

ORIGINAL RESEARCH ARTICLE

Students' emotions for achievement and technology use in synchronous hybrid graduate programmes: a control-value approach

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Synchronous hybrid delivery (simultaneously teaching on-campus and online students using web conferencing) is becoming more common; however, little is known about how students experience emotions in this learning environment. Based on Pekrun's (2006) control-value theory of emotions, the dual purpose of this study was first to compare synchronous hybrid students who attend online versus on-campus in terms of control, value, emotions and perceived success and second to compare students' degree of emotional activation in the domains of programme achievement and technology use. Survey data from 101 graduate business students revealed that online students reported significantly higher levels of technology-related anger, anxiety and helplessness. Furthermore, in comparison to their on-campus counterparts, online students more clearly separated their emotions in terms of programme achievement and technology use. Emotions related significantly to students' perceived success for both programme achievement and technology use, and mediated the effects of control and value appraisals on perceived success.

Keywords: online learning; web conferencing; distance education; graduate business education; mediational analysis

Higher education is in the midst of a dramatic transformation. The proliferation of instructional technologies has greatly expanded the options available for course delivery, placing postsecondary education within the reach of more students than ever before. One way postsecondary institutions have chosen to augment the traditional, face-to-face delivery model is by creating *synchronous hybrid learning environments*. Synchronous hybrid delivery involves providing synchronous instruction to both on-campus and online students using real-time audio and video technology (Roseth, Akcaoglu, and Zellner 2013).

Even though synchronous hybrid delivery may improve access to postsecondary education, it is not without its detractors. Technology-enriched delivery modes have been described as lacking some of the emotionally appealing features that students have come to expect in face-to-face instruction, such as body language, facial expressions and gestures (Vrasidas and Zembylas 2003). However, few would argue that students in technology-enriched learning environments are devoid of emotions.

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Additionally, many education scholars contend that emotions are inextricably linked to academic achievement outcomes, such as student effort (Pekrun *et al.* 2002), adaptive learning strategies (Lehman, D'Mello, and Graesser 2012) and individual exam scores (Noteborn *et al.* 2012). Although research on emotions in academic settings has gained momentum in recent years, few existing studies have focused on the synchronous hybrid modality. Based on Pekrun's (2006) control-value theory of emotions, the dual purpose of this study was first to compare synchronous hybrid students who attend online versus on-campus in terms of control, value, emotions and perceived success and second to compare students' degree of emotional activation in the domains of programme achievement and technology use. The following literature review places this study in the context of the existing research on emotions in technology-enriched learning environments.

Theoretical traditions in emotion-related studies

Emotions research in education has a complex history that is intertwined with the development of philosophical thought (O'Regan 2003). For centuries, Eastern societies have regarded emotions as internal processes, deeming it inappropriate to reify emotions as independent, object-like entities (Uchida and Kitayama 2009). In contrast, Western thought has assumed a conventional dualism between thinking and feeling (Titsworth *et al.* 2013). This theoretical tradition limited the scope of emotions research in educational settings for many years. Today, however, researchers from various fields have asserted that emotions are critical components of the teaching and learning paradigm.

As is often the case in emerging areas of research, contemporary emotion-related studies span a wide range of theoretical traditions, assumptions and applications. For example, Terzis, Moridis and Economides (2013) conducted a study that tested a clinical diagnostics approach to estimating emotional states based on facial expressions. In a related strand of behavioural neuroscience research, Perlman and Pelphrey (2011) found evidence that emotions can be conceptualized as regulating processes that stem from social and cognitive development. In contrast to research involving clinical techniques and brain connectivity, learning theorists have sought to understand how emotions influence performance in achievement settings (Pekrun *et al.* 2011). In this study, Pekrun's (2006) control-value theory of emotions was applied as a theoretical framework to examine the role of emotions in technology-mediated synchronous hybrid learning environments.

Control-value theory of emotions

Emotions that are directly linked to achievement activities or outcomes are referred to as achievement emotions (Pekrun and Stephens 2010). According to Pekrun *et al.* (2002), achievement emotions are not only ubiquitous in academic settings, but also essential to understanding students' academic performance. Based on Pekrun's (2006) control-value theory, achievement emotions can be classified according to valence (positive vs. negative), degree of activation (activating vs. deactivating) and object focus (activity, outcome prospective and outcome retrospective).

Pekrun (2006) posits that appraisals of control and value are critical antecedents of achievement emotions. Specifically, *control* is used to refer to the perceived causal influence of an agent over achievement (Skinner 1996). The term *value*, as defined by

Wigfield and Eccles (1992), denotes the perceived importance of actions and outcomes associated with four dimensions of achievement: intrinsic value (personal enjoyment in a given task), attainment value (fulfilment of one's self-schema), utility value (reaching long and short-term goals) or cost (the consequences of engaging in a particular activity). Previous empirical work has shown that control and value relate significantly to emotions. Pekrun *et al.* (2002) found perceived control to have significant positive correlations with positive activating emotions and significant negative correlations with negative activating emotions. Furthermore, they discovered a significant positive association between high task value and students' positive activating emotions. Students' achievement emotions were also linked to their academic success in traditional learning environments (Pekrun *et al.* 2011).

