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# Exploring the emotions of disadvantaged adolescents in the classroom: Development of the $S^{2*}$ emotion application

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In the present research, three phases were conducted to develop a real-time emotional measure ( $S^{2*}$  emotion application) to examine the emotional experiences and causes for those emotions in disadvantaged Australian adolescents. In the first phase, data were collected from 412 Year 10 students (aged 14–15 years) to understand their emotional experiences in the classroom. Second, the  $S^{2*}$  emotion application was developed and trialed based on the initial findings from the first phase and relevant literature. In the third phase, the  $S^{2*}$  was utilized with participants ( $N = 81$ ) from Year 10 Math and English classes over three time points during an academic term. Results revealed that the most frequent reports of emotions and cause for that emotion were: *boredom* caused by *schoolwork*; *happiness* caused by *peers*; *happiness* caused by *self*; and *boredom* caused by *teacher*. When emotions and causes were examined separately, the most frequent reported emotion was *boredom* and the most frequent reported cause for emotion was *peers*. This tool may be used in future studies to further investigate these real-time emotional experiences allowing researchers to build on theoretical frameworks and provide skills and resources to best support educators.

## KEYWORDS

adolescent emotion, real-time emotion, emotion measurement, causes for emotion, classroom emotions

## Introduction

Students experience a vast range of emotions during their time at school. These emotional experiences are unique to each individual and can be caused by their interactions with peers and teachers, schoolwork, perceptions of their environment, as well as external causes beyond the scope of the school (e.g., home life, family). Classroom

Abbreviations: SES, socioeconomic status; ESM, experience sampling method; ACARA, Australian Curriculum Assessment and Reporting Authority; ICSEA, Index of Community Socio Educational Advantage.

emotions have been a growing topic of research interest over the past 20 years (Pekrun et al., 2018; Goetz et al., 2020), with this expansion of research being in part due to the interconnected relationship between emotions, learning and achievement. Importantly, neuroscience research has revealed that emotion and cognition are sustained by interdependent neural processes, indicating that rather than interfering with learning, emotions are critical for learning (Immordino-Yang, 2016; Prokofieva et al., 2019; Li et al., 2020).

Disadvantaged young people in particular face heightened risk of poor achievement, school dropout (Chen and Vazsonyi, 2013; Platell et al., 2019) and mental health problems (Bower et al., 2015; Platell et al., 2019), yet there is little, if any, research exploring their emotional experiences in school. Research indicates that young people in lower socioeconomic communities are presented with a multitude of daily stressors, beyond those of most adolescents (e.g., violence, substance abuse, familial financial difficulties, and problematic behavior), which puts them at greater risk for intense emotional reactivity compared with their peers in more advantaged communities (Uink et al., 2018). It is essential to learn more about the emotional experiences of disadvantaged young people so we can inform educators how to best support their social and emotional learning and wellbeing.

The aim of the present research was to acquire a better understanding of the emotional experiences of Year 10 students from a low socioeconomic background in Math and English classes as well as the causes for these experiences. Furthermore, we sought to develop a computer-based application to capture these multifaceted experiences in real-time, without causing disruption to the classroom. Subsequently, the findings enrich the existing literature by providing greater insight to classroom emotional experiences of disadvantaged adolescents as well as the development of a dynamic new methodological approach that has the ability to capture emotional experiences and antecedents, with the capacity to do so in classrooms worldwide. While this research was conducted prior to the COVID-19 pandemic, the implications of this new form of measurement can assist in the need to prioritize student emotional wellbeing.

## The context of classroom emotions

We recognize that emotions are physiological arousals which are caused by cognitive appraisal of a stimulus involving both the body and mind (Immordino-Yang and Sylvan, 2016). For the purposes of the present research, the term *emotion* is used to cover a broad range of emotional experiences and moods, comprised of psychological, cognitive, affective, expressive and motivational components (see Frenzel and Stephens, 2013 for a comprehensive definition). Control-value theory accepts the notion that individual and situational appraisals (i.e., individual reactions to specific events) are critical

aspects of the establishment of an emotion (Pekrun, 2006). Appraisals play a valuable role from an educational viewpoint, as “they can be assumed to mediate the impact of situational factors and can be targeted by educational interventions intended to foster positive emotional development” (Pekrun, 2006, 317).

Ecological systems theory postulates that human development can only be understood by recognizing the entire ecological system surrounding the individual (Bronfenbrenner, 1979, 1994). As such, this theory is pertinent to understanding the multiple contextual factors influencing student emotions in the classroom. We adopted a holistic approach in our endeavor to understand the emotional experiences of students, recognizing that we as humans are influenced by the various environments which surround us. We acknowledge that young people cannot just turn off the contextual factors that affect them when they enter a classroom. Although antecedents to emotional experiences in the classroom have been investigated, the majority of research has limited the students’ ability to select from a range of experienced emotions (Moeller et al., 2020) and antecedents. The present research intends to provide students with the opportunity to select from a variety of emotional experiences and causes for those experiences in real-time classrooms. It is essential to capture a holistic picture of the emotional experiences of students, particularly those from more disadvantaged communities at greater risk, if we want to positively influence student motivation, interest and achievement and create more enriching classrooms.

