

Fostering creativity from an emotional perspective: Do teachers recognise and handle students' emotions?

Kin Wai Michael Siu, Yi Lin Wong

Abstract

Emotions have a significant effect on the processes of designing and creative thinking. In an educational context, some emotions may even be detrimental to creativity. To further explore the link between creativity and emotion, a series of interviews were conducted with design and technology (D&T) teachers in Singapore, Hong Kong and Beijing concerning their experiences of working with students on design projects. The intent was to investigate how these teachers understood and managed their students' emotions while teaching creative design skills. Some teachers indicated that they understood their students' emotions through observing their behaviour, connecting with them by synchronising emotions or by evaluating student performance. The teachers also reported using various other methods to handle their students' emotions. This study highlights the importance of equipping D&T teachers with skills for awareness and regulation of emotions so that they can better enable students to cultivate creativity in the design process.

Keywords: *creativity; emotions; design and technology; emotional regulation*

Introduction

Emotion is commonly associated with design, given the emotional effect that creative designs can have. However, the emotions involved in doing design work are not only responses to the designs themselves (e.g., products, environments, graphics or systems) but also the emotions related to engagement in the design process. Due to the complex nature of design activities, a designer needs to invest a considerable amount of time and effort in finishing a task. It is thus unsurprising that a designer may experience several changes in mood over the course of the process. For example, when a problem cannot be solved, the designer (or design student) may feel frustrated. Conversely, if the problem is solved with a sudden brilliant idea, then he or she may feel elated. Other emotions, such as anxiety, depression or anger may also be experienced during the lengthy and demanding design process. All designers must deal with their own emotions during design activities, and teachers of design must deal with the emotions of novice designers or schoolchildren in design classes (Ho & Siu, 2011; Siu, 2003).

The literature on design has not directly explored the associations between the design process and emotions. However, the literature does show a clear link between creativity and emotions (e.g., Baas et al., 2008; De Dreu et al., 2008; Filipowicz, 2006; Perry, 1989; Russ & Schafer, 2006; Sung & Choi, 2009; Van Kleef et al., 2010). As design is closely related to creativity and creativity is central to design (Lawson, 2006), it can be argued that emotions have an effect on the design process, and therefore influence the design outcome. In the context of design and technology (D&T) education, emotion is even more important, as it affects not only the design process and its product, but also the cultivation of creativity. D&T teachers, as facilitators in

guiding their students in design and creativity, need to be aware of their students' emotions. It is especially important for secondary school students that their teachers demonstrate how to manage and make use of emotions in the design process. In actuality, however, it is open to question whether D&T teachers are sensitive to their students' emotions and mood changes.

This study focuses on secondary school D&T teachers and investigates the degree to which they are aware of their students' shifts in emotion. The study also surveys the methods that teachers use for managing their students' emotions during the design process. Interviews were conducted with eight D&T teachers to assess their awareness of their students' emotions. These teachers described their experiences with students in working on design projects. They provided insights on how they understood their students' emotions and what emotion-regulation strategies they used in teaching. The findings indicate that in addition to teaching students skills in creativity and design, it is also important for the teachers to be emotionally literate, to develop relationships with their students and to provide appropriate emotional guidance (see teachers A, B and X). From a teachers' viewpoint, the findings from this study highlight the importance of recognising and handling students' emotions for cultivating creativity and developing an environment conducive to creative work.

Design and creativity

Design is similar to creativity (Howard et al., 2008) in that both involve solving problems and inventing solutions (Middleton, 2005; Rutland & Barlex, 2008). The output of designers is inherently creative (Barlex, 2007; Ho & Siu, 2011). In the design process, an individual may generate a number of creative ideas, and it is possible that several kinds of creative thinking activities are involved (Wong & Siu, 2012). These activities can be referred to in general as the creative design process. Lawson (2006) claimed that creativity is central to design. In an in-depth study of the design process, Dorst and Cross (2001) even proposed that creativity is part of every design project. In other words, creativity is at the core of design (Figure 1), and without creativity the value of any design is questionable.

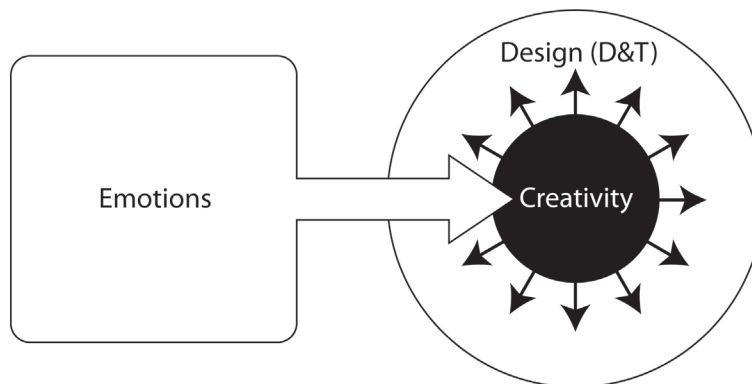


Figure 1 Relationships among emotions, design and creativity

It is thus unsurprising that creativity is one of the main topics of research in design studies. Researchers have made sustained efforts to examine the nature of creativity in the design process.

For instance, Cross (1997) investigated the activities of a small design team and suggested that the ‘leaping’ that often appears in the generation of creative designs is better described as ‘bridging’. Dorst and Cross (2001) observed the nature of creativity through studying the quality of design concepts produced by nine industrial designers. These researchers found that creativity is related to ‘developing and refining together both the formulation of a problem and ideas for its solution, with constant iteration of analysis, synthesis and evaluation processes between the two notional design “spaces”—the problem space and solution space’ (p. 434). To better understand how designers produce creative designs, Li et al. (2007) studied the factors affecting individual creativity in product design. They presented a model of creativity in product innovation based on cognitive psychology, information technology and computer application technology. Goldschmidt and Tassa (2005) investigated the links among good ideas in the design process at an architectural studio and found that the most influential and creative ideas were always associated with numerous other ideas that drew on the thinking of many people.