While emotions research not driven by Pekrun's (2006) control-value theory is more common in technology-enriched environments, a number of studies have adopted Pekrun's framework. In particular, recent research on control-value theory has focused on asynchronous course delivery (Marchand and Gutierrez 2012), virtual tutoring systems (Lehman, D'Mello, and Graesser 2012) and self-paced online courses (Artino and Jones 2012). Specifically, Marchand and Gutierrez (2012) used multigroup path analysis to find that students' utility value significantly predicted frustration, in both online and on-campus courses. Similarly, by manipulating students' degree of control in virtual tutoring systems, the Lehman, D'Mello, and Graesser (2012) experiment showed that limiting students' control within a technology-enriched environment resulted in higher levels of negative emotions. Artino and Jones (2012) found that students' metacognitive control over a self-paced online course and their value appraisals of the information presented were both associated with a variety of emotions. The results of these studies supported that students' cognitive appraisals of control and value play consistent roles as antecedents of achievement emotions in technology-enriched learning environments.

Synchronous hybrid learning environments

This study examined students' emotional activation in synchronous hybrid learning environments. Roseth, Akcaoglu, and Zellner (2013) described synchronous hybrid learning environments as a course delivery option where online and on-campus students receive instruction simultaneously. It should be noted, however, the simultaneous teaching of on-campus and online students has been variously termed 'blended synchronous learning' (Bower *et al.* 2012), 'multi-access learning' (Irvine, Code, and Richards 2013) and 'synchromodal learning' (Bell, Cain, and Sawaya 2013).

In spite of the diverse lexicon used within the field of educational technology, the unique benefits of synchronous hybrid programmes have recently captured the attention of many educators and researchers. In terms of pedagogy, Vu and Fadde (2013) demonstrated that implementing a backchannel chat interface in synchronous hybrid learning environments encourages students to interact with one another across attendance modes. Irvine, Code and Richards (2013) emphasized that synchronous hybrid programmes offer flexible course access options that do not sacrifice the spontaneous quality of authentic learning experiences. Shield, Atweh and Singh (2005) established that synchronous tutorials can be used to build hybrid learning communities that include both online and on-campus students. Despite the

increased interest in synchronous hybrid programmes, no previous studies have explored students' emotional activation in this emerging approach to course delivery.

Programme achievement and technology use as domains of emotional activation in synchronous hybrid learning environments

Students' emotional experiences are, to a great extent, organized in domain-specific ways (Goetz *et al.* 2007). While the term domain can be used to denote different content domains (i.e., different subjects or disciplines), this study employed a broader definition whereby domains represent the general frame or structure associated with a given emotion or set of emotions (Wierzbicka 1990). For example, instructors can provide students with opportunities to use technology in the absence of achievement expectations (technology prominent affective domain), or conversely, they can hold achievement expectations that do not require technology to accomplish (achievement prominent affective domain). When students enrol in synchronous hybrid programmes, their learning environment requires both programme achievement and technology use.

The first domain of interest in the synchronous hybrid learning environment is programme achievement. Research involving traditional classrooms has identified achievement as the standard indicator of student learning (Guay, Ratelle, and Chanal 2008). Accordingly, Pekrun *et al.* (2002) found that achievement is a major source of human emotions. Thus, while synchronous hybrid learning is markedly different from traditional, face-to-face instruction in terms of delivery, programme achievement is arguably an important affective domain in both environments.

The second critical domain in the synchronous hybrid learning environment is technology use. Indeed, it would be imprudent to assume that students are blissfully unaware of the technology needed to facilitate technology-enriched course delivery options. To this end, Daniels and Stupnisky (2012) argued that the introduction of new course delivery options in emotions research has made it 'more important than ever to consider the source of the emotion in addition to the emotion itself', asserting that students are likely to 'experience emotions in response to the technology itself' (p. 225). Accordingly, Regan *et al.* (2012) suggested that the factors affecting the emotional tone of technology-enriched learning environments are different from those that influence emotions in traditional, on-campus classrooms. Therefore, domain-specificity is an important consideration for examining emotional activation involving programme achievement and technology use.

