern about it – then it is done while we didn’t understand the use

Debesh says, “I like all but word problems are tricky. Use difficult words … or they
are difficult to understand”. These students are learning in English which they only
use at school. Some students perceive that mathematics broadens their mental
capacity, Netsanet says,

In sequence, we use formulas. But before we use formulas, there are items which we do
simply by observation, by looking at it attentively. That helps you to think and analyse; it
broadens your mental capacity.

Her perception is mediated by the school rules. The students’ perceptions of
relevance to their identity might also be understood in a dialectical relationship
between the individual and the collective. Ruth says, “Most social science students
don’t like mathematics. Only few students work hard. Thus our teacher always
advises us”. She is high achieving and in other discussions as well she refers to the
whole of students and the social science when locating herself in the mathematics
classroom. There could also be a shift in students’ perceptions. Beza says, “When I
saw that I scored B in mathematics in 10th I didn’t expect and I believed that I can
perform well”. Her perception changed because of her score. The school rules which
insist score in exam as success in learning and the score as a tool mediated her
perception.

**Mathematics is relevant because it empowers one to make informal decisions**

Some perceive that mathematics and the other subjects are there for them to expose
their talents. Erikihun says:

I want to study language or philosophy. … I am doing well in language. … Mathematics
and most of the subjects we are learning now might not be related to what we learn in the
future. But, they help us to identify/know our interest and direct us to the future. We used
to learn music; it is not important but if you have the interest then you will know. Some
of us may end up in a field that doesn’t involve mathematics at all but others may need it.
He perceives that the other subjects are competing with mathematics for students’ choice or attention. Since he made other choices of social science, he perceives that he doesn’t need mathematics, but learns it because others in his group need it. His perception is mediated by the other subjects, the school rules and community.

**Mathematics is relevant because the student trusts the curriculum**

There is a sense of trust in the curriculum. Asad perceives that they learn mathematics because “[they] should learn it”. Ruth trusts the curriculum because “the teacher tells [them]” and her perception is mediated by the school community. Azenegash says:

[The teacher] is our eye. … If it were not relevant we wouldn’t have been taught … my teacher was telling me, now I realized that it was right: ‘when you are walking, it is the shortest distance to travel on the straight path’. He did it for himself.

The teacher is the source of perception for trusting the curriculum, and the division of labour in the school activity also mediates her perception. She didn’t see how the teacher did it and her role was to listen. She puts her trust in the teacher that what is taught would have meaning in her life to come. On the other hand, Debesh says, “We don’t see. But, the teacher tells us; for example, log in earthquake measuring, in chemistry, though the concepts are difficult for us”. In one of my classroom observations in Debesh’s class (a social science 11th grade classroom) the teacher was providing an example about earthquake and pH value in a lesson about logarithm. The mathematics teachers have natural science background, which might influence their practices in implementing the school curriculum, which mediates students’ perceptions of relevance.

**Mathematics is relevant because it has exchange value**

These students are supposed to score a qualifying grade to be admitted to the university, and Ethiopia is a poor country in which success in education and securing a job relates to sustaining the life of the individual as well as the family. Beza says, “We used to hear that 10th is the turning point for life. … [Studying] any social science would be ok [to be a hostess]. … Mathematics is compulsory”. She is sure that success in mathematics is the gate keeper to joining the university. The division of labour in the local community also mediates students’ perceptions. For example Ruth says, “Earlier I wanted to study law but it is 5 years. [I] study economics … then I can help my parents. … If I don’t have the basis in mathematics I can’t do [economics]”. Thus, she learns mathematics to sell it at the marketplace of learning economics so as to get job at the end. The division of labour – her responsibility to help her parents – mediates her perception of relevance. The tools in the school activity mediate Yirdaw’s perception in his endeavour to become “a private accountant”. He says, “Mathematics books from abroad are better at applications than domestic ones. … I prefer the [latter] for success in exams. But, for my interest I prefer the [former]”. Here we see that this perception is a development which resulted from the contradictions between the mediating artefacts and the school rules.
Ahadu wants to “become a [medical] doctor”, and he thinks that “whether one becomes a medical doctor or something else learning mathematics is part of the process”. His perception is mediated by his future goal. Emotion also mediates students’ perceptions. Alewi says, “I am not interested in it but it is required … I liked polynomial at the beginning. … when I scored poor at the first test, I turned my back to it again”. There is contradiction between her emotion – that she liked it at the beginning – and the school rule – that she should succeed in exam – which led her to a change of perception, dropping it as irrelevant.

**Mathematics is relevant because it gives a fresh perspective of life**

Some students give spiritual meaning to the mathematical concepts they are learning. Hayal says:

> I brought the idea of limit to my life and interpreted it as, there is time when life ends; all the things that bother me together with my life in this world, come to an end, and begin the new life in heaven.

Her perception is mediated by the rule in the local activity – the religious teachings. Her society believes that there is life after death where this new life is static. In the same interview group, another student, Makida says:

> Similar to what is mentioned by Hayal, when I learnt sequence, I learnt that things are in order they don’t occur/happen randomly. It is as the saying goes ‘there is time set for something’ [Solomon’s saying from the Bible]. For example, we can’t say 1 then 5; in life also we can’t walk immediately after we were born; it goes in steps. Things in life are ordered or they happen sequentially. This is what we learn indirectly.

Since the school curriculum did not provide direct applications the school rule mediated these perceptions of relevance.

**CONCLUSION**

The participant students perceive that mathematics in general is relevant to their real life situation. But, they perceive that the mathematics dominantly in use is that which they learnt at primary school and some concepts they are learning at the current stage have got some uses in other subjects or workplaces. This relates to their access to material and technology which might involve application of higher mathematical concepts. They perceive that the mathematics they are learning has use in some unknown future which is mediated by their future goals; and others don’t see any relevance to their future studies. They also perceive that mathematics is a means of access to the university and getting a job, which relates to the economic context of Ethiopia as well as the responsibility of the students to support their family/parents. Some put trust on the curriculum and their teachers. They exhibit some kind of identity related to mathematics which sometimes changes. Some attach to it a meaning of empowerment to make informal decisions while others attach a spiritual meaning which relates to the peculiar features of Ethiopian society: the belief in life after death which is static, and The Holy Bible. A question remains to be answered
whether there is any relationship between the different categories of students included in the sample and different characterizations of perceptions discussed above. Addressing these questions is left to the next stage of the project.

NOTES

1. EDIR is social institution in the Ethiopian culture where members gather to discuss about issues related to social problems. They contribute money every month, and on the death of a member or siblings, they arrange a mourning ceremony including the funeral which lasts for three days. Members earn money as compensation on the death of a member or siblings. It is led by an elected board members consisting of chairman and a secretary. In some cases there are EDIRs for women only.

2. It is a common phenomenon in Ethiopia that mothers didn’t go to school. Some might have gone to the traditional school (called Kes Timihit literary means Priest School) where they learn the Geez alphabet (an old language now used in the Ethiopian Orthodox Church only and Amharic uses the same alphabet) and Ethiopian numerals which range from 1 to 1000 only, after 1000 it is elph (which means infinity).

3. In the Ethiopian education system students are enrolled to preparatory schools if they qualify in a national exam at the completion of 10th grade. Then, they will be assigned to the preparatory schools where they learn for two years and take another national exam which screens those who will be eligible for university studies.

REFERENCES