From this brief review, it is clear that design and creativity are closely related. Consequently, it is obvious that creativity is also a central aspect of D&T education. Spendlove (2005) believed that D&T plays ‘a significant role in the enhancement of students’ creative capability through the fashioning of product responses through consideration of “what might be” rather than “what is”’ (p. 13). Numerous researchers on D&T and design-related education have investigated the factors involved in creativity. For instance, Barlex (2007) suggested and discussed five factors that have a significant effect on creativity in D&T education. In researching the creative thinking process, Howard-Jones (2002) introduced a dual-state model to enhance students’ creativity as part of the D&T curriculum. Similarly, Webster et al. (2006) discussed generative and non-generative mental states and conducted a study to investigate the effects of these mental states on students in D&T classrooms.

Design/creativity and emotion

Designing is not a smooth process that can be conducted in a straightforward fashion (Siu, 2000). Designing somewhat resembles ‘those chaotic party games where the players dash from one room of the house to another simply to discover where they must go next’ (Lawson, 2006, p. 39). The design process that designers experience does not necessarily consist of distinct stages and steps, and different designers may approach a design brief differently. Due to the wide variety and endless possibilities of design processes, many uncertainties or unexpected issues can arise in the course of design activities. Researchers have sought to develop models of the design process as it is experienced by both novice and experienced designers (e.g., Archer, 1984; Gero & Kannengiesser, 2004; Jones, 1984; Lawson, 2006; Luckman, 1984). These models, of course, vary in their levels of complexity and practicability. Clearly though, given the complex nature of design activities, a designer needs to invest a considerable amount of time and effort to finish a task, and emotions are certainly involved in this process.

Although the current literature on design does not confirm a direct association between emotion and design, it does show linkage between emotion and creativity, which is a key element of design (see Figure 1). The involvement of emotion in the creative thinking process is supported by a number of studies (Russ & Schafer, 2006). A considerable amount of research has focused

on the influence of certain emotional states on creative performance (Ho & Siu, 2011; Van Kleef et al., 2010). De Dreu et al. (2008) reviewed the relevant literature and reported that numerous researchers have found a link between positive emotions (e.g., happiness and elation) and divergent thinking in the right hemisphere of the brain. The positive emotions often “broaden peoples’ momentary thought-action repertoires and build their enduring personal resources” (Fredrickson, 2004, p. 1369), and such a thought pattern ‘leads individuals to experience their situation as safe and problem free, to feel relatively unconstrained, to take risks, and to explore novel pathways and new possibilities in a relatively loose way, relying on heuristic process styles’ (De Dreu et al., 2008, p. 741). In contrast, negative emotions (e.g., anger and sadness), which restrict peoples’ attentions (Fredrickson, 2004), favour convergent thinking, as these feelings ‘facilitate left hemispherical, secondary process cognition, which is more verbal, sequential, and analytical’ (De Dreu et al., p. 742). Similarly, in a study of memory and divergent thinking, Russ and Schafer (2006) suggested that there are two types of affect process that are important in creativity: ‘the access to affect-laden thoughts’ and ‘the actual experience of the affect state’. The access to affect-laden thoughts reflects an ‘ability to think about and express ideation with affect-laden content’, whereas the actual experience of affect states reflects ‘the ability to experience affect or mood state’ (p. 347). The importance of the capacity to access affect-laden thoughts and to experience their positive effects (Filipowicz, 2006) is associated with divergent thinking, and this pattern suggests that emotions can determine the quantity and quality of ideas that an individual can generate (p. 348).

Other research has shown that a particular emotional state can either facilitate or hinder creativity. In general, positive affect is conducive to creativity (Baas et al., 2008; Filipowicz, 2006; Sung & Choi, 2009), although it can also have a negative influence (Filipowicz, 2006). Negative affect can similarly have either a positive or negative influence on creativity (Van Kleef et al., 2010). Van Kleef et al. (2010) showed that anger facilitates creativity when a person has a high epistemic motivation, but hinders creativity when that person has a low epistemic motivation. Surprise may also promote creativity (Filipowicz, 2006), and the sense of futility may have some relationship with creativity among some groups of artistic professionals (Perry, 1989).

Other researchers have not only related positive or negative affects to creativity, but have also taken the arousal aspect of affect into consideration. According to Russell (1980), affect can be categorised into two dimensions: the ‘pleasure-displeasure dimension’ and the ‘arousal-sleep dimension’. For example, ‘excitement’ is a pleasure-arousal affect and ‘contentment’ is the corresponding pleasure-sleep affect. De Dreu et al. (2008) adopted a similar approach to link emotions and creativity. These researchers regarded the ‘pleasure-displeasure dimension’ as the hedonic tone of the affect, and the ‘arousal-sleep dimension’ as the level of activation for the affect. De Dreu et al. proposed that an activating affect, regardless of tone, is beneficial to creativity, because moderate activating affects tend to increase an individual’s motivation to seek more relevant information and consider alternative ideas. In other words, activating affects facilitate divergent thinking. From a neurological perspective, a state of activation also increases the capacity of working memory. The only difference between positive and negative activating affects is that they generate creativity through different pathways (De Dreu et al., 2008). A positive activating affect leads to cognitive flexibility and inclusiveness, which finally leads to creative fluency and originality, because such an affect helps an individual to consider more information and make use of that information flexibly to generate creative ideas. Conversely, a

negative activating affect leads to perseverance and cognitive persistence, which means that creative ideas are generated over a longer period within a given context.

Guiding students' emotions in D&T

The foregoing review highlights that creativity and emotion are closely related, and that both creativity and emotion are in turn related to design. If creativity is central to design (Lawson, 2006), and if various types of emotions contribute to opening the pathways to creativity (De Dreu et al., 2008), then it can be argued that it is appropriate and practicable to include the discussion of emotions in the context of design education.

In D&T education at the secondary school level, the influence of teachers on students is vital, as the teachers guide their students to generate creative ideas. Students learn how to deal with different problems in the creative design process under their teacher's supervision. The ability of teachers to recognise their students' emotional issues is important. This ability may influence the students' emotional states, their design process and the quality of artefacts they produce in design lessons. This ability on the part of teachers may also have an effect on the student's level of creativity (Ho & Siu, 2011). Pianta and Hamre (2009) pointed out that teachers who can give appropriate emotional support to students are more likely to operate effective classrooms (i.e., classrooms with better behavioural management and higher academic achievement). Burleson and Picard (2007) also believed that emotional support from teachers affects students' levels of learning performance and motivation.