The current study: testing control-value theory in synchronous hybrid programmes

The purpose of this study was twofold: (1) to compare synchronous hybrid students who attend online versus on-campus in terms of control, value, emotions and perceived success; and (2) to compare students' degree of emotional activation in the domains of programme achievement and technology use. These domains were examined in the contexts of synchronous hybrid Masters of Business Administration (MBA) and Masters of Public Administration (MPA) programmes. This study was unique in that it examined an emerging delivery mode (i.e., synchronous hybrid programmes) from the perspective of Pekrun's (2006) control-value theory of emotions (see Figure 1). This investigation involved planned (a priori) comparisons between online and on-campus students on measures of control, value, emotions

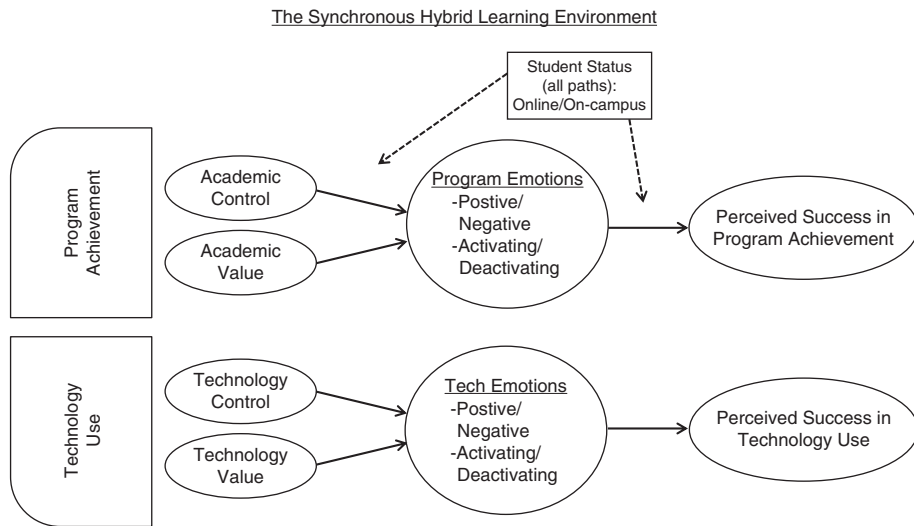


Figure 1. Conceptual model used to test control-value theory in synchronous hybrid learning environments.

and perceived success. The links between these variables were examined using correlational and mediational analysis.

Method

Participants and procedure

Participants in this study comprised self-selected groups of online and on-campus students enrolled in either the MBA or MPA programme offered in the college of business at a large, Midwestern USA research university. In order to improve student access, the college of business has offered all courses within the MBA and MPA programmes in a synchronous hybrid format since the 2007 Fall Semester using Adobe Connect™ web conferencing software. Each class has a group of local students attending on-campus, as well as a group of distance students who attend online from any location using synchronous audio and video streaming technology. The features of the synchronous hybrid systems through which the MBA and MPA courses are delivered are essentially identical.

Near the middle of the 2013 Spring Semester, all 273 students enrolled in either the MBA or MPA programme were given the opportunity to complete an online survey via an email containing a hyperlink. Excluding the demographic questions, the survey contained 51 items that assessed control (16 items), value (8 items), emotions (20 items) and perceived success (7 items). These scales included separate items to measure the variables in the domains of programme achievement and technology use. In exchange for completing the survey, students were entered into a drawing for an iPad Mini. Over a period of 3 weeks, 120 individuals accessed the survey (an initial response rate of 44.0%). Nineteen participants were excluded from analysis due to incomplete data regarding the primary study variables. Accordingly, the final response rate was approximately 37.0%, yielding a sample of 101 students (71 MBA; 30 MPA).

The participants included 37.6% females and 62.4% males ranging in age from 20 to 59 years ($M = 29.88$; $SD = 7.38$). The sample was 93.1% White/Caucasian.

Approximately 45.5% were married; 12.9% were unmarried, living with partner; 37.9% were single; and 4.0% were separated, divorced, or widowed. Work experience among the participants ranged from 0 to 35 years ($M = 5.34$; $SD = 6.87$). In the current sample, 64.4% were working full-time, 26.7% were working part-time and 8.9% were unemployed. In terms of the hybrid learning environment, 36.6% attended on-campus and 63.4% attended online. On average, students had completed roughly half of the credits required by their programme at the time the survey was administered ($M = 16.04$; $SD = 10.28$). Enrolment status among the participants was 54.5% part-time and 45.5% full-time.

Measures

Control

Perceived control over programme achievement was assessed using Perry *et al.*'s (2001) eight-item Perceived Academic Control Scale (1 = *Strongly disagree*, 5 = *Strongly agree*). The original scale measured students' perceived control over their performance in a 'psychology course', at 'university', and throughout their 'college career' (Perry *et al.* 2001, p. 789). For this study, these items were adapted to assess students' perceived control over their performance in the MBA/MPA programme. An example item was, 'I see myself as largely responsible for my performance in the MBA/MPA programme'. In a confirmatory approach to factor analysis conducted using SPSS, the data supported a single-factor solution. The scale was found to have sufficient internal reliability with a Cronbach's alpha of 0.83.

