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What motivates adults to learn mathematics through trade unions in the workplace: social factors and personal feelings

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This research is based on interviews with adults about their motivation to study mathematics in the workplace, through classes organised and funded by trade unions in the UK. The findings point to motivation as a function of individual's emotions and cognition that are influenced by social experiences. The research identifies a difference between the initial motivation to re-engage with learning and that required to continue, or persist. Continuing learning relies on a socially and emotionally supportive learning environment which adults identify as 'different' from previous experiences. The term an 'Affective Mathematical Journey' is developed to describe the positive emotional changes experienced by adults, which helps them overcome negative memories. The adults' resultant increase in confidence and motivation encourages them to successfully develop and use their mathematical skills both inside and outside the classroom.

Keywords: Mathematics, motivation, teaching methods, affect, emotions.

Introduction

There is much research into learning mathematics that seeks to explain why children and adults have problems with the subject and subsequently struggle to learn mathematics (Boaler, 2000; Coben et al, 2007). Those interviewed for this research reported obstacles to their learning such as; previous unsuccessful learning experiences, demands of shift work and family responsibilities. Yet they had chosen to re-engage with learning mathematics at or below GCSE level in the workplace through opportunities negotiated by trade unions with employers. It was not a requirement of their current job, so this group of adults must have been highly motivated to return to learning mathematics and were chosen to develop a better conceptual understanding of motivation.

The adults in my research have taken up a learning opportunity at work enabled by national trade unions allocating resources to this purpose. Trade Union officers, usually ULRs, are activists whose job it is to encourage workers to develop their skills, give advice and guidance, identify workers needs, and negotiate on-site learning opportunities with employers). Trade unions fund the teachers and equipment needed to support that learning, while employers provide the physical space and sometimes time off work to learn. In 2016, nearly 10,000 ULRs across the UK were involved in training through TUC Education and over 27,000 individuals took up an opportunity to improve their English and maths skills through their union (Unionlearn, 2017, p. 4).

This research identifies the importance of how people feel about the learning in relation to their motivation. Adults need to trust people who are encouraging them to join the classes and feel safe in the learning environment in order for them to develop confidence with mathematics. Union Learning Representatives (ULRs), are trusted colleagues that play a key role in encouraging and supporting adults to join classes in the workplace. Trade unions also promote a 'different' learning approach in their courses, influenced by the 'collective ethos' of trade union culture. The learners identify this different pedagogic approach as key to them persisting learning (Kelly, 2018).

Research into learning in the workplace has usually focused on mathematical concepts used for work or the more contentious notion of the ‘transferability’ of mathematical concepts between school and the workplace (Lave & Wenger, 1991; FitzSimons & Godden, 2000). In an endeavour to understand differences in learning approaches research has also usefully included descriptions of pedagogical characteristics (Evans, Wedege, & Yasukawa, 2013) in terms of formality: this research concentrates on adults’ motivations to learn mathematics in the workplace, to gain a formal qualification in a less-formal learning setting.

Research into affective issues in mathematics education have been explored by McLeod (1994), who conceptualised emotions, attitudes and beliefs in relation to motivation in terms of stability and intensity. Eynde, De Corte and Verschaffel (2006), posited motivational concepts act in different levels of social contexts. Hannula (2012) further theorised affect in mathematics education suggesting it could be explored in three dimensions, as concepts: cognitive, affective or motivational; as varying in relation to time and in relation to ontological traditions of research. This moves us on from simply identifying ‘maths anxiety’ (Buxton, 1981) as an emotional barrier to learning, to exploring the wider, more complex domain of affect in relation to motivation to learn.

