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The interplay between person and environment, cognition and emotion: Using the concept of perezhivanie in mathematics education

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Vygotsky's concept of perezhivanie considers the interplay between cognition and emotion of an individual's development within an environment. Empirical research using perezhivanie has mainly focused on early years education and has hardly ever been used in mathematics education. This theoretical paper starts with the problematic issue of the role of the environment in cognition and proposes the use of perezhivanie as a unifying concept to study an individual's development in mathematics education. We provide an exposition of the concept of perezhivanie, seeking to understand its relation to key memorable events and threshold concepts, which are currently being used to analyse classroom activities and events. We conclude by pointing out the importance of perezhivanie as an analytical approach to four areas of study in mathematics education.

Keywords: Perezhivanie, university mathematics education, emotion, cognition.

The Russian word perezhivanie (plural pereshivaniya; from *zhivat* – to live, and *pere* – carrying something over something) has been used in educational research to describe a series of personally-significant, emotionally-charged experiences and how an individual has overcome them to become the person they are today. The concept has rarely been used in mathematics or science education research literature (e.g., Black et al., 2019; Fragkiadaki & Ravanis, 2021), and it has predominantly been used in research on early years education (e.g., Ng & Renshaw, 2019). Perezhivanie nevertheless is a powerful concept that considers the unity of person-environment and cognition-emotion as central to explain an individual's development, something that in general has not been prominent in mathematics education research. For instance, some theoretical perspectives have looked through a mental cognitive lens (e.g., the development of student's algebraic thinking is characterised by the use of alphanumeric symbolism). Some others have studied emotions from the individual's perspective without regard to how socio-cultural factors shape those emotions and hence the cognitive processes of the person. These perspectives neglect or downgrade the inherent relation between cognition and emotion. In response, we agree with Radford (2014) that a study of the development of students' mathematical thinking should be thought of as an unfolding dialectic process of culturally

and historically constituted forms of knowing which involves, for example, embodied forms of thinking and emotional and ethical engagement, amongst others.

Hence, we take the position that perezhivanie is a meaningful research tool for a developmental account of an individual but how to conceptualise and investigate it is still “an open research problem for sure” (Radford, 2014, p.275). Therefore, this paper aims to advance the understanding and use of perezhivanie in mathematics education research. We explore the concept of perezhivanie within the research literature of mathematics education and beyond. We start with an introduction to the problem of the environment as it was conceived by Vygotsky (1934/1994) and an exposition of the concept of perezhivanie as understood by him and later expanded by other scholars. We then seek to understand its relation with other concepts used in mathematics education literature, which relate to emotion (i.e., key memorable events) or cognition (i.e., threshold concepts) and that seem to be used to study similar problems to those that can be studied with perezhivanie. We ask: How does perezhivanie provide a deep and detailed understanding of individual development, not captured by key memorable events or threshold concepts? We conclude with a discussion on the added value of perezhivanie in four areas of study in mathematics education.

The problem of the environment

In *The Problem of the Environment*, Vygotsky used the word perezhivanie in relation to the study of the role that a child’s social environment has in the formation of their personality, as opposed to the part played by their genetic inheritance. Central to Vygotsky’s thought was the idea that rather than a setting, the environment should be considered as dialectically related to a person’s development:

“environment should not be regarded as a condition of development which purely objectively determines the development of a child by virtue of the fact that it contains certain qualities or features, but one should always approach environment from the point of view of the relationship which exists between the child and its environment at a given stage of his development.” (Vygotsky, 1934/1994, p. 338)

Vygotsky exemplified the two-way relation between person and environment from his own research. The example was that of three children experiencing the same environmental condition (mother with alcoholism) in different ways. The youngest child developed neurotic symptoms, the second demonstrated contrasting emotional attitudes towards his mother, whereas the third and eldest acted as a senior member of his family to protect his youngest siblings.