In addition, participants were asked to rate their agreement (1 = *Strongly disagree*, 7 = *Strongly agree*) on an eight-item scale designed to assess perceived control over technology (Hladkyj *et al.* 2004). The items on this scale measured students' perceived control over achievement tasks such as 'using computers', 'improving one's computer skills', and 'learning new software' (Hladkyj *et al.* 2004, pp. 1–7). The items were used verbatim as they appeared in Hladkyj *et al.*'s (2004) original scale. An example item was, 'I have a great deal of control over how well I can use computers'. Based on the results of factor analysis, the data indicated that three items should be removed from this scale due to weak factor loadings. After these items were removed, a single-factor solution was found. The Cronbach's alpha for the remaining five items was adequate for this exploratory study ($\alpha = 0.65$).

Value

Adapted from Wigfield and Eccles' (1992) study of achievement task value, two four-item scales (1 = *Strongly disagree*, 5 = *Strongly agree*) were used to separately assess the degree to which participants valued: (1) the tasks required by their 'MBA/MPA programme', and (2) the tasks required by their 'experiences with technology in the MBA/MPA programme'. The scale items reflected the four key dimensions of task value identified by Wigfield and Eccles (1992): intrinsic value (e.g., 'I look forward to doing the tasks required by the MBA/MPA programme'), attainment value (e.g., 'It is important to me that I do well in my MBA/MPA programme'), utility value (e.g., 'My experiences with technology in the MBA/MPA programme are very useful for what I want to do in the future') and cost (e.g., 'The time and effort that my experiences with technology in the MBA/MPA programme require are worth the cost').

Factor analyses resulted in single-factor solutions for the programme- and technology-based task value scales. Both the programme value scale ($\alpha=0.83$) and the technology value scale ($\alpha=0.89$) were found to be internally reliable. The items that assessed programme value were summed into one scale, and the items measuring technology value were combined in another. For both scales, higher scores indicated greater task value in the associated domain.

Emotions

Using a 10-point scale (1 = *Not at all*; 10 = *Very much so*), students indicated the extent to which they experienced the 10 discrete emotions identified on Pekrun, Goetz and Perry's (2005) Achievement Emotions Questionnaire (AEQ). These 10 emotions varied in terms of valence and activation: positive activating (enjoyment, hope, pride), negative activating (anger, anxiety, shame, guilt), positive deactivating (relief) and negative deactivating (helplessness, boredom). Participants rated their emotions separately in relation to (1) their overall experience in a synchronous hybrid programme, and (2) their experiences using technology in a synchronous hybrid learning environment.

Perceived success

Perceived success in the overall synchronous hybrid programme (i.e., programme achievement) was measured using an adapted version of Hall *et al.*'s (2004) six-item Perceptions of Academic Success Scale (1 = *Very unsuccessful*, 7 = *Very successful*). The original scale asked students to indicate how successful they felt in regard to their perceived performance in areas such as 'grades', 'learning goals', and 'knowledge gained' (Hall *et al.* 2004, p. 599). In order to more precisely target participants' perceptions of programme achievement, each item was adapted to include the words 'in the MBA/MPA programme'. An example item from the scale was, 'How successful do you feel you are in the MBA/MPA programme overall?' Factor analysis confirmed that all of the items loaded onto a single construct ($\alpha = 0.89$). A single item ('How successful do you feel in using the technology required in the MBA/MPA programme?') was used to assess participants' perceived success in relation to technology use (1 = *Very unsuccessful*, 7 = *Very successful*).

Results

Rationale for analysis

Descriptive statistics were calculated to identify inconsistencies in the data. All of the single items and summed scales approximated a normal distribution. A confirmatory approach to factor analysis was used to assess the dimensionality of the measured items. After splitting the sample based on online versus on-campus group membership, independent samples *t*-tests were performed to examine the effects of attendance mode on the primary study variables. Paired samples *t*-tests were then used within each group to compare students' mean level of control and value appraisals, emotions and perceived success in the domains of programme achievement and technology use. Next, zero-order correlations were calculated to explore the bivariate relationships within each group. Lastly, mediational analyses were used to determine the degree to

which emotions mediated the effects of control and value on perceived success in relation to programme achievement and technology use.

Mean differences

Independent samples *t*-tests showed that online students surpassed on-campus students in terms of several mean emotion levels for technology use: anger, $t(98) = 2.44, p = 0.017, d = 0.51$; anxiety, $t(98) = 3.20, p = 0.002, d = 0.67$; and helplessness, $t(95.93) = 3.18, p = 0.002, d = 0.60$ (equal variances not assumed for helplessness). In contrast, no significant differences were found between online and on-campus students in terms of programme-related emotions or programme/technology control, value, or perceived success, suggesting that these groups share largely similar experiences overall. The increase in technology-related anger, anxiety and helplessness among online students, however, may result from the additional technological obstacles online students face when using the web conferencing software (i.e., system crashes, connection errors, audio and video failures, etc.).