In the triadic schema of emotion proposed by Spendlove (2007), the process domain explicitly addresses the importance of any emotions experienced in the design process. Spendlove claimed that teachers need to nurture students' emotional sensibilities, engage students emotionally in their classroom activities and cultivate an emotionally supportive environment for the students. Teachers also need to motivate students through emotional engagement and to demonstrate how they themselves deal with emotions. It can be argued that these kinds of emotional support are closely related to the nurture of emotional intelligence.

Emotional intelligence, according to Mayer et al. (2004), is 'the capacity to reason about emotions, and of emotions to enhance thinking' (p. 197). Such intelligence incorporates different cognitive and reflective abilities that 'promote emotional and intellectual growth' (p. 197). Individuals with higher emotional intelligence are able to think and behave based on information related to emotions (Mayer et al., 2008). According to Goleman (1995), such abilities can be categorised into five domains: knowing one's emotions, managing emotions, motivating oneself, recognising emotions in others, and handling relationships. The relation between emotional intelligence and creativity was demonstrated by Zhou and George (2003) in the context of business. Their research also found that a business leader's emotional intelligence is essential for fostering the employees' creativity, because 'the root of creativity-supportive leadership behaviour is emotional intelligence' (p. 546). It can be argued that in D&T and other creativity-related activities, teachers with higher emotional intelligence are also more beneficial in fostering students' creativity, as teachers can be considered as the leaders within a learning environment.

Case studies in Hong Kong, Singapore and Beijing

A case study was conducted to assess teachers' abilities in recognising and guiding students' emotions in secondary level D&T education. Teachers in Hong Kong, Singapore and Beijing were selected for the case study. Hong Kong and Singapore have similar academic structures, and the capital city of the Chinese mainland, Beijing, is the nation's major focal point, so that schools there should be representative of the country. These locations were selected because they are well-developed Asian cities that have different historical backgrounds but similar cultural environments. In addition, the schools in these cities have varying degrees of experience in offering D&T courses, and there is some diversity in their education systems and their approaches to D&T education.

Review of D&T education in Hong Kong, Singapore and Beijing

Hong Kong. D&T education in Hong Kong was traditionally associated with hands-on subjects such as woodwork and metalwork. This subject was first introduced to secondary schools in 1983. In the last few decades it has developed into a course that requires students to creatively solve problems of daily life by using various design skills and workshop techniques (Siu, 1994, 2002a, 2002b, 2009). The course's aim is to provide 'learning opportunities for students to develop technological awareness, literacy, capability and lifelong learning patterns' (Curriculum Development Council, 2000). Most of the current D&T teachers originally taught woodwork or metalwork in industrial or vocational schools.

Singapore. D&T education in Singapore has a relatively shorter history. D&T was launched as a secondary school subject in 1990, when (as in Hong Kong) it replaced subjects that were intended for technically inclined students such as woodwork, metalwork and technical drawing (Yau & Ong, 2005). The entire programme is now design-oriented with practical applications. Students 'engage in design-and-make activities and experience a basic process of design adapted to their abilities, interests and design context' (Curriculum Planning and Development Division, 2006). Most of Singapore's D&T teachers are engineering graduates who have completed an additional one-year postgraduate teacher-training programme at the National Institute of Education.

Beijing. D&T education is known as General Technology (GT) in Chinese mainland schools. This is a new subject at the senior secondary school level, and it was introduced in Beijing in 2008. Most GT teachers have been transferred from teaching other subjects such as Physics or Mathematics. GT is established as part of the curriculum nationwide now, with the aim of cultivating and promoting students' technological literacy, creativity and ability to undertake practical work (Mu, 2010). The curriculum is based on the approach to basic technology education taken in the USA (Feng, 2013).

Participants

A qualitative approach was adopted for conducting this study. Eight teachers were involved, two from Hong Kong, three from Singapore and three from Beijing. These teachers were selected because they had led their students to participate in creative competitions and clearly had experience in guiding students to become more creative. Some of them were D&T teachers and some taught GT courses. Although the number of participants was small, this process of in-depth interviews and qualitative analysis yielded the kinds of rich data that are important for this type of research. The eight teachers were able to provide adequate information for analysis and discussion, and to produce insights useful for further investigation.

Among the eight teachers, seven were men. The dominance of male interviewees might reflect the actual proportions of male to female teachers in D&T or GT courses in the three locations, especially in Hong Kong and Singapore. A study conducted in Singapore during 2007 indicated that the ratio of male to female D&T teachers was approximately 4:1 (Wong, 2008). In Hong Kong, the ratio is much higher, as more than 95% of the D&T teachers are believed to be men. The following descriptions, along with Table 1, provide a brief background summary on the interviewees in Hong Kong, Singapore and Beijing.

Hong Kong. The two D&T teachers selected from Hong Kong had led their students to win various creative competitions in both Hong Kong and elsewhere. These teachers were experienced in coaching and guiding students to work on creative projects. They had taught D&T and related subjects for 37 years and 20 years, respectively. One of them had led students to win an international creative design competition, and the other had led students to win a number of robotics competitions both locally and internationally.

Singapore. The three D&T teachers from Singapore were recommended by an experienced D&T education expert from the teacher-training institute. They were known to be successful teachers, as some of their students had won design competitions. They had taught D&T for 9, 8 and 4.5 years, respectively. They had also taught computer science during their careers.

Beijing. The three Beijing teachers were selected from among attendees at a session on General Technology at a teacher-training institute in Beijing. They were identified by a teacher-trainer as being particularly creative. One of them had 14 years of experience in the field and had led students in several local design competitions. The other two teachers had also led students to win creative competitions, and had 2 and 3 years of experience, respectively. The students of both these teachers had entered a competition to design a weight-bearing structure, and had achieved good results in terms of the maximum weight that their structures could bear.

