A learner's experience of flow when engaged with mathematics

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Learners of mathematics often have great enjoyment when carrying out mathematical tasks, questions or problems. This experience can be labelled as 'flow'. The learner experiences 'flow' when he or she is totally absorbed in the situation and/or task to the exclusion of all else, with a complete connection. Flow is a quality of experience. In this paper, I start from the premise that flow is an essential part of the mathematical learning process. Although flow 'states' will have common characteristics, the individual will attach the meaning, because each individual has a unique experience of flow. A longitudinal study was carried out with a group of secondary students, anticipating how flow can assist positive relationships with mathematics. Students' experiences of flow in the classroom were recorded, videoed and questioned. Initial findings suggest certain didactics (including task design, delivery methods, and questioning techniques) elicit flow and engender an 'optimal experience'.

Keywords: Flow; challenge; social flow; solitary flow; silent way; pedagogical design; subordination of teaching to learning

Background

Throughout this research, Mihály Csíkszentmihályi's consolidated framework of flow theory is embraced. (Moneta & Csíkszentmihályi, 1996). Part of this theory states, that no matter the activity, flow can be characterised by 9 phenomenological dimensional characteristics. (Csíkszentmihályi, 1975). These holistic attributes of the flow experience underpinned the theoretical framework, and the theory.

1. There must be clear goals set.
2. There should be clear and immediate feedback.
3. Flow occurs when both challenges and skill exceed the learners' normal levels.
4. No awareness of doing the task, just doing the task.
5. There is total immersion in the task.
6. Outside influences have no effect; distractions and diversions are removed from the conscious.
7. There is no worry of failure on the part of the learner.
8. The learner is in control.
9. The passing of time is distorted and misrepresented.

Caveat - a 'doing' element

It may be useful here to differentiate this description of the flow state as being useful in the moment, rather than mindless of the moment. To elucidate further, there must be a 'doing', an 'effort' or 'action' element to the activity. It is not simply being lost and absorbed, as perhaps watching a soap opera on television (Csíkszentmihályi, 1997). More complicated, structured and organised activities such as learning mathematics enable a materialization of 'flow experience' more readily than others. This is possibly because arranged activities provide an individual with more control over perceived skills and challenges. Typical situations when flow occurs are when an individual is allowed the latitude to select the type and complexity of an activity, and is presented opportunities for self-determination acquiring new and novel skills (Moneta and Csíkszentmihályi, 1996).

From this rich description of what we mean by flow, learning and teaching mathematics presents many opportunities for the flow experience to manifest. In point of fact, the classroom experience can be structured to give learners control over necessary mathematical skills and challenges, and by stretching intellect new opportunities are presented to gain knowledge and understanding.

In relation to students doing and learning mathematics I asked:

- *What does flow look like in the classroom, both to participant and observer?*
- *How do learners of mathematics, experience being in 'flow'?*
- *How is the notion of 'flow' attested, manifested and demonstrated by mathematical learners?*
- *What didactics (including task design, and questioning techniques), elicit 'flow'?*

Data collection & analysis

Capturing thoughts and feelings accurately and measuring an experience has a gamut of associated difficulties, including subjectivity of the participants (Csíkszentmihályi & Csíkszentmihályi 1992; Hektner, Schimidt & Csíkszentmihályi, 2007). The ethnographic element of the enquiry meant the researchers' (my) field journal became an essential part of the evidence collection, and led me to introduce a student 'flow' journal, that, in addition to assisting with the research, became an important pedagogic tool (Moon, 2006), for example; "I'm pretty sure I was in flow when I was making a generalised formula for quadrilaterals to have the same proportion. I notice I had made calculations very quickly when making a specialised example." (Lamar, flow journal entry, April 14th, 2016.)

In addition, I used participant self-assessment of their flow experience creating questionnaires based on Csíkszentmihályi & Csíkszentmihályi (1992), the flow short scale proposed by Engeser and Rheinberg, (2008), and my findings within the classroom. Researchers over or under exaggerate descriptions of experiences depending upon when it is measured (Stone et al, 1991; Mazzoni and Memon, 2003). To overcome this shortcoming, an adaptation of the experience sampling approach was used, a ‘systematic phenomenology’ (Hektner et al, 2007), in which timers were utilised to ensure added objectivity when completing the questionnaires.

I looked at multiple data sets, collecting evidence repeatedly from a single class over a period of 18 months, a generally accepted practice to investigate experiences (Stone Kessler, & Haytbornthwaite, 1991; Wheeler & Reis, 1991). I relied upon external observations of flow using flow ‘markers’ (identified by flow theory), using video and audio analysis. Images of students working and examples of student work furthered the triangulation process. The student work showed not only the mathematical prowess and mastery from students, but also often documented their strategies to enable flow for themselves.