The results of paired samples *t*-tests indicated that while emotions for online and on-campus students were generally stronger in relation to programme achievement, the online students' technology-related anger and helplessness scores were significantly greater than the anger and helplessness levels they experienced regarding programme achievement. Furthermore, in comparison to their on-campus counterparts, online students more clearly separated their emotions in terms of programme achievement and technology use. Specifically, the results showed that only five out of the 10 comparisons between programme- and technology-related emotions were significant for the on-campus group, whereas mean levels for nine out of 10 emotions were significantly different between these domains for online students (see Table 1). This finding may reflect the online students' greater dependence on the course delivery system, which can restrict their learning when non-operational.

Correlational analysis

In support of Pekrun's (2006) control-value theory, the majority of the bivariate correlations calculated among the study variables were significant for both online and on-campus students (see Table 2). For both groups, several large positive correlations were found for the emotions across the domains of programme achievement and technology use. That is, with the exception of shame and guilt, the data showed that a high score in a given programme emotion was significantly correlated with a high score for the same emotion in relation to technology ($r = 0.33$ to 0.75). This implies that students' emotional experiences regarding the programme are associated with the introduction of technology into the learning environment.

Of the relationships between emotions and perceived success, enjoyment was the only emotion that was significantly correlated with success for both groups in relation to programme achievement and technology use ($r = 0.40$ to 0.65). Nevertheless, many of the other linear relationships involving students' emotions and perceived success were also significant. For the online group, seven significant correlations existed between emotions and perceived success in each of the two domains (i.e., programme achievement and technology use). For the on-campus group, many more significant relationships were found when perceived success was correlated with programme achievement emotions (9 out of 10) than with technology emotions (3 out of 10).

Table 1. Descriptive statistics for emotions, control, value and perceived success.

Variable	Programme achievement			Technology use			<i>t</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range		
On-campus								
Enjoyment	6.95	2.07	1–10	6.22	2.47	1–10	2.03*	0.32
Hope	6.68	2.20	1–10	5.30	2.69	1–10	3.23**	0.56
Pride	7.27	2.38	1–10	5.41	3.00	1–10	4.65***	0.69
Anger	3.46	2.16	1–9	2.92	2.40	1–10	2.02	0.24
Anxiety	4.97	2.32	1–9	2.70	1.91	1–7	5.90***	1.07
Shame	2.05	1.60	1–7	1.65	1.16	1–5	1.46	0.29
Guilt	2.03	1.54	1–7	1.62	1.28	1–5	1.43	0.29
Relief	4.84	2.60	1–10	4.05	2.48	1–10	1.82	0.31
Helplessness	2.32	1.84	1–7	2.24	1.92	1–9	0.27	0.04
Boredom	4.51	2.52	1–10	2.62	1.77	1–7	4.41***	0.87
Control	33.65	5.20	21–40	31.73	3.49	21–35	2.44*	0.43
Value	16.43	2.89	9–20	14.46	2.87	7–20	3.63***	0.68
P. success ^a	5.45	0.98	3–7	5.73	1.02	4–7	–1.54	0.28
Online								
Enjoyment	7.02	1.96	2–10	6.14	2.55	1–10	3.30**	0.38
Hope	7.06	2.15	1–10	5.24	2.78	1–10	5.80***	0.73
Pride	8.10	1.57	2–10	5.17	2.93	1–10	8.90***	1.24
Anger	3.32	2.05	1–10	4.16	2.49	1–10	–2.88**	0.37
Anxiety	5.62	2.43	1–10	4.24	2.52	1–10	3.97***	0.56
Shame	1.75	1.22	1–7	1.70	1.50	1–9	0.21	0.03
Guilt	2.21	1.94	1–10	1.59	1.10	1–5	2.59*	0.39
Relief	4.76	2.74	1–10	3.44	2.54	1–10	3.80***	0.50
Helplessness	2.79	1.80	1–8	3.76	2.84	1–10	–3.00**	0.41
Boredom	3.84	2.42	1–10	2.78	2.11	1–9	3.43***	0.47
Control	34.49	4.23	22–40	31.76	3.11	20–35	4.99***	0.74
Value	16.44	2.56	11–20	14.57	3.33	5–20	5.92***	0.63
P. success ^a	5.46	1.05	3–7	5.51	1.29	2–7	–0.32	0.04

Note: Degrees of freedom for *t*-tests for the on-campus group (*n* = 37) were 36, and 63 for the online group (*n* = 64).

^aThe means of the six-item perceived success scale were used to calculate *t*-tests for programme achievement, while the single-item measure for perceived success was used for technology.

p* < 0.05, *p* < 0.01, ****p* < 0.001 (two-tailed).

These differences suggest that on-campus students do not place as strong an emphasis on technology use in synchronous hybrid learning environments as their peers online.

