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Students' experiences of learner autonomy in mathematics classes

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This paper presents representative excerpts from post-project interviews conducted with 8th and 9th grade students from a Norwegian countryside school. Interviews attempt to explore students' experiences of learner autonomy in mathematics classes. These students participated in a larger study where they responded to a pre-project questionnaire followed by solving practical group projects using mathematics and science knowledge and post-project interviews. Preliminary interview analysis reveals that students' experiences with learner autonomy in mathematics classes are limited to opportunities provided by their teachers together with an insecurity in perceiving themselves as responsible autonomous learners. However, these learners clearly exhibit a desire to acquire autonomy, the potential to suggest changes, and participate in discussions and decisions concerning their mathematics teaching-learning process, together with their teachers.

Keywords: Student experience, learner autonomy, classroom environment and mathematics instruction.

Introduction

Developing autonomy in learners has been emphasized as a goal of mathematics education (Ben-Zvi & Sfard, 2007; Yackel & Cobb, 1996). Learner-centered teaching strategies such as mathematics teaching based on real-life contexts, inquiry-based and problem-centered learning (Wheatley, 1992; Yackel & Cobb, 1996) have been discussed to increase learners' autonomy in learning mathematics. However, discussions related to autonomy in mathematics education literature have mostly depicted it as an *intellectual* attribute to be acquired while working with mathematical problems in order to identify, enquire and develop alternative solutions, and/or as the ability to scaffold mathematical algorithms and procedures in a better way (McConney & Perry, 2011; Mueller, Yankelewitz, & Maher, 2014; Wood, 2016; Yackel & Cobb, 1996). Specifically, intellectual autonomy has been defined as, "students' awareness of and willingness to draw on their own intellectual capabilities when making mathematical decisions and judgements" (Cobb & Yackel, 1998, p. 170). However, less researched aspects of autonomy in mathematics classes are the ones in which learners themselves "develop a particular kind of psychological relation to the process and content of [their mathematics] learning" (Little, 1991, p. 4). Developing such a *psychological* relationship with their mathematics learning can help students better understand, intervene and improve the ways *they* learn mathematics.

The first section of chapter one of the Norwegian Education Act (NEA), states that "[through education] students and apprentices must learn to think critically, and act in an ethically and environmentally conscious way. They *must have co-responsibility* and *the right to influence* [their education]" (Opplæringsloven, 1998/2018, italics added). For pupils to have the responsibility and right to influence their mathematics education, they need to take charge of their own learning in mathematics, that is become autonomous, at least partially. Further, if learners are supposed to apply their mathematical knowledge toolkit effectively in order to solve real-life problems after finishing formal education, they should be autonomous learners. Not only to solve their own real-

life problems using mathematics, but also to participate as critical, responsible and active future citizens of society, learners need to have experience and training in understanding and thinking over their current situations along with taking right decisions and actions to reach desired outcomes. This would require learners to acquire and practice both, the *intellectual* (i.e., the capability to take reasoned decisions), and the *psychological* aspects (i.e., a perception and an experience in exercising) of their autonomy. Although each learner is autonomous and possesses some decision-making skills, these should be nourished by getting an experience of exercising them within their immediate community and own peer-group (in the mathematics class). By learning how to balance power, authority, freedom and co-responsibility among themselves, students would effectively use their autonomy to take charge of their own lives, decisions and their consequences, and benefit society. Consequently, researching psychological aspect of *learner autonomy* in mathematics classes, in addition to its intellectual aspect, is equally significant if learners are to be motivated to succeed in mathematics (George, 2012).

By *learner autonomy* in this paper, I mean learners' ability to develop a psychological relation with, and freedom to take *responsibility* of their own mathematics learning process. This *responsibility* includes learners taking initiatives, participating in discussions, planning and executing self-beneficial mathematics learning activities, making decisions about what one wants to learn, how one likes to learn, at what pace and why together with their teachers, and simultaneously reflecting on these choices. Learner autonomy is a widely researched concept and is considered to be an essential attribute for learners of any second/foreign language because of its positive correlation with language learning (Little, 2003). However, the positive influence of acquiring learner autonomy may not be limited only to second/foreign language learning. Therefore, in this paper, I explore the research question "What can young learners' descriptions communicate about their experiences of learner autonomy in their mathematics classes?" in order to explore young learners' experiences with learner autonomy in mathematics classes as per the aim of NEA.