Through the interactions with the different aspects of a given environment, an individual’s perezhivanie determines what influence this environment has on their development. In that sense, in order to analyse the impact of a learning environment on developmental processes, one should consider both cognitive and emotional aspects. In the research field of mathematics education there are studies that consider these aspects, but separately. For instance, Key Memorable Events (Marmur & Koichu, 2018) focus on emotion to study events in the classroom with which students identify or strongly remember. By using this concept one can point out various prominent events that take place in the mathematics classroom and that could potentially be important for students’ learning; but research on these events has no direct link to students’ development as (mathematics) learners. Further, Threshold Concepts have been used in mathematics education to study cognitive events. The

learning of concepts such as the limit, continuity, etc. in calculus, are fundamental for students' mathematical development. The existing literature nevertheless leaves aside the emotional aspects or the contextual factors that the learning of these concepts entails. Hence, there is a need in the field for the use of a concept that takes into account both cognitive and emotional aspects in the interaction of an individual with their learning environment and that highlights the influences on their development.

What is perezhivanie?

Perezhivaniya are the events, episodes, activities, happenings or experiences in which people are active participants. The perezhivaniya in someone's life help them answer the question "Who am I?", by showing who they were and how they came to be the person they are now – the experiences they had and how these formed them.

In relation to learning, Kim (2021) argued that perezhivanie experiences can facilitate the learning process when the learner recognises meaning in the environment, evaluating or appraising the experience as important. In other words, the experience provides "what is available to the person to do something with" (van Lier, 2004, p. 90), thereby becoming developmentally significant. Hence, perezhivaniya become for the person that which proves to be personally significant for them (Rubenstein, 1957). They are the chapters of one's autobiography, the events that were life-changing and emotionally-charged.

As a research tool, perezhivaniya are the units of consciousness or of the personality as a whole. They encompass intellect, affect, memory, attention, will, etc. They are experiences as a whole, and each has their own plot, its own inception and movement towards its close (Dewey, 1939). Perezhivaniya are *both* subjective and objective, they are both personal and environmental (e.g., the loss of a job for a young person is not the same as for someone whose job is their entire career). A perezhivanie is the prism through which the subject refracts the influence of the environment. Vygotsky (1934/1994, p. 342) remarked that "in perezhivanie we are always dealing with an indivisible unity of personal characteristics and situational characteristics".

These experiences are life-changing in the sense that they are problematic, and one has to overcome, survive or over-live (*überleben*) them. Perezhivaniya do not have to be only painful, there can be good perezhivaniya (e.g., a risk that paid off and opened a new life phase) (Kotik-Friedgut, 2007).

Success in overcoming a perezhivanie entails changing the social situation, either by transforming the object of activity, transforming the subject or both. Blunden (2016) asserts that development comes from a process of catharsis. In ancient Greece, catharsis was the experience of an audience who, when watching a play at the theatre, externalised their emotions by empathising with the performers who were acting the emotional experience out for them. This had a "purging" effect. Blunden (2016) points out that Freud (1914) was also familiar with perezhivanie, and that he used psychoanalysis to make a patient remember and repeat an emotional experience and working through it, overcoming and "surviving", "transcending" it, or "sublating" it (in the manner of Hegel). The psychoanalytic process seems to suggest that the aid of another person, who is capable of objectifying and reflecting back the feelings of the person going through a perezhivanie, of guiding them and making use of the resources of the culture to assist them in finding and accommodating their new

situation, is usually needed (e.g., teacher, therapist).

The concept of *perezhivanie* also allows us to understand experiences that are not so dramatic, and what has been said above applies to those relatively minor joys and embarrassments that “stick in our minds” and become part of our development, that evoke an emotional response and are connected with our motivation, without becoming life-changing traumas.

How is the concept of *perezhivanie* related to other concepts of emotion or cognition that are used in mathematics education literature?

In spite of its potential, *perezhivanie* is rarely used in mathematics education research. In this section, we seek to understand the concept of *perezhivanie* by critically analysing the concepts of Key Memorable Events and Threshold Concepts that seek to explain similar phenomena with *perezhivanie* in mathematics education.