Mediation

Multiple regression mediation analyses confirmed several causal sequences involving the predictive effects of control and value on perceived success via potential mediator emotions. The mediating effects were tested in the domains of both programme achievement and technology use (see Table 3). The analyses followed the three-step multiple regressions model proposed by Baron and Kenny (1986). In step one, bivariate regressions were performed to test the predictive effect of control and value on each emotion. In step two, bivariate regressions were used to test the predictive effect of control and value on perceived success. In step three, simultaneous multiple

Table 2. Correlations between emotions, control, value and perceived success.

Variable	Programme achievement			Technology use			Programme Emo. with Tech Emo.
	Control	Value	Success	Control	Value	Success	
On-campus							
Enjoyment	0.50**	0.44**	0.46**	0.22	0.56**	0.37*	0.55**
Hope	0.44**	0.55**	0.45**	0.10	0.50**	0.26	0.45**
Pride	0.36*	0.38*	0.46**	0.16	0.43**	0.31	0.61**
Anger	-0.14	-0.48**	-0.41*	-0.31	0.07	0.01	0.75**
Anxiety	-0.24	-0.10	-0.18	-0.32	-0.14	-0.01	0.40*
Shame	-0.14	-0.22	-0.35*	-0.44**	-0.16	-0.37*	0.28
Guilt	-0.25	-0.32	-0.49**	-0.37*	-0.11	-0.27	0.26
Relief	0.28	0.46**	0.35*	0.01	0.47**	0.37*	0.47**
Helplessness	-0.41*	-0.36*	-0.48**	-0.45**	-0.05	-0.12	0.52**
Boredom	-0.29	-0.41*	-0.43**	-0.30	-0.12	-0.12	0.30
Control	-	0.38*	0.57**	-	0.32	0.46**	0.45**
Value	0.38*	-	0.62**	0.32	-	0.55**	0.34*
Online							
Enjoyment	0.39**	0.48**	0.65**	0.12	0.75**	0.40**	0.60**
Hope	0.23	0.61**	0.30*	0.03	0.58**	0.21	0.51**
Pride	0.34**	0.56**	0.49**	0.03	0.61**	0.33**	0.47**
Anger	-0.21	-0.47**	-0.32**	-0.16	-0.25*	-0.37**	0.49**
Anxiety	-0.11	-0.15	-0.21	-0.15	-0.18	-0.39**	0.38**
Shame	-0.06	-0.10	-0.29*	-0.25	-0.17	-0.22	0.11
Guilt	0.02	-0.12	-0.15	-0.16	-0.10	-0.27*	0.33**
Relief	0.03	-0.11	-0.05	-0.10	0.26*	-0.15	0.46**
Helplessness	-0.54**	-0.47**	-0.47**	-0.23	-0.18	-0.49**	0.46**
Boredom	-0.23	-0.57**	-0.25*	-0.04	-0.52**	-0.33**	0.42**
Control	-	0.32**	0.28*	-	0.07	0.33**	0.33**
Value	0.32**	-	0.40**	0.07	-	0.27*	0.67**

Note: N = 101 participants (37 on-campus, 64 online).
 *p < 0.05, **p < 0.01, ***p < 0.001 (two-tailed).

regression models were used to test the predictive effects of control, value and the individual emotion variable on perceived success. In addition, the significance of the observed effects was tested using 95% bootstrap confidence intervals (Preacher and Hayes 2004).

The results of these analyses were used to identify various predictive and mediational relationships. A direct effect without mediation indicated that control or value significantly predicted perceived success with no mediation by emotions (control or value → success). A fully mediated indirect effect occurs when a mediational effect is significant (control or value → emotion → success) and the direct effect is non-significant. While non-significance of the direct effect is necessary for full mediation, this is not required for an indirect effect to exist. The direct effect and the indirect effect are part of the total effect and a direct effect and a mediated effect can also occur simultaneously. Existence of a direct effect does not suggest that there is no mediation. Both full and partial mediation imply that the direct effect (control or value → success) was initially significant; yet, the observed changes in this predictive relationship after the mediator emotion was added indicated either (1) complete or full mediation when the direct effect became non-significant; or (2) partial mediation when the direct effect reduced in magnitude. These relationships

Table 3. Tests of mediational relationships for all cases.

