The Value of Emoticons in Investigating Student Emotions Related to Mathematics Task Negotiation

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'Emoticons' are simple face icons expressing common feelings such as happiness, interest and boredom and are popularly used in electronic communication. Emoticons were utilised in this study as experience sampling devices. Year 10 students selected emoticons to indicate their emotional states at set intervals during classroom tasks. Marked emoticons provided important information regarding the quality and timing of experienced emotions. As prompts in post-lesson interviews, emoticons were found to elicit rich feedback concerning associations between emotional experiences and task properties. In combination with interviews, emoticons facilitate probing of student emotions.

This paper reports on a particular data-gathering instrument which was employed by the author within his PhD study in 2013. The impetus for this research came from a long-term set of observations made by the author within his professional practice as a teacher of secondary mathematics. It concerns the origins of affective factors which influence student academic performance. The form of affect which has been of particular interest to the author is emotions.

The purpose of this study is the exploration of associations between student emotions and mathematics classroom task properties. A research design challenge was posed by the need to identify emotions as they arose in conjunction with task negotiation.

To meet this need, the author selected 'emoticons' as a primary research tool. An emoticon is a simple face icon representing a standard emotion such as happiness or sadness. They were employed by Ainley, Corrigan and Richardson (2005) to gather data in their investigation into the contribution of emotions during reading. Students were asked to mark emoticons as they read set texts. In the study reported here, students selected emoticons which best represented their feelings at specified points while negotiating a mathematics task.

Emoticons are a form of nonverbal communication first used in 1982 (Krohn, 2004). Krohn suggests that users of emoticons "regard [such] expressions of emotions as more trustworthy than words" (p. 322). He claims that those born after 1980 tend to be particularly familiar and adept with emoticon use, providing justification for their employment in this study.

Background

A student's emotional experiences within a classroom can impact upon the quality of their academic performance (Astleiner, 2000; Glaser-Zikuda, Fub, Laukenmann, Metz, & Randler, 2005; Pekrun, Frenzel, Goetz & Perry, 2007). Generally, with some exceptions, positive task-related emotions such as enjoyment and interest serve to enhance performance while negative task-related emotions such as boredom and anger diminish the quality of student academic outcomes (Pekrun, Goetz, Titz & Perry, 2002). Anxiety is an

example of an ambivalent classroom emotion. Depending on its nature and intensity, anxiety can act to either assist or detract from performance (Pekrun et al., 2002).

Students commonly experience a wide range of emotions as they participate in academic classroom activity (Pekrun et al., 2002). While emotions may be associated with a variety of sources both within and outside the classroom, as well as being fuelled by existing predispositions, influences related to academic task negotiation can be significant. In particular, specific aspects or properties of tasks, such as open-endedness or challenge, can be linked to emotional outcomes (Glaser-Zikuda et al., 2005; Hascher, 2010; Lumby, 2011).

Classroom teachers routinely value the student experience of enjoyment, curiosity and other positive emotions related to academic activity. The presence of these feelings often signals high levels of engagement and interest within the classroom (Gorard & See, 2011). The relationships between implemented classroom activities and elicited student emotions, particularly enjoyment, are therefore of great interest. Such considerations lead to the research question: *How are student emotions associated with mathematics classroom activity?*

Theoretical Framing

The study utilises Hascher's (2010) understanding of emotions. Based on classroom research and distilled from a meta-analysis of a large number of previous studies in the field, Hascher conceptualises emotions as responses which involve physiological, psychological and behavioural aspects. This form of affect is associated with motivation and acting and can be expressed, observed and felt in the body. Hascher notes that emotions can be associated with a point of reference, the self, other individuals or a situation, important properties for the purposes of this study. Emotions can also be distinguished in terms of intensity as well as quality.

Pekrun et al. (2002) share Hascher's view of emotion in their definition of "academic emotions": "[Emotions] directly linked to academic learning, classroom instruction, and achievement (e.g., enjoyment of learning, pride of success, or test-related anxiety)" (p. 92). Because this study concentrated on student emotions as affective outcomes of negotiated classroom tasks, the same concept of academic emotions was adopted.

Researchers in the area of classroom emotions (e.g., Jarvenoja & Jarvela, 2005; Morgan, Evans, & Tsatsaroni, 2002) commonly gather data using two investigative approaches which were described by Izard (1973). Behavioural and expressive modes of data-gathering, often categorised as observation and self-reporting, are suited to naturalistic settings such as the classroom. The self-reported data gathered in this study, through emoticons and subsequent post-lesson interviews, complemented observational data collected through video recording of lessons (Pirie, 1996). Information generated through the use of emoticons offered a personal perspective which greatly assisted in the identification of emotions.