## Disadvantages of students in low socioeconomic status communities

Uink et al. (2018) argued that research examining daily reports of emotions amongst adolescents are primarily concentrated on young people from middle-income communities, which is concerning as it is disadvantaged youth who encounter greater daily stressors than their wealthier peers. One recent study examined a range of school-based feelings experienced by high school students in the United States (Moeller et al., 2020). They further investigated correlations of these feelings with demographic characteristics and found that while, as a whole, all groups reported mostly negative feelings, there was a small effect size implying that higher SES was correlated with greater reports of positive feelings and lower reports of negative feelings (Moeller et al., 2020).

Lamb et al. (2020) argued that within Australia “our education and training systems are dogged by inequality” (p. 130). In the latest report on educational opportunity in Australia, the percentage of senior year students of high SES meeting or exceeding the math, science and reading international benchmark standard was 86.2 compared to only 48.6 of their low SES counterparts, with a similar gap in the middle year students (Lamb et al., 2020). This is interesting

given that Australia's education system is relatively high performing in comparison to other countries (McConney and Perry, 2010). SES is also predictive of student engagement in Australia. Cognitive and emotional engagement specifically related to school is nearly double in students from high SES families compared to those in the lowest SES families (Lamb et al., 2015). Furthermore, disadvantaged students are more likely to become disadvantaged adults (State of Victoria Department of Education and Early Childhood Development [DEECD], 2010; Lamb and Huo, 2017; Perry, 2018), therefore, it is crucial to understand more about the emotional experiences of these students to help educators support their needs and find ways to engage them.

## Measurements of classroom emotions

Emotion measurement is not a simple task. Given that emotional experiences are subjective and can change in an instant, the task of measuring emotions is challenging, yet essential to better understand the impact emotions have on student learning, wellbeing and academic success. In the education context, some approaches to measure emotions include asking students about their emotions through verbal accounts, visual stimuli or a combination of both (Frenzel and Stephens, 2013). Instruments designed to measure emotions in the classroom beyond test anxiety include both qualitative and quantitative self-report measures, as well as observations, however, the options are limited (Pekrun and Bühner, 2014).

Most educational research on emotions has been conducted using self-report measures (Pekrun, 2016) retrospectively. Researchers have argued that retrospective questionnaires measuring emotions or moods can often be altered by recall biases (Stone et al., 1998; Reid et al., 2009; Pekrun and Linnenbrink-Garcia, 2014a; Pekrun, 2016; Moeller et al., 2020). When individuals try to recall emotional experiences, their responses can often be skewed by current mood and abstract reflection (Stone et al., 1998; Reid et al., 2009). We aim to develop a tool to capture these emotional experiences in real-time, diminishing recall biases, and allowing participants to report these experiences throughout an entire class session, rather than afterward, or during controlled intervals.

While research on emotions in the classroom has been steadily growing over the past two decades, the capacity to collect these data using real-time measurements is just beginning to emerge. To our knowledge there have been only a few studies recently published that have attempted to collect real-time student emotions and they have all used the experience sampling method (ESM) (see Hektner et al., 2007). Moeller et al. (2020) conducted a study that sought to collect *in-the-moment* experiences of feelings using ESM. This involved using an App to have students complete short surveys on their phones at specific time points, toward the end of class. Participants were

alerted with a beep and had an hour to complete the survey. They also completed online surveys retrospectively (Moeller et al., 2020). Goetz et al. (2020) also used ESM to investigate the academic emotions (enjoyment, anxiety, and boredom) of high school students in relation to their real-time perceptions of teaching characteristics. Similarly, participants had an electronic device that prompted students at one time-point during a 40-min lesson to report their experience (Goetz et al., 2020).

ESM limits impromptu collection of emotional experiences as participants are prompted at a specific timepoint to respond to the device, rather than reporting at free will. Interrupting participants during class time to report emotions can potentially interrupt classroom flow and learning (Feyzi Behnagh, 2019). Additionally, as the collection of data is prompted, this may lead to missing out on valuable data (Goetz et al., 2016). We believe this is the first study to develop a computer-based application based on the reported experiences of the participants, as well as to capture these real-time experiences from secondary students from a disadvantaged community. Furthermore, it is also the first study to collect both the emotional experience as well as the cause throughout entire class sessions, as prompted by the student rather than a device.