Key memorable events

The concept of Key Memorable Events (KMEs) refers to classroom events that are accompanied by either positive or negative strong emotions and are imprinted as meaningful in students’ memory, because of their contribution to students’ learning (Marmur & Koichu, 2018). In that sense, KMEs can be used as a theoretical lens for analysing affective moments and gaining an insight into the learning process. With their use, one can recollect memories and thoughts of emotionally loaded events that seem to be particularly interesting for the individual. In this way one can consider the role that affect plays in students’ experiences during the learning of mathematics and in this regard we can recognise a similarity with the concept of *perezhivanie*. However, for us, the difference is in the consequences that this experience has for the development of the individual. With KMEs we have a tool for listing and categorising the kind of events that stay in the individual’s memory and can have an effect on their learning. *Perezhivanie* provides us with a very detailed process, where different perspectives and aspects are considered with the scope to give us a deeper understanding of the situation and of the impact on the individual’s learning trajectory and development.

The use of KMEs as an analytical tool in mathematics education research requires particular methodologies, such as the stimulated recall methodology. Students are assisted in recollecting their experiences from a particular lesson and provide information regarding their thought-processes. This raises criticism regarding the degree of importance of each event in students’ learning, since the students are reminded of specific classroom events and then comment on them, instead of recalling themselves what was distinctly important for them. We assert that an experience becomes significant for an individual (and not necessarily for others) and changes outcomes for that individual by requiring a challenging situation that has been overcome and resulted in a cathartic outcome.

Furthermore, although with the KMEs one can identify and classify emotionally charged events that take place in the learning of mathematics, there is not an explicit way to understand whether the students act or not upon these events. For instance, in a recent work by Marmur and Koichu (2018) where the concept was used in order to pinpoint the incidents that were memorable for students during undergraduate mathematics tutorials, most of the students referred to events that played a role in their motivations regarding the learning of mathematics (e.g., “It was beautiful. It’s an eye opener.”), rather

than their engagement. Based on these recollected events it is not clear if students took action in changing their ways of learning or if these events had an impact on their identities as mathematics learners, something that is crucial in *perezhivanie*. Overall, KMEs can be a useful instrument for classifying strong affective moments and explain various phenomena that take place during the learning of mathematics in the classroom (or in the lecture hall). They can improve the lesson design by analysing students' emotional reactions to particular teaching practices, but they do not give us a clear picture of the impact that these emotionally-charged situations have on students' further learning and engagement with the subject.

Threshold concepts

Threshold concepts are topics that are considered crucial when a person tries to master a certain subject. Meyer and Land (2006) described threshold concepts as portals which open a new and previously inaccessible way of thinking about a subject. According to them, threshold concepts have five characteristics that can be used in identifying them: (1) they are transformative i.e., they result in a shift of a person's perception of a subject; (2) they are irreversible, meaning that the change in perception is irreversible; (3) they are integrative due to their ability to allow connections of previously unrelated concepts to be made; (4) they are bounded because they might lie at the conceptual border between disciplinary areas; and (5) they are troublesome because they are inherently difficult to grasp.

In the mathematics education literature, Breen and O'Shea (2016) proposed that limits, functions, cosets and quotient groups are mathematical topics that hold the above characteristics and can thus be considered threshold concepts in analysis and group theory. They argued that traditional teaching approaches and curricula in undergraduate mathematics often result in memorising content and procedures which leads to shallow or rote learning. In order to address these issues, Breen and O'Shea proposed to change the curriculum (often built around the structure of mathematics and a linear fashion of teaching content) to one structured around threshold concepts (leading to a recursive design that enables learners to revisit threshold concepts throughout the duration of the course).

Threshold concepts offer ways of identifying topics that act as portals and thus represent important stages of a learner's mathematical development. As a construct, threshold concepts relate to the cognitive aspects of learning mathematics, i.e., what has to be learned in order to master a certain topic. However, their transformative and troublesome nature suggests that a learner's experience in understanding a threshold concept could result in an emotionally charged situation, an aspect that is not acknowledged or taken into account by threshold concepts. In that sense, *perezhivanie* offers a more holistic account that can capture the interplay between both the cognitive and emotional phenomena involved while a learner tries to master a threshold concept.