During this research, the concept of an *Affective Mathematical Journey* (AMJ) was developed to describe changes in learners’ feelings in relation to mathematics. An AMJ occurs when positive (or negative) learning experiences inspire adults to modify their feelings towards mathematics. In this research, the change in affect becomes more positive and this change not only contributes to adults’ increased confidence and motivation to learn the subject but also influences their potential to use their new skills beyond the classroom. Elliot, Dweck and Yeager’s (2017) research supports these findings recognising the possibility of ‘socialisation practices’ to foster different mind-sets in learners which have a ‘cascade of effects, altering their meaning systems and their academic outcomes’ (p. 135).

Research by Hannula, Pantziara, and Martino (2018) highlighted the tradition of research into affect and mathematics education in CERME conferences, but the focus is still on school education. Boaler’s (2000) research into motivation and mind-sets has also focused on children. This research points to the contribution that adults who experience a ‘stalled education’ can add to research into affect and mathematics education.

Methodology and methods

The analysis is based on twenty in-depth semi-structured interviews with members of trade unions, aged between 25 and 65, twelve males and eight females. They come from a range of trade unions, employed in a variety of contexts, in small and large organisations, publicly and privately owned. They studied in a variety of environments; individually following on-line courses with tutor support or in teacher-led groups. However, this is small sample with no claim to be representative of the characteristics of the broader union learning population, especially since learners who were studying basic mathematics up to level 2, the equivalent to a GCSE.

The identification and recruitment process of interviewees relied upon the agreement and support of trade union officers and ULRs. Hence the method of sampling was a combination of purposeful, ‘criterion sampling’ (Bryman, 2012, p. 419), as I was seeking adults that fulfilled a particular set of criteria and snowball sampling (Atkinson & Flint, p. 275) in that I needed key gatekeepers (ULRs)

to agree to help me access potential participants. The research centres on individuals and their 'interpretations' of situations, so naturally relies on qualitative data, which was tested for the trustworthiness and authenticity of the findings (Bryman, 2012, p. 390). The whole interview and storage process followed BERA (2011) guidelines, ensuring interviewees anonymity especially when their words would be used in the research. Nvivo™ was utilised to help track and analyse the learner's words. Enabling me to interrogate the data and build and group ideas in different ways; as well as identifying commonly used words such as 'confidence'.

The analysis takes a critical approach because the researcher is a teacher trainer who explores how research into adults learning in the workplace might usefully influence mainstream mathematics education practice. The research is also built on the feminist research tradition of exploring personal viewpoints, as Reinhartz and Davidson (1992) suggests when citing Datan (1989, p. 175) 'it is an axiom of feminism that the personal is political' (p. 234). Therefore, when analysing the adults' words there is a subjective encounter with the individual that seeks to understand different perspectives, relating this motivation at the individual level to emotions and cognition, within particular social contexts.

Hence in this research, motivational factors are considered at three levels: the individual, the social and the societal, which all influence each other. At the individual or personal level McLeod (1994) focuses on needs and goals. Evans, Wedege and Yasukawa, (2013) broaden the notion of personal motivational factors to include 'the cognitive and affective as part of the whole person' (p.222). In this research individual learners feelings are key to their descriptions of their motivations to learn mathematics, reflecting Hannula's (2012) dimension of the 'domain of affect' linking cognitive, motivational and emotional factors.

At the social level, local face-to-face groups include people who adults trust and influence their motivation (Barbalet, 1996), such as; fellow learners, families, union members and Union Learning Representatives. Families play an important support role but ULRs and fellow learners also play a key role in motivating trade union members to engage with learning and persist in classes.

The wider socio-economic environment, is a context where individual members are given a 'second chance' to learn mathematics through trade unions who have negotiated resources with both central government and employers to enable this to happen. Therefore, the social context of learning is influenced by the values, history and culture of both the trade union movement and the workplace, acting in wider United Kingdom society.