Table 1 Backgrounds of the interviewees

City/Country	Teachers	Teaching experience (years)	Creative experience
Hong Kong	A	37	International creative competitions
	B	20	International robotics competitions
Singapore	P	9	Student projects; local design competitions
	Q	8	
	R	4.5	
Beijing	X	14	Local design competitions
	Y	2	
	Z	3	

Instrument and procedures

Semi-structured interviews were conducted to determine the teachers' awareness of their students' emotions. The teachers were each invited to attend an individual semi-structured interview with the researcher. As these teachers were experienced in teaching design classes, it was believed that their reflections were worthy of investigation. According to Patton (2002), such selection of subjects is a kind of purposeful sampling for qualitative research in which subjects who have rich information are especially useful for investigating a topic intensively. An interview guide was set up for the interviews, and the following questions were included.

1. Have your students ever submitted any creative artefacts to you for their class assignments or learning activities? Can you describe what those artefacts were like? How did the students create/generate those creative ideas?
2. How do you inspire students to be creative? What difficulties have you encountered?
3. What would you do if your students suggested creative but unfeasible ideas? What unfeasible ideas have your students proposed? How do you guide those students?
4. Have you ever encountered highly creative students? What did they do, or how did they behave that made you think that they were creative?
5. How do you find it when dealing with creative students? Can you share some of your experiences?

As the study was designed to examine the teachers' awareness of students' emotions, the survey did not include questions that directly referred to their students' emotions. Instead, the teachers were asked to recall their experiences and memories of working with their students. According to Singer (2004), memory is naturally associated with emotions. Recalling memory is easier when it is connected to emotions (Bower, 1981). Also, it is impossible to understand emotions without cognition (Strongman, 2003). Provided that design is a creative activity related to emotions, it can be argued that recalling the design process will tend to bring up experiences associated with emotions. In a study conducted by Roseman, Wiest and Swartz (1994), recalling experience was also used for understanding the association between behaviour and emotion. The interviewees in that study were prompted to describe experiences related to certain kinds of emotions. However,

the interviewees in this study were only prompted to generally describe the design processes they experienced with their students.

All of the interview questions were asked in the context of D&T learning and teaching. The interviewed teachers also understood that their answers should refer specifically to their experience of guiding and teaching students to develop their design ideas or perform 3D modelling work. Some of the teachers had coached and led students in entering various creative competitions, and in those cases some questions were rephrased as suitable to the context of creative competitions instead of D&T classrooms. For example, for Question 1, instead of asking whether students had ever submitted or the teachers had witnessed any creative artefacts in D&T classrooms, the question concerned which creative approaches or solutions their students had used in their competitions.

The interviews were conducted in Cantonese for the Hong Kong teachers, English for the Singapore teachers and Mandarin for the Beijing teachers. The discussions were conducted on a one-to-one basis, except for the interviews with the Beijing teachers. During the interviews with teachers from Beijing, a teacher-trainer from an educational institute was present to monitor the interview process.

Findings

Relating creativity or design process with emotions

Five of the teachers directly addressed the topic of their students' emotions when talking about their D&T lessons or creative competitions. Four of these teachers (Teachers A, B, X and Y) spoke about the influence of negative emotions, and one of them (Teacher Q) talked about the effect of positive emotions. From the teachers' responses, it was clear that their students were sometimes emotional. Some students had quarrels and others were clearly anxious or happy on various occasions.

Among the teachers who directly described their students' emotions in the context of D&T or creative competitions, Teachers A and X gave the most detailed descriptions of the situations concerned (see Table 2). Teacher A pointed out that the students' emotions tended to 'accumulate', and that if the students (who were 13-14 years old) were not able to 'escape' from their negative emotions, they could 'explode'. Although Teacher X did not directly address her students' emotions, she spoke of comparing her own emotions with those of the students, and finding that their emotions tended to match hers. The matched emotions she described were all related to anxiety.

Teachers B, Q and Y addressed their students' emotions in a simpler way. They evaluated the emotions mainly according to the pleasure-displeasure dimension. Teachers B and Y pointed out that their students sometimes quarrelled with each other, and Teacher Q claimed that her students mainly felt happy. Table 2 shows the teachers' responses to their students' emotions.

Table 2 Teachers' responses to their students' emotions in the design process

Teachers	Relate creativity/design process with emotions?	Teachers' responses*
A	Yes	'Sometimes they are emotional ... sometimes they wonder why their ideas were not accepted by others, and they may have quarrels easily. Students at this age are not able to escape from their emotions. When these accumulate to a certain extent, the student may explode'.
B	Yes	'Surely they argue and have quarrels with each other. You can see the two boys here and the two girls outside this room. They have quarrels with each other'.
P	No	-
Q	Yes	'... the students themselves are also very happy when they make something that is really, really pleasant and interesting'.
R	No	-
X	Yes	'Sometimes I would feel worried or anxious, and sometimes nervous. At the end, it was happy for sure. Most of these emotions synchronised and matched with my students' emotions. The only difference between me and the students is that I am relatively calmer'.
Y	Yes	'They had quarrels, and needed to cooperate with each other'.
Z	No	-

* The responses in Cantonese (Teachers A and B) and Mandarin (Teachers X, Y and Z) were translated into English by the authors.

Strategies to deal with students' emotions

The teachers were able not only to describe their students' emotions, but also to indicate some strategies they used in dealing with those emotions, especially the negative emotions. Teachers A, B and X described their responses when encountering students' negative emotions. Teacher A gave two of the practices he used. He said that in dealing with emotional students, it was important to allow them to express themselves. Then, he asked his students to change roles and rethink the situation. He said that he 'absorbed' his students' emotions, and then allowed them to take some time to think until they could act properly again. Towards the other students in the class, Teacher A acted as a role model, showing the students how he reacted to the situation. Teacher B made a similar point, saying that he allowed the students time to calm down. Teacher X said that she directed overly emotional students to think more objectively.