Background of the study

This study is a part of a bigger research project called Local Culture for Understanding Mathematics and Science (LOCUMS, 2016). This project explores if using practical activities rooted in *learners' own culture* can benefit them in learning mathematics and science in lower secondary classes. Building on experiences from a former research project where solving practical tasks rooted in students' local culture in discipline design and technology promoted their school engagement (Lysne & Hoveid, 2013), LOCUMS intends to research if similar approach can increase students' interests in learning mathematics and science. While reviewing the literature, I observed that learner-centered intervention studies carried out in mathematics classrooms are often planned either by the researchers or the teachers, and learners' choices remain un(der)stated. For designing practical activities rooted in students' local culture for learning mathematics and science, it was important to get informed about learners' interests. Therefore, I designed a pre-intervention questionnaire consisting open and closed ended questions about themes such as: learner's general views about education, perceptions about mathematics and science education, their activities of interest, what they desire to learn about at the school, their thoughts on culture etc. The purpose of these questionnaires was two-fold – to design a learner-centered teaching approach voicing learners' opinions, choices and interests which acted as an input for designing practical activities;

and to explore learners' potential of taking reflected decisions and responsibility of learning mathematics. It was while analyzing students' questionnaire responses such as "I don't know what I want to learn in mathematics", "I do not know what [content] is useful to learn in mathematics", "I am not interested in learning mathematics, yet learning mathematics is important", to open-ended questions concerning mathematics that the notion of *learner autonomy* in mathematics classes emerged as my research interest. Therefore, learners' autonomy was investigated further through semi-structured interviews. Data gathered for LOCUMS was directed towards both mathematics and science, and consisted of a cycle of pre-project student questionnaires, practical group tasks, followed by individual semi-structured interviews with selected students. Group tasks required knowledge of mathematics and science to be solved. Semi-structured interviews were focused to probe learners' experiences of autonomy in mathematics classrooms among broader themes such as getting a vision of learners' experience on project day, their general outlook towards learning mathematics and science, the extent of activities used in the mathematics and science teaching and its relevance etc. Learners' responses about experiences of learner autonomy in mathematics classes collected in the first ten semi-structured interviews are presented in this paper.

Theoretical framework

Learner autonomy was first defined as "the ability to take charge of one's own learning" (Holec, 1981). The rationale of fostering autonomy in learners "... is quite simply that a teacher may not always be available to assist. Learners need to be able to learn on their own because they do not always have access to the kind or amount of individual instruction they need ..." (Cotterall, 1995, p. 220). The first definition of learner autonomy was later elaborated by Little (1991) as, "a capacity – for detachment, critical reflection, decision-making, and independent action" (p. 4). Further, Little (2003) mentions that, "... *autonomous learners* understand the purpose of their learning program ..., take initiatives in planning and executing learning activities, and regularly review their learning and evaluate its effectiveness" (p. 4, italics added). Therefore, learner autonomy entails more than intellectual autonomy, meaning the learners can "act freely with a sense of volition and choice" (Deci & Flaste, 1996, p. 89) and involves an activating psychological process in order to attain autonomy in relation to one's learning processes. Little (1991) moreover reminds of the difference between an autonomous learner and an independent learner. Being an autonomous learner does not mean that one is an independent learner and is able to learn without any assistance of the teacher, but it means taking a partial control of one's own learning process. By having a partial control, the learner should her/himself understand and reflect upon one's learning curve in order to figure out what strategies work best for her/himself. Resultantly, a learner can comprehend how one learns better and design, plan, execute and analyze self-beneficial mathematics learning strategies.

Students' intellectual autonomy has been discussed, but, I found fewer studies devoted to promoting learners' autonomy among students in mathematics education research literature. Research initiatives in directions such as *critical mathematics education* (Skovsmose, 2014), *culturally-responsive mathematics education* (Greer, Mukhopadhyay, Nelson-Barber, & Powell, 2009), *mathematics education for social justice* (Gutstein, 2003), and *sociocultural and sociopolitical awareness* (Sriraman & Knott, 2009) have illuminated social implications of learning mathematics for the learners and our future society. These research areas address concerns to acknowledge learners' interests, promoting pupils' critical awareness towards sociocultural and sociopolitical

issues involving mathematical calculations, and engage students in struggle for social justice through mathematics education. For learners to become mathematically literate critical citizens of society, they should be able to understand their responsibility of learning mathematics, comprehend the role mathematics plays in their lives and society, and make decisions involving mathematical calculation. These capabilities require students to understand and take charge of their own learning in mathematics. Skovsmose (2014) mentions that, “It is a preoccupation of critical mathematics education ... to develop a mathematics education that might provide new possibilities for the students” (p. 117). This study tries to enhance research concerning learner autonomy in mathematics education by providing the learners with an opportunity to express their experiences regarding learner autonomy in mathematics classes. The focus is to explore if learners are aware of their responsibility and can suggest changes to improve the quality of mathematics classes, provided they can assume more control of their mathematics teaching-learning process, as NEA expects from them.