Findings

Motivation to learn mathematics: initial and continuing

Adults in the sample indicated their initial motivation differed from that required to continue or persist in learning. Their initial motivation to re-engage with learning was related to their individual needs and goals, such as: improving job security, filling a perceived personal knowledge or skills gap, gaining public recognition of their knowledge or skills through certification and helping their children. However, their motivation to re-engage with learning was also supported and encouraged by significant social local face-to-face groups such as work colleagues, ULRs, fellow trade union colleagues, other learners and family members. At the wider societal level, the opportunity for

learning is reliant upon trade unions negotiating funding with central government and workplace agreements with employers, as stated above.

Motivation to continue, or persist, with learning relied more on the action of the social face-to face groups, both teachers and fellow learners providing what the interviewees called a ‘different’ learning experience to that previously encountered. The adults described the characteristics of the learning as: more collaborative than previously experienced, taking place in smaller classes, in a relaxed atmosphere where they felt they could talk openly about mathematics and their problems. They also spoke about the mathematical topics being relevant to their life experience, in the sense that the concepts, where possible, were related to practical applications (such as building a shed) or finances (interest rates) or trade union issues (regarding health and safety).

Emotions and motivation

During the analysis it became clear that emotions played a key role in the adults descriptions of their learning experiences. Eight people, out of twenty interviewed, used such words as hate, phobia, fear and horrendous to describe their previous experiences with mathematics. When talking about the learning organised through the trade unions seven interviewees spoke about feeling more “relaxed”, four described the learning experience as “fun” and five as “brilliant”. When discussing their motivations to learn and use mathematics eleven interviewees used the word ‘confidence’ to describe the changes in their *feelings* and *beliefs* about their abilities and motivation.

The notion of developing confidence through the achievement of mathematics contributed to the interviewees being more motivated to learn in the classroom but also to act differently when outside. For example, when they were negotiating on behalf of fellow trade union members, dealing with home finances, training to become trade union mathematics teachers or supporting children to learn mathematics at home. Combining personal feelings (of confidence) developed through social experiences (learning mathematics) creating those intentions to act differently, I describe this as adults experiencing a positive *Affective Mathematical Journey*, relating motivation to emotions, and cognition.

Relevance of the Findings to the Research Field

When considering the notion of increased confidence adults’ motivation to learn mathematics relates to affective domains, reflecting Hannula’s (2012) two dimensions of motivation acting at an individual emotional and cognitive level but something that can change over time. However in this research the support of various members of local social groups was also key to learning, reflecting Eynde et al’s (2006) focus on the dynamic interaction between the individual and the social group.

Developing individual’s Confidence: an Affective Mathematical Journey

Interviewees often used emotional words when discussing their motivation to learn mathematics, indicating that successful learning experiences, especially after previous ‘failures’, lead to changes in how they saw themselves and how they act in social situations. Psychological research into motivation reinforces the idea of a positive correlation between self-confidence and achievement in mathematics (McLeod, 1994; Zan et al. 2006). This research suggests that achievement increases self-confidence while Hannula (2012) argues self-belief and achievement are reciprocal influences.

Although theoretically confidence can be a problematic concept when used to judge others, the way the interviewees use the term to describe their own beliefs and feelings about themselves and their willingness to act in different social situations, suggests it as an ‘emotion of self-projection’ as described by Barbalet (1996, p. 77). McLeod (1994) argues confidence is mainly cognitive but the emotional words used in this research reinforce Barbalet’s (1996) argument. Mahn and John-Steiner (2002) further maintain developing confidence has a strong social dimension developed through group activities, which strengthens the findings of this research suggesting the use of the word confidence links the adult’s motivation to emotions and social experiences.

When adults report feeling more confident about themselves and more positive about learning mathematics it suggests a change in their identity development at a ‘profound’ level after a ‘transformative’ learning experience (Illeris, 2014). The conjecture is that feelings towards mathematics can change and effect an individual’s motivation and this concept contributes to the theoretical construct an *Affective Mathematical Journey* (AMJ), where adults’ beliefs, motivation and feelings about mathematics change. DeBellis & Goldin (2006) argue a range of emotions are experienced during problem solving in the mathematics classrooms, describing them as ‘pathways’, this research builds on that idea but points to changes in adult’s emotions happening over a longer period of time, in some cases years, thus it is more of a journey.