Table 3 Teachers' suggested strategies to deal with students' emotions

Teachers	Strategies to deal with students' emotions?	Teachers' responses*
A	Yes	'First of all you cannot talk to them rationally. Being

		rational has no use. Do not tell them what they should do but let the student speak out his problem—let him express. Then ask him to change roles with the others and ask how he will manage the situation’. ‘The second way is to absorb what I don’t accept first. Other students will see that I absorb it, and they will accept it more easily ... I set him free for a while, and let others see that I have accepted his undesirable behaviour. Because everyone should understand their responsibility, he will be back to work later ...’
B	Yes	‘Wait for them to finish arguing, and let them go out to have a walk. Everyone has a temper. The only way is to cooperate with each other and see how to change and adapt’.
P	No	-
Q	No	-
R	No	-
X	Yes	‘For negative feelings, I try my best to persuade them to view [the problem] from a more objective perspective’.
Y	No	-
Z	No	-

* The responses in Cantonese (Teachers A and B) and Mandarin (Teachers X, Y and Z) were translated into English by the authors.

Analysis and discussion

Teachers’ understanding of students’ emotions

The D&T or GT teachers in Hong Kong, Singapore and Beijing often worked with their students on a daily basis. They did so because some students did not have enough time finish their design projects or competition designs during the lessons. The teachers and students often worked after school for developing ideas and modelling. In some cases, especially when participating in creative competitions, the teachers and students had to work at night, as the deadline was approaching. Therefore, in the design process (or more precisely in the design experience), the teachers not only needed to guide students to generate creative work, but also to handle emotions in stressful situations. The responses given by the teachers showed how they recognised and reacted to the students’ emotions in the midst of designing practice.

Among the interviewed teachers, Teachers A, B and Y spoke of their abilities to recognise students’ emotions through their behaviour. The emotional behaviour addressed by these teachers often involved ‘quarrels’. Actually, it may be difficult for teachers to be aware of their students’ internal emotions, as students often avoid sharing their inner thoughts and feelings with others. Especially in the East Asian context of this study, teachers and students tend to be more introverted and reserved when dealing with emotions (Averill et al., 2001). Many teachers may

only be able to ‘observe’ students’ emotions by their outward behaviour. However, Teachers Q and X were able to understand students’ emotions in a different way.

Teacher X mentioned that her own emotions were synchronised with those of her students. The concept of synchronisation of emotions may be best described as a form of emotional contagion. According to Hatfield et al. (1992), emotional contagion is defined as ‘the tendency to automatically mimic and synchronise facial expressions, vocalisations, postures, and movements with those of another person and, consequently, to converge emotionally’ (pp. 153-154). In other words, the synchronisation of emotions happens through a series of interactions between two individuals or among a group of people. It can be argued that this kind of emotional synchronisation is built on a close teacher-student relationship, and it is not just a coincidence when it happens. One reason that teachers need to be emotionally literate is that it is impossible for them to synchronise their emotions with those of others without first understanding their own emotions. It appears that the synchronisation of emotions is not a procedural strategy that one can follow step by step. Rather, it is an outcome that results from building a close interpersonal relationship. Having this kind of relationship may be one of the best ways for teachers to understand the emotions that students experience during the design process. Forming relationships is also a good way for teachers to influence their students’ emotions, as this allows a synchronisation of emotions between teachers and students.

Several of the teachers described using observation of outward behaviour (Teachers A, B and Y) or teacher-student synchronisation (Teacher X) to understand their students’ emotions. These are process-oriented activities that the teachers could use to enable the process of design and creative thinking. As mentioned in the previous sections, students and designers may experience various kinds of emotions during the design process. However, such emotions appear not only in the midst of the design activity, but also at the end of the process. Teacher Q explained that his students were happy with the outcome of their design projects. This comment reveals that he understood his students’ emotions through their responses after completing the design process. The quality of the outcome or result had an effect on the students’ emotions. This was a retrospective kind of outcome emotion, i.e., an emotion experienced after reaching a goal (Pekrun, 2006). Teacher Q’s observation implied that the outcome of creativity was of value to the students and that it was important for them to achieve this emotional outcome.

From the preceding analysis, it is clear that some of the interviewed teachers understood their students’ emotions through observing their behaviour, having teacher-student synchronisation, or by assessing the students’ responses to the outcome of their efforts (Figure 2). It can be argued that a merging of all three methods could help teachers to understand their students’ emotions more effectively. The black area in Figure 2 (i.e., the area where the three circles overlap) shows the most effective combination of means for understanding emotions. The dark grey area is the overlapping area of ‘process’ and ‘outcome’ methods. Understanding emotions through either one of the ‘in-process’ methods (i.e., either through observing students’ behaviour or through teacher-student synchronisation), along with observing students’ responses to the process outcome, can also be an effective approach. A combination of in-process and outcome-related methods is more holistic. The light grey area (which is the zone of overlap between the two in-process methods) indicates a less holistic approach than the dark grey or black areas, as the light grey area concerns only process-related methods.

As the interviewed teachers who understood their students' emotions had considerable experience in training students to be creative or to achieve success in various creative competitions, it can be argued that their methods represent some of the ways that creative teachers use to understand their students during the design process. Teachers who use such methods may be able to engage with their students' experiences of creative work in a deeper and more active way. Teachers may also become more directly involved in the design process through this kind of emotional engagement. If we assume that emotions have an effect on creativity and design, then it seems reasonable that having teachers who are able to engage with their students' emotions may help the students to become creative. It should be especially helpful if those teachers are able to teach creativity skills while guiding their students to handle emotions at the same time.