Methodology

The situations which were investigated involved a series of purpose-designed mathematics tasks, undertaken during lessons. The emotional responses to specific aspects of these tasks formed the focus of the study. Its aim was to identify and describe emotions in terms of valence, quality, intensity and point of reference.

Lessons under the study reported in this paper were characterised as either 'rich' or 'routine' in nature. Rich lessons were designed according to task planning guidelines sourced from experts in the field of classroom mathematics (e.g. Stein, Grover & Henningsen, 1996; Sullivan, Griffioen & Gray, 2009; Astleiner, 2000). The promotion of properties which elicited student responses associated with positive affect was an important consideration in rich task design. Rich tasks featured characteristics such as practical activities, the production of mathematical models and exploration of open-ended problems (Sullivan et al., 2009). Implementation of the rich tasks offered students more scope for framing their own response at the expense of teacher-organised structure.

Routine tasks were devised according to more traditional pedagogies as described by Schoenfeld (1988) and Lampert (1990). Lessons within these traditional pedagogies generally included teacher-led discussion, transcription of whiteboard notes and worked examples and worksheet-based consolidation of demonstrated solution processes. Both rich and routine tasks were included in this study to allow the exploration of a wide range of task properties in association with elicited emotions.

The five routine tasks and five rich tasks investigated were implemented alternately over the course of a semester in a Year 10 mathematics class. The class consisted of students who had been grouped on the basis of histories of modest Year 9 mathematics test and exam performances. All lessons were taught in the same mathematics classroom except for Rich Lesson 4. This lesson was taught in the science laboratory because it required the construction of rectangular prisms out of card and sticky tape that were then filled with water.

Students were aware of the teacher-researcher's interest in their reported emotions in association with the negotiation of work. Emoticon marking was employed in this class during the semester leading up to the research period and was a part of the normal classroom routine. The majority of the Year 10 class taught by the researcher (as class teacher) elected to participate in the research.

At the start of each lesson, students were issued with a booklet of emoticons (see Figure 1). A video camera was set up in front of two or three students selected from a roster which gave all participants an opportunity to be recorded at least once during the research period. Interviews of twenty minutes duration were conducted with the recorded students as soon as possible after the lesson.

The data collected included detailed recording of facial expressions, conversation, postures and other body language. Video information contributed in responding to the research question by capturing visual and auditory evidence before, during and after times at which emoticons were marked. This information was used to explore the context in which the markings occurred. Corroborating evidence for the selected emotional states was sought and associations with task properties were identified.

The video equipment was sensitive enough to clearly detect teacher addresses to the class. Participants generally appeared to be unaffected by the presence of the camera (although one student admitted to "working harder" because he felt he was "being watched").

Two forms of self-reporting were used. The first involved the selection or marking of hard-copy emoticons (Ainley et al., 2005) at specific intervals during each lesson. The emoticon lists, used by Ainley et al. (2005) (in a computer screen format) in accessing emotional states as components of reading task interest, were based on standard human emotions described by Izard (1977) (see Figure 1). At three or four moments during the

lesson, designated by the teacher-researcher, the students were asked to mark the emoticon which best represented their current feeling state and the intensity with which it was experienced.

The markings were incorporated into this study to facilitate the retrieval, during interviews, of thoughts specifically associated with students' self-identified affective experiences at moments of interest to the researcher. In this sense, the emoticon acted as a record of a "critical incident" (Ericcson & Simon, 1980, p. 221). The authors suggest that this is a suitable technique, "… to produce data stemming directly from the subjects' actual sequences of thought processes" (p. 221).

Ainley reported that if students were instructed to restrict the marking process to a limited duration, they were not significantly distracted from task perfromance. In this study, students were encouraged to spend a total of 5 to 10 seconds in both considering and marking an emoticon.
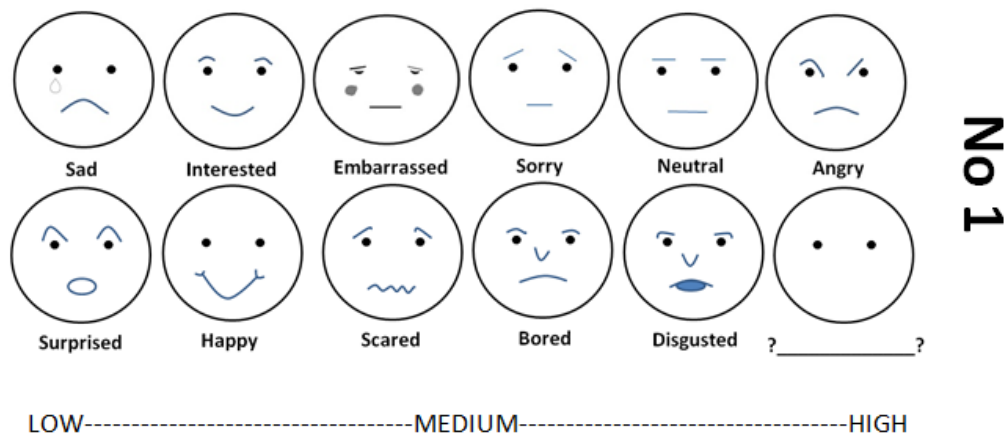