In summary, choosing a threshold concept as context may be useful for researching an individual's mathematical development and for introducing *perezhivanie* as a research tool. In contrast to key memorable events, *perezhivanie* identifies significant experiences of an individual in a certain environment; importantly, *perezhivanie* considers the working over of such experiences that characterise the development of an individual as well as who they came to be regarding those experiences.

Final reflections on perezhivanie in mathematics education

The concept of perezhivanie was left unfinished by Vygotsky. Many scholars have since contributed to its development and the concept has recently received increased attention by researchers interested in the topics of emotion, motivation and subjectivity. In empirical research in education, perezhivanie has been used as an analytical approach to the unity of emotion and cognition (e.g., Fleer & Hammer, 2013) and/or the unity of individual and environment (e.g., Chen, 2015). Researchers using perezhivanie have mainly focused on understanding the refracting prism of an individual who interacts with an environment and interprets it in a subjective way (e.g., Adams & March, 2015). Perezhivanie has rarely been used to study the experiences that are significant for the individual and, due to its *cathartic* nature, play a significant role in their development and life-long learning. We contend that this was Vygotsky's main aim at developing the concept of perezhivanie.

We take the position that perezhivanie is a useful tool and concept in mathematics education research, by providing an analytical approach to a phenomenon under study that considers the unity of cognition and emotion and/or individual and environment, while allowing researchers to see how these units become the key pieces in an individual's development. These are powerful features that can offer new, in-depth understandings in mathematics education research and practice. Based on our readings of the literature, we present four areas of mathematics education research as examples of where perezhivanie could be a useful research tool. The majority of empirical research using perezhivanie has focused on early years; we will focus on areas of the study of older students.

The first area is the study of educational transitions (e.g., mathematics transition to university) and the identification of students at risk of dropping out. For many students, the transition to university is a highly emotional event where past experiences merge with the social relations and material aspects of the new environment. Studying the prism through which individuals refract transitional events, researchers can understand the situations that help or hinder students in different ways to make an un/successful transition and document a pool of perezhivaniya experiences from longitudinal data, or from cross-cultural comparisons. The cathartic nature of these experiences is evident since the transition to university is a defining event in students' lives; some see it as a 'rite of passage', or an opportunity to become someone new, hence determining their development as individuals.

The second area we suggest is the study of mathematical resilience. Researchers have related resilience to individuals' cognitive and affective abilities to overcome obstacles and challenging situations in the learning process, turning them into situations that support them (Hutauruk & Priatna, 2017). A view of resilience as relational between the individual and their environment can be potently studied through perezhivanie. Research on the perezhivaniya of resilient learners (i.e., the reflected lived experience of overcoming a challenging situation) might illuminate practices that encourage dispositions that allow individuals to negotiate their contexts in advantageous ways (cf. Hernandez-Martinez & Williams, 2013).

A third area of study is the research of life-changing decisions with respect to mathematics education, particularly the choices of women or other underrepresented groups in mathematically-demanding careers. Perezhivanie can be used to understand those choices where objective circumstances are refracted through the prism of gendered or racialised subjectivities. Using perezhivanie as the lenses

through which we understand these choices allows for a holistic perspective of the life trajectories of these individuals.

A final area is the study of how individuals become professional mathematicians. A study of this type, which uses *perezhivanie* as a research tool, would look for events that steered an individual to become interested in mathematics, the contexts and circumstances that made possible for that individual to sustain, or even nurture, their mathematical identity. Surprisingly, research into narratives of being or becoming a mathematician, or different ways to be a mathematician, is still limited; stereotypical views of mathematicians as “geniuses” or “eccentric” are still widespread among students and society at large, which in turn discourage many from pursuing a career in mathematics.

This paper described the concept of *perezhivanie* as first conceived by Vygotsky and subsequently extended by many other scholars. We compared this concept with others in the mathematics education literature that share commonalities with *perezhivanie*, and described how the concept could be used in mathematics education research. We believe that this concept is useful in understanding the interplay between cognition and emotion, and personal and environmental factors in a way that other theoretical frameworks do not.

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