Variable	Control, value → success		Control, value → emotion		Control, value, emotion → success			95% Bootstrap CI ^a				Control, value → success: predictive effect ^b		Final model ^c <i>R</i> ²
	Control	Value	Control	Value	Control	Value	Emotion	Control		Value		Control	Value	
								LB	UB	LB	UB			
Programme achievement														
Enjoyment	0.25**	0.40***	0.30***	0.36***	0.12	0.25**	0.41***	0.04	0.30	0.13	0.64	complete	partial	0.40
Hope	0.25**	0.40***	0.13	0.54***	0.24*	0.36***	0.07	-0.03	0.09	-0.21	0.41	direct	direct	0.29
Pride	0.25**	0.40***	0.23*	0.38***	0.19*	0.30**	0.25*	0.01	0.19	0.05	0.47	partial	partial	0.33
Anger	0.25**	0.40***	-0.08	-0.43	0.24*	0.34***	-0.13	-0.03	0.08	-0.04	0.36	direct	direct	0.30
Anxiety	0.25**	0.40***	-0.14	-0.08	0.23*	0.39***	-0.12	-0.01	0.09	-0.05	0.10	direct	direct	0.30
Shame	0.25**	0.40***	-0.05	-0.14	0.24**	0.37***	-0.23**	-0.05	0.08	-0.03	0.25	direct	direct	0.34
Guilt	0.25**	0.40***	0.01	-0.18 [†]	0.25**	0.37***	-0.17*	-0.05	0.05	-0.01	0.20	direct	direct	0.31
Relief	0.25**	0.40***	0.10	0.08	0.24**	0.40***	0.02	-0.03	0.03	-0.04	0.07	direct	direct	0.29
Helplessness	0.25**	0.40***	-0.37***	-0.29**	0.15	0.32***	-0.27**	0.03	0.28	0.04	0.38	complete	partial	0.33
Boredom	0.25**	0.40***	-0.15 [†]	-0.44***	0.24*	0.38***	-0.05	-0.03	0.08	-0.17	0.23	direct	direct	0.29
Technology use														
Enjoyment	0.28**	0.31***	0.14 [†]	0.64***	0.25**	0.19	0.12	-0.01	0.03	-0.02	0.13	direct	direct	0.22
Hope	0.28**	0.31***	0.03	0.54***	0.28**	0.29**	0.04	-0.01	0.01	-0.03	0.05	direct	direct	0.20
Pride	0.28**	0.31***	0.07	0.52***	0.27**	0.23*	0.15	-0.01	0.02	-0.01	0.08	direct	direct	0.21
Anger	0.28**	0.31***	-0.28**	-0.08	0.24*	0.30***	-0.15	-0.01	0.05	-0.01	0.03	direct	direct	0.22
Anxiety	0.28**	0.31***	-0.26**	-0.10	0.23*	0.29**	-0.19*	0.00	0.05	-0.01	0.03	partial	direct	0.23
Shame	0.28**	0.31***	-0.24*	-0.14	0.24*	0.29**	-0.15	-0.01	0.03	-0.01	0.02	direct	direct	0.22
Guilt	0.28**	0.31***	-0.20*	-0.08	0.24**	0.23***	-0.18*	0.00	0.04	-0.01	0.02	partial	direct	0.23
Relief	0.28**	0.31***	-0.05	0.33***	0.27**	0.34***	-0.09	-0.01	0.02	-0.04	0.01	direct	direct	0.21
Helplessness	0.28**	0.31***	-0.28**	-0.10	0.19*	0.28**	-0.31***	0.01	0.07	-0.01	0.04	partial	direct	0.29
Boredom	0.28**	0.31***	-0.21*	-0.33***	0.26**	0.29**	-0.08	-0.02	0.03	-0.02	0.05	direct	direct	0.20

Note: Standardized Beta (β) regression coefficients are presented with the exception of unstandardized coefficients in confidence intervals.

^aMediational effect present if range between lower bound (LB) and upper bound (UB) of confidence interval does not include zero.

^bDirect only = control/value predicts success with no mediation by emotions; complete = control/value prediction of success completely mediated by emotion; partial = control/value prediction of success partially mediated by emotion.

^c*R*² is significant at the $p < 0.001$ level for all models.

[†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (two-tailed).

were tested for the complete sample of all participants (online and on-campus) within the domains of programme achievement and technology use.

In the domain of programme achievement, the data showed that while control and value were both significant predictors of perceived success, value was a more common predictor of emotions (for 5 out of 10 emotions) than control (3 out of 10). With the exception of relief, all of the emotions were found to have strong significant predictive effects on perceived success. Enjoyment and helplessness were found to fully mediate the positive effect of control on success as well as partially mediate the positive effect of value on success. Pride was also found to partially mediate the positive effects of control and value on success in programme achievement. The final regression models explained a notable portion of the overall variability in perceived success in the domain of programme achievement ($R^2 = 0.29$ to 0.40).

In the domain of technology use, the results showed that perceived success in technology use was significantly predicted by control and value. The bivariate regressions indicated that emotions were more frequently predicted by control (for 6 out of 10 emotions) than value (5 out of 10). As in the domain of programme achievement, all of the emotions aside from relief were found to have strong significant predictive effects on perceived success. Accordingly, anxiety, guilt and helplessness were found to partially mediate the positive effect of control on success. When taken together, the overall regression models explained a considerable portion of the variance in perceived success in using the technology required in the synchronous hybrid learning environment ($R^2 = 0.20$ to 0.40).