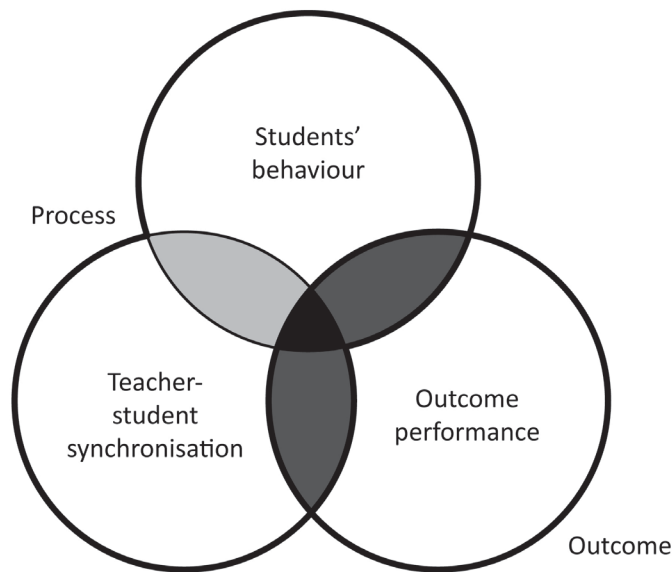


Figure 2 How the interviewed teachers understood their students' emotions

It is noted that Teachers P, R and Z did not mention any of their students' emotions in describing interactions with them. In their interviews, these teachers primarily focused on the necessary drawing ability that students have to develop (Teacher P), the management skills that teachers need to use in classrooms (Teacher R) and the achievements that the students made in creativity competitions (Teacher Z). It may be that these teachers saw the administrative and learning outcomes as more important than emotion, or that the issues of administration and learning outcomes required more attention in their teaching environments. This practical focus by the teachers may be attributed to various causes, such as the teachers' learning and teaching experience, their teaching philosophy, classroom environment or personal characteristics. Further investigations are needed to clarify the factors involved. Nevertheless, the phenomenon of neglecting to mention emotion suggests that teachers are able to become aware of their students' emotions only when other distracting issues are solved or settled.

Teachers' emotion-regulation strategies for creativity cultivation

Although some studies have shown that creativity can be achieved through negative emotions (see Perry, 1989; Van Kleef et al., 2010), such emotions are not encouraged in the classroom. This discouragement of negativity makes the cultivation of creativity more difficult. It is not possible for teachers to guarantee that learning will be joyful. It is also very possible that in the process of cultivating creativity, negative emotions will arise, and these emotions will hinder the students from engaging in class activities (Assor et al., 2005). Pragmatically, teachers have to consider a number of variables, such as the types of knowledge and the types of design activities or challenges that their students are facing. Such variables may affect the emotional responses of the students. For instance, some students may grow extraordinarily sensitive (i.e., too stubborn or too pliable) in response to certain topics that are closely related with their past experience. Teachers have to deal with these kinds of unexpected variables and must react to their students' emotions based on their own life experiences and their understanding of the students' personal characteristics. In this regard, some teachers may avoid striving for creativity if they expect failure or unpleasant feelings to be involved. In other words, if teachers do not have a certain level of emotional intelligence, it is difficult for them to achieve the goals of cultivating creativity cultivation and of helping the students to have a pleasant learning experience. Teachers need to both cultivate creativity and help the students enjoy the learning process. The teachers' challenge is to foster creativity by cultivating a pleasant learning environment. When faced with unpleasant incidents or events, they have to facilitate or guide the students to handle emotions so they are able to enjoy the process. In fact, positive emotions have an effect on motivation and risk taking (Meyer & Turner, 2002). Motivation and willingness to take risks help students to learn creativity (Amabile, 1983; 1996; Copley, 2001). As students at the secondary school level sometimes have emotional conflicts (Slavin, 2009), it is important for teachers to handle these kinds of problems in class. The teachers need to have various strategies to both encourage positive emotions and to help their students resolve difficulties involving negative emotions. Some of the interviewed teachers described their strategies for handling their students' negative emotions.

In their interviews, Teachers A, B and X showed that they were able to recognise and manage their students' emotions. Obviously, Teacher A had more strategies or methods for tackling these issues. This teacher also had more teaching experience than the other teachers. He handled the emotional problems of his students in terms of relating to their experience, and he believed that the methods he used were useful to the students. One of the methods Teacher A used involved the social sharing of emotions. Such allowance for talking about unpleasant events may be seen 'as a discharge process which should eliminate the load of the emotional experience' (Zech et al., 2004, p. 161). In addition, Teacher A allowed his students to 'escape' temporarily from stressful situations. Teacher B also used this method of handling students' emotions. These emotion regulation methods may lead to rumination. However, rumination can also exacerbate the situation if the student is in a depressed or angry mood (Nolen-Hoeksema & Morrow, 1993; Rusting & Nolen-Hoeksema, 1998). It is seldom clear if a student has gone through a helpful process of self-focused rumination while temporarily 'escaping' the situation.

This issue shows the need for teachers to be equipped with emotion-regulation strategies when working with students, especially in the process of cultivating creativity. It may be essential to

equip teachers with emotion-regulation strategies and skills, as teachers at the secondary school level may often need to manage their students' emotions. The importance of emotion-management skills may be even greater for classes that seek to cultivate creativity, because showing students how to be creative commonly requires that teachers spend a lot of time with students to help them finish their projects and solve the problems involved.

Teacher X also stated that she had a method for handling the students' emotions. Her method was related to an emotion-regulation strategy known as the re-appraisal of cognitive change (Gross, 1998). This method aims to transform the situation cognitively. The emotionally challenged individual then perceives the situation in a different way, and this shift in perspective can help to soften the effect of negative emotions. The method used by Teacher X may be of value for other teachers as one of the emotion-regulation methods they use in the process of cultivating creativity.

It is clear that Teachers A, B and X were more actively involved in their students' emotions than the other interviewed teachers, as they showed that they had used various strategies in guiding students to handle their emotions. In other words, Teachers A, B and X played an active role in their students' design process and emotion-regulation. Although some of their strategies can be considered as generic approaches to helping students handle emotions in general, these strategies were specifically applied while the students were engaged in design activities. It can be argued that the use of these strategies can play a helpful role for enabling creativity in the design process, because emotions are closely related to creativity (e.g., Baas et al., 2008; De Dreu et al., 2008; Filipowicz, 2006; Perry, 1989; Russ & Schafer, 2006; Sung & Choi, 2009; Van Kleef et al., 2010) and creativity is central to design (Lawson, 2006). Teachers may use these strategies to help cultivate a joyful learning environment for learning to be creative.