Figure 1. The emoticon list from which students selected a representative icon.

The intent behind the marking of emoticons was to capture indications of current emotional states, a form of experience sampling. However there were limitations to employing emoticon marks as direct indicators of emotions related to task properties. These included not recording the longevity of a feeling. Although experiences of emotion can range in duration from fractions of a second to many minutes in length (Izard, 1973), emoticon marks only represented an emotional state at the moment they were recorded. In this study, the video and interview design processes enabled the exploration of reported emotions in terms of their duration.

Another limitation related to the quality of experienced emotion. An expressionless emoticon above a blank space was provided for students to report emotional states which were not represented by the provided emoticons. However it was possible that students with mixed feelings were unable to properly convey their emotional experience and so did not use the expressionless emoticon.

The most common use of the blank emoticon was to report the sensation of 'confused'. Feelings of 'hungry', 'tired' and 'sick' were occasionally indicated. Interestingly, 'anxious', one of the most researched emotions in mathematics education (Pekrun at al., 2002), does not appear in Izard's list of standard emotions and was not once reported by

students. The absence of self-reported anxiety may reflect the research condition that all lessons were free of course assessment.

The second form of self-reporting involved post-lesson interviews of videoed participant pairs. The icons selected by students were used as prompts for elaboration and more detailed recall. Post-lesson interviews were generally conducted within 24 hours of research lessons. Participants who had been video-recorded, usually a grouped pair per lesson, were each issued with their marked emoticon booklet and engaged in a 20 minute semi-structured interview. They were asked to recall the circumstances and reasoning which led them to select each of their marked emoticons.

Results and Analysis

In total, 18 participants across 10 lessons marked 507 emoticons. Seventeen participants were video recorded throughout at least one lesson as they marked a total of 70 emoticons (three participants were recorded twice). All of these students participated in post-lesson interviews.

The analysis presented here aims to demonstrate the central role played by emoticon marks during interviews. Where relevant, video data is also cited to assist in the interpretation of student responses. Two excerpts have been selected to illustrate the richness of data obtained through emoticon-based interviews. They display associations which may be drawn between emotions indicated through emoticon reports and properties of mathematical tasks.

Excerpt 1: Rich Lesson 4, 'The Biggest Box', Alice – first emoticon: 'Interested'

Students were shown a box made by the teacher prior to the lesson and were otherwise given little in the way of instruction. They were asked to form a template from a standard sheet of card by cutting squares from each corner. They needed to find the cut size which would produce the box of greatest volume. The interviewees were a pair of female students, Alice and Ivana. This excerpt is of interview discussion around the first marked emoticon, 12 minutes into the lesson. The researcher planned the timing of the emoticon marking to coincide with a part of the lesson in which students would probably first become aware of the task challenge.

Researcher: Now, Alice, what have you got down first?

Alice: I've got 'interested'. Well after, you just like told us what we were doing, I was interested to see how it went so that's why I said 'interested'.

Researcher: Oh, ok. Can you just elaborate on that 'interest'? Ok, I'll just recap what I said. I said, 'In the activity today the challenge is to find what size squares do you cut from this rectangle to make the biggest box?'

Alice: Yeah, well I was just intrigued to see what the result would be so that's why I said 'interested'.

Researcher: Ok, did you have an expectation or any idea to start with?

Alice: It kind of puzzled me because I thought in my head if you cut it bigger you're going to get higher walls but then it was like you're going to get minimum paper so I was kind of like wondering how it was going to work and what were the results going to be.

Alice has associated her emoticon report of 'interested' with the task property of challenge. She has succinctly verbalised the nature of the optimisation challenge presented

by the task, namely the tension between increasing at least one dimension of the box yet decreasing its surface area at the same time.