Discussion

Based on Pekrun's (2006) control-value theory, the dual purpose of this study was: (1) to compare synchronous hybrid students who attend online versus on-campus in terms of control, value, emotions and perceived success, and (2) to compare students' degree of emotional activation in the domains of programme achievement and technology use. First, the results of independent samples *t*-tests showed that online students reported higher levels of technology-related anger, anxiety and helplessness than their on-campus counterparts. These higher mean levels of negative technology-related emotion in the online group provided support for Regan *et al.*'s (2012) claim that online environments have a distinct overall emotional tone that differs from traditional educational settings. This information regarding differences in affect between online and on-campus students suggests instructors may wish to provide tailored emotional support for individual learners based on attendance mode.

The results of paired samples *t*-tests indicated that online students separate their emotions in relation to programme achievement and technology use. This pattern was observed to a lesser extent in the on-campus group. At this point, it is not clear whether online students make this separation consciously or if it is a natural consequence from interacting with the hybrid technology in ways that are not experienced by on-campus students.

The reported results also included several noteworthy linear associations involving students' degree of emotional activation and their mean levels of perceived success. In general, the significant correlations between emotions and perceived success in synchronous hybrid learning environments aligned with the relationships found in traditional classrooms (Pekrun *et al.* 2002). With reference to domain-specific relationships, the online group had an equal number of significant correlations

between perceived success and emotions in regard to programme achievement and technology use. The on-campus group, on the other hand, had three times as many significant relationships concerning perceived success and emotions for programme achievement over technology use. This idiosyncrasy may result from on-campus students' reduced dependence on the web-based course delivery system.

The results of mediational analyses indicated that within the domain of programme achievement, enjoyment and helplessness fully mediated the positive effect of control on success as well as partially mediated the positive effect of value on success. Pride also partially mediated the positive effects of control and value on success in this domain. In terms of technology use, key mediational results revealed that anxiety, guilt and helplessness partially mediated the positive effect of control on success. These results align with the findings of Pekrun *et al.* (2010), which also suggested that control and value appraisals affect students' emotions and achievement and that emotions can mediate the achievement effects of appraisals. This growing body of evidence suggests that educational practitioners should strive to create learning environments that support positive appraisals of control and value.

To date, numerous theoretical perspectives on emotions have been used to examine a wide range of course delivery options. As a point of differentiation from the existing research, this study applied Pekrun's (2006) control-value theory in an empirical investigation of an emerging course format—synchronous hybrid delivery. Taken together, this study's focus on synchronous hybrid delivery, along with the application of Pekrun's (2006) control-value framework, makes a unique contribution to the literature, thus supporting this combination in future research on synchronous hybrid programmes.

Given the recent popularity of studies on affect in technology-enriched learning environments, it was logical that emotions would also be pervasive among synchronous hybrid students. This study, however, was particularly informative in that it measured students' emotions specifically in relation to technology use. Despite the prevalence of technology-mediated course delivery, few previous studies have examined how technology use itself induces emotional experiences.

Strengths, limitations and future research

This study adds to the literature by explicating the relationships among antecedents, emotions and achievement in synchronous hybrid programmes; however, further empirical research is needed to improve upon the current study's limitations. Perhaps the most notable limitation was this study's use of single-item self-report measures to assess participants' emotions. While single-item measures may have been necessary to assess a wider range of emotions without creating participant fatigue, this approach can reduce reliability. Furthermore, single-item self-report measures are not ideal for differentiating between typical emotional experiences (trait emotions) and momentary occurrences of emotional activation (state emotions). In this study, participants were asked to report their typical emotional experiences in relation to programme achievement and technology use (trait emotions). It is possible, however, that the prominence of unanticipated events may have led some students to give responses that were more representative of state emotions. Likewise, from an affective-reactivity perspective, it is worth noting that not all students experience the same magnitude of emotional activation when confronted with similar affect-relevant events (Tellegen 1985). In order to overcome these limitations, future research could be conducted

using multi-item scales such as Pekrun, Goetz and Perry's (2005) AEQ, which has been successfully adapted to assess trait, state and course-specific emotions.

With regard to study design, Pekrun *et al.* (2002) suggested that longitudinal evidence is often necessary to disentangle the complex relationships among antecedents, emotions and outcomes. By collecting longitudinal data, future research could analyse emotions with respect to not only intensity and object focus, but also duration. With multiple data points from a larger sample, future research could also endeavour to longitudinally predict students' emotional experiences and academic achievement.

Conclusion

In many ways, technology is inherent to the learning environment experienced by many university students. Indeed, there is a growing population of students who earn a postsecondary degree entirely through technology-enriched course options such as synchronous hybrid delivery. While this format may improve access to higher education, it is important to note that synchronous hybrid learning environments affect the relationships among students' control and value appraisals, emotions and perceived success in the domains of programme achievement and technology use. Ideally, explicating the role of achievement emotions in synchronous hybrid courses will help educational practitioners shape these technology-enriched learning environments in affectively beneficial ways.

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