Method and study participants

Qualitative research design using semi-structured interviews with students was adopted as a method to learn about students’ experiences. Since I wanted to know individual opinions, perceptions and thoughts of the learners participating in mathematics classes, interviewing seemed as an optimal way to proceed. Semi-structured interviews provided me with the opportunity to engage the learners in a free conversation with occasional follow-ups, without the restrictions of time limitations and a strict structure. In this way, participants could also, to some extent, control the direction of the interview, so that I avoided being the steering authority in the interview, and could gather authentic and trustworthy information.

Learners of age 13 to 14 years, studying in 8th and 9th grade in a countryside school located in central Norway were informants of this study. One learner per group was chosen from 4 or 5 groups in each class, based on the level of their activity on the project day. Keeping in mind the principal of representativeness, an attempt was made to select students with different interests, level of activity (high, medium and low), achievement in mathematics (high, moderate and low achievers) etc. so that various experiences could be gathered. Here, I present representative excerpts from interviews with 5 girls (one of them with Sámi background) and 5 boys (one of them with Eritrean background). Most of these students’ parents were working or driving farms, holding an average socio-economic status.

Results and discussion

The interviews were conducted in Norwegian, translated to English and interview transcripts were analyzed in order to identify learners’ experiences regarding learner autonomy in mathematics classes. Interview questions were designed so that learners had to reflect on their mathematics teaching, make choices, take decisions and suggest changes in it; and were analyzed to find learner responses involving words such as *control*, *decision*, *responsibility* etc. concerning their mathematics education. This section presents selected interview excerpts followed by the *descriptive analysis* of learners’ responses from the first ten informants. In the following transcripts, *I* indicates the interviewer and *L_{number}* indicates which of the ten learners is responding. Interviews were conducted after practical group activities and hence in the first extract presented below, the

interviewer is asking how in the learners' experience the learning situation on the day of project was different from the learning situation in their usual mathematics classroom. The following snippet illustrates the learners' experience:

- I: eh... do you think this way to repeat mathematics and science content was different from the usual teaching?
- L₃: yes...
- I: how would you describe that why was it different from usual teaching? ... how would you describe that the situation was different then? what was the difference?
- L₃: ... we did not sit in the classroom and raised our hands and talked like... we do not calculate like we discuss so much and find it together...
- I: but is it then different from usual teaching or would you say that it's also you who controls there as well?
- L₃: no... there it's the teacher who has more control
- I: but do you get it [the responsibility] usually like in mathematics and science classes?
- L₆: or... like we don't get to decide everything on our own because then it's like they have already decided what we should do from beforehand but also...

Both of the learners' responded that the learning situation they experienced on the day of project was different in terms of having control and responsibility. These experiences of learners about usual mathematics classroom exhibit limited experience with self-control and self-decision where the teacher is usually the one who manages the class and everything that is to happen in the classroom is decided beforehand. These classroom experiences, where learners are not exposed to the responsibility of their own learning, may inhibit learners' potential to understand, reflect, analyze and make decisions to improve their own learning processes for their self-benefit. Therefore, only when provoked a bit to assume autonomy, most of the learners suggested probable improvements in mathematics classroom:

- I: are you satisfied with the way teachers teach you?
- L₄: yes...
- I: why do you think that this way to be taught is alright?
- L₄: because... eh... I don't know maybe I'm used to having it like that like this so...I have done it all these years so, I think it's a fine way to learn...
- I: but if you had a chance... would you change the teaching in mathematics ...?
- L₄: no...
- I: nothing?
- L₄: maybe a bit more activities in mathematics but otherwise I don't think so of anything...

I: would you have included any other activities like some practical activities in mathematics teaching?

L₈: eh... I would have done it because what we've done in the whole 8th grade is just to write, write and write and solve the task and then it becomes quite boring and you lose the interest and you sit there just to write and when the class is over so you think "oh yes, finally finished..."