Conclusions

Drawing on the experiences of D&T or GT teachers in Hong Kong, Singapore and Beijing, this study has addressed the role of teachers in recognising and handling students' emotions, and the role of emotional support in fostering creativity. Emotions are closely related to design and creativity in that they influence the processes of design and creative thinking. If D&T or GT teachers are able to sense and handle their students' emotions, then the cultivation of creativity can be optimised. Some of the D&T teachers (Teachers A, B, Q, X and Y) involved in this case study understood their students' emotions through observing their behaviour, synchronising their own emotions with those of their students or evaluating the resultant design outcomes. Using all of these methods simultaneously may help teachers to better understand their students' emotions. In addition, some D&T teachers (Teachers A, B and X) handled their students' emotions through encouraging them to share their feelings or by giving them time to ruminate. It is unclear whether all of these methods are conducive to the students' learning and their emotional health, but this ambiguity makes it more important that teachers develop sensitivity in their choices of emotion-regulation strategies.

This study focuses on emotions as one of the perspectives for approaching the topic of creativity cultivation. This is an important perspective that teachers can consider when seeking to foster

creativity among students. Teachers are reminded that in addition to finding procedural and scientific strategies to facilitate their students' creative thinking skills, it is also essential to meet the students' emotional needs during the creative thinking process. Sometimes teachers may not understand the causes of their students' emotions, or the students may bring their fluctuating emotions from outside the classroom. Nonetheless, the most important thing is for the teacher to recognise and respond to the students' emotions. Creativity is not simply an 'inhumanised' attribute or a technical skill. Instead, the learning and teaching of creativity is related to building interpersonal relationships in an educational context. Consequently, it is essential for D&T or GT teachers to develop strong relationships with their students. Teachers of creative design programmes need to be equipped with emotion-regulation skills to enable the cultivation of creativity. Like teachers A, B and X in this study, D&T teachers should seek not only to develop the skills required to perform creative work, but should also foster the students' emotional and social capacities for becoming creative people. To do this, they need to be actively involved in their students' processes of design and creative thinking (Siu, 2001). Teachers need to serve as an example and to demonstrate how to deal with emotions in the midst of design and other creative activities.

References

- Amabile, T. (1983). *The social psychology of creativity*. New York, NY: Springer-Verlag.
- Amabile, T. (1996). *Creativity in context: Update to the social psychology of creativity*. Boulder, CO: West View Press.
- Assor, V., Kaplan, H., Kanat-Maymon, Y., & Roth, G. (2005). Directly controlling teacher behaviours as predictors of poor motivation and engagement in girls and boys: The role of anger and anxiety. *Learning and Instruction, 15*(5), 397-413.
- Archer, L. B. (1984). Systematic method for designers. In N. Cross (Ed.), *Developments in design methodology* (pp. 57-82). New York: Wiley.
- Averill, J. R., Chon, K. K., & Hahn, D. W. (2001). Emotions and creativity, east and west. *Asian Journal of Social Psychology, 4*(3), 165-183.
- Baas, M., De Dreu, C. K. W., & Nijstad, B. A. (2008). A meta-analysis of 25 years of mood-creativity research: Hedonic tone, activation, or regulatory focus? *Psychological Bulletin, 134*(6), 779-806.
- Barlex, D. (2007). Creativity in school design and technology in England: A discussion of influences. *International Journal of Technology and Design Education, 17*(2), 149-162.
- Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*(2), 129-148.
- Burleson, W., & Picard, R. W. (2007). Gender-specific approaches to developing emotional intelligent learning companions. *IEEE Intelligent systems, 22*(4), 62-69.
- Cropley, A. J. (2001). *Creativity in education & learning: A guide for teachers and educators*. London, UK: Kogan Page.
- Cross, N. (1997). Descriptive models of creative design: Application to an example. *Design Studies, 18*(4), 427-455.
- Curriculum Development Council [CDC]. (2000). *Syllabuses for secondary schools: Design & technology (Secondary 1-3)*. Hong Kong: Education Department.
- Curriculum Planning and Development Division. (2006). *Design & Technology Syllabus: Lower Secondary Special/Express/Normal (Academic)*. Singapore: Ministry of Education.

- De Dreu, C. K. W., Baas, M., Nijstad, B. A. (2008). Hedonic tone and activation level in the mood-creativity link: Toward a dual pathway to creativity model. *Journal of Personality and Social Psychology*, 94(5), 739-756.
- Dorst, K., & Cross, K. (2001). Creativity in the design process: Co-evolution of problem-solution. *Design Studies*, 22(5), 425-437.
- Feng, W. W. (2013). *Exploring the future of technology education in China*. PhD thesis. Hong Kong: The Hong Kong Polytechnic University.
- Filipowicz, A. (2006). From positive affect to creativity: The surprising role of surprise. *Creativity Research Journal*, 18(2), 141-152.
- Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 359, 1367-1377.
- Gero, J. S., & Kannengiesser, U. (2004). The situated function-behaviour-structure-framework. *Design Studies*, 25(4), 373-391.
- Goldschmidt, G., & Tatsa, D. (2005). How good are good ideas? Correlates of design creativity. *Design Studies*, 26(6), 593-611.
- Goleman, D. (1995). *Emotional intelligence*. New York: Bantam Books.
- Gross, J. J. (1998). The emerging field of emotional regulation: An integrative review. *Review of General Psychology*, 2(3), 271-299.
- Hatfield, E., Cacioppo, J., & Rapson, R. L. (1992). Emotional contagion. In M. S. Clark (Ed.), *Review of personality and social psychology: Vol. 14. Emotion and social behavior* (pp. 151-177). Newbury Park, CA: Sage.
- Ho, A. G., & Siu, K. W. M. (2011). Emotionalise design, emotional design, emotion design: A review on their relationships from a new perspective. *The Design Journal*, 15(1), 9-32.
- Howard, T. J., Culley, S. J. & Dekoninck, E. (2008). Describing the creative design process by the integration of engineering design and cognitive psychology literature. *Design Studies*, 29(2), 160-180.
- Howard-Jones, P. A. (2002). A dual-state model of creative cognition for supporting strategies that foster creativity in the classroom. *International Journal of Technology and Design Education*, 12(3), 215-226.
- Jones, J. C. (1984). A method of systematic design. In N. Cross (Ed.), *Developments in design methodology* (pp. 9-31). New York: Wiley.
- Lawson, B. (2006). *How designers think: The design process demystified (4th ed.)*. Oxford; Burlington, MA: Elsevier/Architectural.
- Li, Y., Wang, K., Li, X., & Zhao, W. (2007). Design creativity bin product innovation. *International The International Journal of Advanced Manufacturing Technology*, 33(3-4), 213-222.
- Luckman, J. (1984). An approach to the management of design. In N. Cross (Ed.), *Developments in design methodology* (pp. 83-97). New York: Wiley.
- Mayer, J. D., Salovey, P., & Caruso, D. R. (2004). Emotional intelligence: Theory, findings, and implications. *Psychological Inquiry*, 15(3), 197-215.
- Mayer, J. D., Salovey, P., & Caruso, D. R. (2008). Emotional intelligence: New ability or eclectic traits? *American Psychologist*, 63(3), 503-517.
- Meyer, D. K., & Turner, J. C. (2002). Discovering emotion in classroom motivation research. *Educational Psychologist*, 37(2), 107-114.
- Middleton, H. (2005). Creative thinking, values and design and technology education. *International Journal of Technology and Design Education*, 15(1), 61-71.