Much of the data collected was qualitative visual evidence. Audio collection proved more difficult, much of it inaudible due to the large class size. I coded the visual data using multi slice imaging (Konecki, 2011), alongside situational analysis (Clarke, 2005).

Flow theory presupposes there is no ceiling to our search for complexity of task, therefore task difficulty could not be used as a measurement (Moneta & Csíkszentmihályi 1996). Nevertheless, task difficulty, type and choice still played a large part in engendering flow due to the importance of the juxtaposition between skill and challenge.

Some findings and discussion

Social flow vs solitary flow?

Some commentators argue the nature of learning as a social interaction that is improved through group interactions with peers (Wertsch, 1985). Group or social flow is when a peak optimal experience occurs within a group setting (Armstrong, 2008). A substantial amount of comments from students were on aspects of social flow, for example; “I was in flow when we were speaking about $x + y = xy$, in social flow. I was also listening because it wasn’t too challenging so I didn’t lose focus.” (Dalia, flow journal entry, September 8th, 2016) and “I’m enjoying talking about maths because it helps me get into flow.” (Kayla, questionnaire comment, September 15th, 2016).

The more traditional viewpoint of flow however defines a solitary or individual experience, i.e. being ‘in the zone’, while totally absorbed in an activity, mathematical or otherwise (Csíkszentmihályi, 1975).

Group, social or collective flow has many similarities to individual or solitary flow, (i.e. loss of awareness, time distortion, challenges and skills in correct alignment), nonetheless has some noticeable incongruities. As an example, whilst in a group situation we may have been observing with some disengagement a mathematical problem. One or two of the members are now in flow and suddenly we become engrossed within the group, in an optimal state, euphoric in characteristic. The flow state has been ‘transferred’ from one member to another (Salanova, Rodríguez-Sánchez, Schaufeli & Cipher, 2014). Social situations have inherent distinct characteristics, individuals act, think and feel differently, hence it is unsurprising that social flow contrasts with solitary flow (Walker, 2010.)

It is perhaps important at this juncture, to recall the approach that qualitative research as an acceptance of what is, and cannot always be explained or should be explained (Holliday, 2007). Whether in a group situation or on our own we are still experiencing the emotion of flow. The mathematics is assisting and engendering the optimal experience.

Subordination of teaching to learning - The power of (teacher) silence as a tool for enabling flow

Early analysis of the collected data illustrates a particularly effective flow ‘enabler’; a technique of teaching silently, which grew out of the research of Gattengo, (1971). This didactic style assists removing the teacher as a barrier to learning. Teacher ‘vocal’ input was something students were used to, but I judged (correctly) that they could cope and adapt. The move away from the teacher was a risk, but many commented positively, as an example; “You know when you go up to a white board and you don’t say anything and you just write down I concentrate more.” (Alexandra, flow focus group, stimulated recall, November 9th, 2015).

It created an advantageous zone of proximal development (Wertsch, 1985). Using a medium other than speech to impart mathematical knowledge gives students power and control over their learning, thus fulfilling a flow ‘condition’ (Csíkszentmihályi, 1975). The ‘empty space’ was used to focus attention on the properties of the mathematics, and assisted the teacher (myself) to identify what students were attending to (Mason, 1998). It encouraged classroom communities, (Walshaw and Anthony, 2008); the talking is almost exclusively mathematical within this bit of the lesson, and none of it is from the teacher.

Being judged by peers as opposed to the teacher alters the dynamic of the classroom (Forman and Cazden, 1985). Self-efficacy (Bandura, 1977), is encouraged because the teacher can facilitate students who aren’t usually engaged. A reduction in ‘noise pollution’, (Klaus Dieter-Rossade, personal communication, February 3rd, 2017), enabled discovery, removed some of the judgement and offered more choice for the learner. In addition, a student’s headspace was not invaded with the teacher’s voice. The student is given less instruction and thus gains more understanding, illustrating a reduction of ‘didactic tension’ (Jaworski, 1994).

Going Forward

I have started to define the quality of experience amongst learners within the mathematics classroom. As an example, early findings demonstrate group flow is a decidedly different experience to individual flow. Silently teaching parts of lessons has a profound, significant and positive effect on the flow experiences of learners within the classroom. Flow takes place when skill matches challenge; and a teacher is in a privileged position by being able to provide that correct challenge.

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