Further research could be undertaken, exploring ways that enable adults to experience *Affective Mathematical Journey* in relation to ‘different’ learning experiences described earlier. Particularly so for teachers in Further Education in the UK who have to teach 16-19 year olds, who have already experienced failure to achieve GCSE mathematics, at least once.

The role of different social face-to-face groups in motivation

Bandura (2004) identifies social persuasion as key to motivation, this goes beyond verbal persuasion alone, because getting someone to attend a mathematics class would not be enough to develop their self-efficacy. Adults also need to feel supported in order to achieve and to develop their own self-belief. In this research trusted ULRs take on this role persuading members to join mathematics classes; ensuring the classes are accessible and providing a supportive and ‘emotionally safe’ environment (discussed below), leading to positive learning experiences.

Helping children with their skills development is also an important motivator for adults, particularly for females, findings supported by research by Swain, Baker, Holder, Newmarch, & Coben (2005) and Coben et al., (2007). This research accentuates the importance of supporting children as both an initial motivational force to re-engage with learning as well as a reason to persevere. For those adults who are newly arrived in the UK, with English as their second language, supporting children to learn can also help them to understand and integrate into the wider ‘home’ society. Hence, learning mathematics can be a positive contributor to a better functioning family in both economic and social terms.

Motivation related to pedagogical approaches used in the learning group

The adults spoke regularly of the importance of having a ‘different’ learning experience, when re-engaging with mathematics. The pedagogical approach promoted by trade unions (Rees, 2007) and described by adults was ‘more relaxed’, ‘more social’ and ‘supportive’; closer to notions of

informal or non-formal (Coben et al., 2007; Evans et al., 2013) ways of learning. The learning experiences were described by some as being 'easier' than previous ones linking cognitive to emotional factors in motivation.

Bibby (2002) suggests there is a connection between traditional mathematics class and shame, where mathematical tasks are often seen as right or wrong and in the classroom are open to public scrutiny, judgement and, if not 'correct', humiliation and shame. Wojecki calls these remembered encounters as 'wounding learning experiences' (2007, p. 170) although he posits that adults can and do get over them, something this research supports. Schorr and Goldin (2008) argue it is possible to facilitate changes in emotions given the right circumstances, which they describe as 'emotionally safe environments' (p. 131). This is a place where it is safe to expose misconceptions and where learners' will not suffer public humiliation for getting a calculation wrong.

The interviewees also spoke about the importance of relating the mathematical practice to previous and current experiences in life and work, an approach trade unions promote (Rees, 2007). Linking mathematics to life or work links to the idea of social belonging and relatedness, (Ryan & Deci, 2017) where motivation is something that is culturally relevant, such as trade union activities, or meaningful to the individual, for example calculating interest rates on loans.

Conclusion

The findings indicate that adults' initial motivation to re-engage with learning mathematics can be understood differently from their motivation to continue learning, but that both rely on the dynamic interaction between the individual and social groups. Motivation can be seen as a change in behaviour, which is a function of an individual's motivation, emotions and cognition; developing within social face-to-face groups, all acting within a wider enabling social context.

The research has focused on a special group of learners, that have not succeeded in mainstream education but have achieved in an alternative learning environment that gives us a real insight into ways that adults' motivation and confidence to learn mathematics can be developed. It foregrounds the important role that social face-to-face groups such as trade unions play in developing 'different' learning experiences using less traditional or formal methods but that can be successful in developing adults' mathematical skills and confidence. It also highlights the important role personal emotions play in a motivation, and how trust in others plays a key role in re-engagement with learning, overcoming long held negative views on mathematics and developing confidence with mathematics. This change in feelings in relation to mathematics can be described as them experiencing a positive *Affective Mathematical Journey* (AMJ), where they feel more confident and motivated to both learn and use the subject.

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