- Mu, J. (2010). Discussion on literacy-oriented technology paradigm. *Research and Review on Education – Technology Education (Chinese ed.)*, 35(1), 5-12.
- Nolen-Hoeksema, S., & Morrow, J. (1993). Effects of rumination and distraction on naturally occurring depressed mood. *Cognition and Emotion*, 7(6), 561-570.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practices. *Educational Psychology Review*, 18(4), 315-341.
- Perry, C. (1989). Futility and creativity. *Journal of Analytical Psychology*, 34, 225-241.
- Pianta, R., & Hamre, B. K. (2009). Conceptualization, measurement, and improvement of classroom processes: Standardized observation can leverage capacity. *Educational Researcher*, 38(2), 109-119.
- Roseman, I. J., Wiest, C., & Swartz, T. S. (1994). Phenomenology, behaviors, and goals differentiate discrete emotions. *Journal of Personality and Social Psychology*, 67(2), 206-221.
- Russ, S. W., & Schafer, E. D. (2006). Affect in fantasy play, emotion in memories, and divergent thinking. *Creativity Research Journal*, 18(3), 347-354.
- Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39(6), 1161-1178.
- Rusting, C. L., & Nolen-Hoeksema, S. (1998). Regulating responses to anger: Effects of rumination and distraction on angry mood. *Journal of Personality and Social Psychology*, 74(3), 790-803.
- Rutland, M., & Barlex, D. (2008). Perspectives on pupil creativity in design and technology in the lower secondary curriculum in England. *International Journal of Technology and Design Education*, 18(2), 139-165.
- Singer, J. A. (2004). Narrative identity and meaning making across the adult lifespan: An introduction. *Journal of Personality*, 72(3), 437-460.
- Siu, K. W. M. (1994). *Study of pupils' rationale for the selection of topics in the Project section of the HKCEE design and technology*. MEd thesis. Hong Kong: The University of Hong Kong.
- Siu, K. W. M. (2000). A comparative study of relay thinking activities in degree and secondary level students. *Educational Research Journal*, 15(1), 45-68.
- Siu, K. W. M. (2001). Reconstructing the learning environment for the new needs in engineering training. *Engineering Science and Education Journal*, 10(3), 120-124.
- Siu, K. W. M. (2002a). Improving design & technology education in Hong Kong. *Journal of Art & Design Education*, 18(3), 345-350.
- Siu, K. W. M. (2002b). Meeting the new needs: Curriculum development and assessment of technology subjects. *25th Anniversary Commemorative Album of the Hong Kong Examinations and Assessment Authority* (pp. 48-54). Hong Kong: Hong Kong Examinations and Assessment Authority.
- Siu, K. W. M. (2003). Users' creative responses and designers' roles. *Design Issues*, 19(2), 64-73.
- Siu, K. W. M. (2009). Review on the development of design education in Hong Kong: The need to nurture the problem finding capability of design students. *Educational Research Journal*, 23(2), 179-202.

- Slavin, R. E. (2009). *Educational psychology: Theory and practice (9th ed.)*. Upper Saddle River, NJ: Pearson Education.
- Spendlove, D. (2005). Creativity in Education: A review. *Design and Technology Education: An International Journal*, 10(2), 9-18.
- Spendlove, D. (2007). The locating of emotion within a creative, learning and product orientated design and technology experience: Person, process, product. *International Journal of Technology and Design Education*, 18(1), 45-57.
- Strongman, K. T. (2003). *The psychology of emotion: From everyday life to theory (5th ed.)*. Chichester: J. Wiley & Sons.
- Sung, S. Y., & Choi, J. N. (2009). Do big five personality factors affect individual creativity? The moderating role of extrinsic motivation. *Social Behavior and Personality*, 37(7), 914-956.
- Van Kleef, G. A., Anastasopoulou, C., & Nijstad, B. A. (2010). Can expressions of anger enhance creativity? A test of the emotions as social information (EASI) model. *Journal of Experimental Social Psychology*, 46(6), 1024-1048.
- Webster, A., Campbell, C., & Jane, B. (2006). Enhancing the creative process for learning in primary technology education. *International Journal of Technology and Design Education*, 16(3), 221-235.
- Wong, Y. L. (2008). *A study of students' motivation, gender bias and their relationship in design and technology education in Singapore*. (Unpublished master dissertation). National Institute of Education, Singapore.
- Wong, Y. L., & Siu, K. W. M. (2012). A Model of Creative Design Process for Fostering Creativity of Students in Design Education. *International Journal of Technology and Design Education*, 22(4), 437-450.
- Yau, C. M., & Ong, C. C. (2005). Pupils' views towards design and technology in Singapore. *Design and Technology Education: An International Journal*, 10(3), 37-49.
- Zech, E., Rimé, B., & Nils, F. (2004). Social sharing of emotion, emotional recovery, and interpersonal aspects. In P. Philippot, & R. S. Feldman (Eds.), *The Regulation of Emotion* (pp. 157-185). Mahwah, NJ: Lawrence Erlbaum Associates.
- Zhou, J., & George, J. M. (2003). Awakening employee creativity: *The role of leader emotional intelligence*. *The Leadership Quarterly*, 14(4-5), 545-568.