In the first snippet, learner L₄ expresses being *used to have been taught like this* as the reason of being satisfied with the teaching. Consequently, thinking about some other way of being taught or suggesting a change to the *usual* way sounds like a difficult task to him/her. However, when asked again in a way where she/he could choose, she/he suggested an improvement in the mode of mathematics instruction. Similarly, the frustration of mathematics classes lacking practical activities and a suggestion to include the same if given the opportunity is evident in L₈'s response. The next excerpt shows that given the possibility to suggest changes and design their mathematics teaching themselves, learners can acquire autonomy in mathematics learning.

I: hmmm... now when you have a suggestion about that you could have learnt to set up a budget... have you also thought of how would you have liked to learn it? In what way?

L₅: eh... if we could have got a realistic situation... and then we could have got a task about it so it would have... for example set up a budget for a whole family for a month and you get different expenses and the teacher and you get the income and you have to pay the tax and you have to pay different and you should have a bit sum as saving if you sometimes get into a trouble and such things... like which are important to learn like you don't need to take a loan and you don't have a lot of debt because you just got into a trouble which you never expected in your budget... so we learn how one should use his money because I mean that mathematics... we use a lot of mathematics in society like money and much is controlled by money and money gives power so... because people should not use up... because of people should have better ... like I don't have any concept of... like I don't know what 1 million kroner is... it's a lot and lot but you can't manage to buy a house for one million kroners... so we should learn more about the value like how much 1000 kroner is worth ... and such...

The learner (with Sámi background) not only mentions what he/she desires to learn but also suggests how the lesson could be planned and what kind of tasks they could have worked on. This segment shows that learners have a potential of developing autonomy and co-responsibility in mathematics learning. Further, the extract below presents learners' response to the question of sharing responsibility of their learning with the teacher:

I: what is the difference between if it's only me [who, as a teacher] decided everything and if you are also with me when I decide?

L₉: it becomes more fun if both decide... then... I think it could have happened that people would have liked to come to school more often...

I: when they are asked...?

L₉: yes... when they get to decide a bit what they do at the school...

As indicated in the response of L₉ (Eritrean immigrant, in Norway since three years), the thought of gaining a little bit charge over one's own learning can not only encourage their autonomy but also that they would have liked to come to school more often, exhibiting the importance of listening to student voices.

Conclusion

Learners' responses concerning autonomy in their mathematics classroom exhibit limited experience with self-control and self-decision. This indicates that decisions regarding what will happen in mathematics classroom are usually made in advance by school authorities and the teachers, which can act as a constraint for learners' autonomy to emerge and being practiced. Consequently, learners *get used to* mathematics classes, trust decisions of their school and teachers, and consequently see the *traditional way* to be the only way of mathematics education. This can leave learners unfamiliar with assuming autonomy to comprehend their learning processes in depth and limit their creative potential to experiment with better and self-beneficial ways of learning mathematics. Moreover, if concerns for social justice, adopting a critical stance towards mathematics' role in society and learners' personal lives, and raising consciousness towards sociopolitical and socio-economic issues through mathematics education are to be fulfilled; learners need to experience autonomy in their mathematics education. This way they can feel confident to put forward their argument, discuss and design better learning opportunities in mathematics with their teachers and, moreover, get engaged in, discuss and debate about social issues and initiate social changes in wider society.

Moreover, enthusiasm of learners to experience a partnership and co-responsibility of their own mathematics learning is the same regardless of their ethnic background. Interview excerpts from learners L₅ and L₉ depict similar experiences in mathematics classrooms and they desire similar changes (i.e., *a culture of promoting learner autonomy*) in mathematics learning as their Norwegian classmates. Similar responses from learners having diverse backgrounds complemented my focus on *youth culture* instead of ethnic backgrounds in this study.

Observing learners' potential to suggest, design, co-operate and improve teaching-learning strategies in mathematics, I conclude that learners should be *heard*, encouraged to be critical, take responsibility and decisions regarding their mathematics education to make them autonomous, cooperative and responsible mathematics learners fulfilling the aim of NEA, and become mathematically literate critically aware citizens to deal with challenges of our future society. For encouraging learners to be autonomous, they should be provided with time and space to plan and execute their own learning strategies together with their teachers, and approaches promoting autonomous behavior (Deci & Ryan, 1987) should be adopted. Moreover, to make learners think critically, decide, have more control and co-responsibility of their learning with teachers, just asking them simple questions (Croninger & Croninger, 2016) can be the first step of an interaction leading them to assume autonomy. Learner autonomy can make learners aware of their right to social justice by balancing the power relations between students and teachers. Autonomous learners can build a personal relationship with mathematics and gain experience of participation and authority of

understanding mathematics' role in his/her personal (i.e., their home, classroom, school etc.) and wider society (as visible in L₅'s response).

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