It is possible that Alice may have been able to reveal her thinking without the emoticon prompt. However in the absence of the emoticon, there would have been far greater reliance on Alice's ability to revisit the moment in terms of its exact timing, the nature of the felt emotion and connection to task. Without the emoticon, the researcher would also have found it more difficult to direct his questioning.

Excerpt 2: Routine Lesson 3, 'Venn Diagrams', Leo – first emoticon: 'Happy'

This excerpt is about Leo's first emoticon, marked at the end of a teacher-led discussion which aimed to contextualise Venn diagrams in terms of sets of political supporters in the forthcoming Federal elections. The discussion was supported by the teacher at an informal level. He did not introduce standard technical terms such as 'intersection', 'universal set' and 'mutually exclusive' during this session. The discussion occupied about 6 minutes at the beginning of the lesson and Leo participated actively. In the experience of the teacher (author) this was unusual for Leo. He identified Australian political parties and discussed situations where people showed no party affiliation.

> Researcher: So start with the emoticon record. Number one there, you felt happy about it.
>
> Leo: Yeah, I felt happy.
>
> Researcher: That was at the end of that initial little chat we had.
>
> Leo: Yeah.
>
> Researcher: And tell me, what was it about that section that made you feel happy?
>
> Leo: Just because, it's something, it's been a while since I've actually been good at something to do with maths so …
>
> Researcher: Yep.
>
> Leo: Now that I got it then, I felt a little bit happy about it.

Leo's enjoyment was influenced not only by task properties but by factors which transcended the particular classroom situation, such as a history of self-perceived poor performance in mathematics. However two aspects of the teacher-led discussion were associated with Leo's positive experience. The context of the discussion resonated with his interests as shown in the video by him maintaining eye contact with the teacher for much of the segment and spontaneously calling out responses to his questions.

The discussion was also pitched by the teacher at a level which was accessible to Leo. The lack of technical language may have led to classroom talk with which Leo felt comfortable and invited him to become actively involved. He readily announced to his partner that he was marking 'happy' when asked to select an emoticon at the end of the discussion.

Discussion and Conclusion

While the presented excerpts are only a small snapshot of the overall interview data, they demonstrate the central role which emoticons can play. Emoticon markings provided framework and purpose during post-lesson interviews, drawing interviewees into detailed discussion around the interplay between negotiated tasks and their elicited emotions.

Alice's elaboration of the reasons for her 'interested' emoticon selection provided insight for the researcher into how a task can generate a sense of 'puzzlement' or curiosity in a student. To optimise the box volume was a simple aim which Alice grasped, yet she had become aware that the relationship between cut-size and box volume was not linear, denying her a straightforward solution. Alice was convincing in her confirmation of her report, 'interested', couching the emotion in intellectual curiosity. Alice's interview response pointed towards a strong association between her emotional experience and the challenge presented by the non-linear relationship between the cut-size and box volume variables.

Leo's interview response related partly to circumstances which were peripheral to the discussion task in which he reported 'happy'. However, with added insight from the video record, he was still able to provide compelling evidence for his reported experience and its association with task. His statements distinctly characterised the enjoyment which he expressed through his 'happy' emoticon. Lumby (2011) identifies this type of feeling as a form of enjoyment born from relief or "cessation of anxiety" (p. 249). Leo's awareness of his mathematics task competence, through his worthwhile contributions during a class discussion, elicited a high level of positive emotion.

Video evidence associated Leo's experience with task content and context. His maintenance of eye contact with the teacher pointed towards the concurrent feeling of interest in the context of the discussion. Leo's active contributions to the discussion suggested that he also found appeal in the level of content.

Leo's nuancing of his 'happy' emoticon with relief ("…it's been a while since I've actually been good at something …") identifies a limitation of the range of emoticons which was available to students. Would other feelings, such as 'relief', been reported if they had been included in the standard sets given to students?

Another challenge for future emoticon marking and interview processes is posed by the desire to capture only those experiences specifically associated with task properties of interest to the researcher. It is possible, for instance, that Leo's happiness had at least partially arisen during events preceding the teacher-led discussion (e.g. he may have experienced a particularly high level of enjoyment in his previous lesson). Emoticons used in this study could not discriminate between task-related emotions and feelings influenced by other factors. The interview focus also did not include this possibility.

The findings for this study have implications for teachers in terms of lesson planning. Student feedback through emoticon selection can inform teachers about affective outcomes of their pedagogy which often remain unrevealed. Knowledge of associations between properties of task and elicited emotions could become a powerful source of consideration as teachers design mathematics lesson activities.

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