## The present study

Although research on emotions in the classroom setting has been an evolving topic, there have been scarce advancements in instruments designed to capture these experiences through real-time measurement, from the students' perspectives. Researchers defend the need for new tools to measure classroom emotions (Pekrun and Bühner, 2014) and to examine a range of student emotional experiences simultaneously (Moeller et al., 2020). Additionally, Reid et al. (2009) suggest that using an electronic device to capture data from adolescents may increase response rates, as the familiarization and use of these forms of technology are second nature to young people. The need for methodologically sound instrumentation for measuring emotions in education contexts is vital in the development of theoretical frameworks aimed at creating evidence-based approaches that will be useful for educators (Pekrun and Schutz, 2007; Pekrun and Linnenbrink-Garcia, 2014a).

Capturing real-time measurements of student emotional experiences and their causes would be of great value to educationalists and educational psychologists in better understanding and supporting the learning journey of their students/clients, particularly those from disadvantaged backgrounds. Therefore, the purposes of the present study were first to investigate the emotions and causes for emotion in disadvantaged Year 10 Australian students; second, develop a tool (the S<sup>2</sup>\* emotion application) to measure these real-time emotions and causes for these emotions in a classroom setting; and third, confirm this tool, the S<sup>2</sup>\* as a reliable and valuable

measure of real-time emotions for use with disadvantaged Year 10 Australian adolescents in classroom settings. Four research questions were posed and are addressed over three phases:

- (1) What emotions do disadvantaged Australian adolescents experience in the classroom, and what are the causes for these emotions? (Phase 1)
- (2) How can classroom emotions and causes for these emotions be measured using real-time technology? (Phase 1)
- (3) How do students respond to using the S<sup>2\*</sup> emotion application in a classroom setting? (Phase 2)
- (4) What are the real-time emotions and causes for these emotions of disadvantaged Year 10 Math and English students? (Phase 3)

## Phase 1 item selection and S<sup>2\*</sup> emotion application development

### Methods

First, an exploratory study was conducted to better understand the context of emotions in the classroom for disadvantaged Australian adolescents. This was critical as there is a dearth of research on the emotional experiences for high school students from disadvantaged communities, which is essential given school is where they spend a significant amount of time developing socially and emotionally. Current researchers investigating emotions in educational settings have argued the need for new multi-method approaches, contending that it is essential in the advancement of the research field to provide quality and valuable data (Pekrun, 2006; Pekrun and Schutz, 2007; Pekrun and Linnenbrink-Garcia, 2014a; Feyzi Behnagh, 2019). Therefore, next, a prototype of the S<sup>2\*</sup> was created. The aim was for a simplistic design, using just one screen to quickly capture the participant's emotional state and cause, ensuring minimal classroom disruption. A web developer was contracted to assist with the construction of the application in a format that could be delivered on a tablet exclusive of the internet.

The prototype was delivered on a tablet, allowing 20 emotion words and five causes to be displayed on the screen. The development of the S<sup>2\*</sup> was a two-step process: (i) to determine the 20 emotion words that would appear on the application, answering the question 'How are you feeling right now?'; and (ii) to determine the five causes that would appear on the application, answering the question 'What was the cause?'

### Participants

A total of 412 Year 10 students, aged 14–16 years (mean age 14.64 years) from three secondary schools agreed to participate. Of these participants, 44% identified as male, and 55% identified

as female (180 males, 230 females, and 2 gender non-specified). The overall response rate was 90%. Between 8 and 15% of students identified as Indigenous and 8 to 41% of students had a language background other than English. According to the Index of Community Socio Educational Advantage (ICSEA), all three schools are located in a lower SES community in comparison to the Australian national averages (Australian Curriculum Assessment and Reporting Authority, 2017). ICSEA was developed by the Australian Curriculum Assessment and Reporting Authority (ACARA), and allows meaningful comparisons across schools nationally, by measuring key factors relating to student achievement, such as family background and geographical location (Australian Curriculum Assessment and Reporting Authority, 2015). The median ICSEA score is set at 1000, with a standard deviation of 100 (500 represents extremely disadvantaged, while 1300 represents very highly advantaged); all three targeted schools were ranked between 900 and 945, with a mean score of 926 (Australian Curriculum Assessment and Reporting Authority, 2016).

### Instrument

Students completed an open-ended survey specifically designed for this study to collect information about *Emotions* and *Triggers* (see [Supplementary Appendix A](#)). The survey contained two columns asking students to list the emotions they have experienced in class (column one), as well as the triggers that caused these emotions (column two). Students also provided their gender, age, year level and class session.

### Procedure

Approval for the ethical conduct of research was obtained from the administering university and the Queensland Department of Education. The principals at each of the three schools were invited to be involved in the project and were provided with an overview of the study, copies of information letters, consent forms and the abovementioned surveys. All principals agreed for students at their schools to take part and subsequently, information letters were distributed to the parents/guardians of all Year 10 students at each school. An electronic hyperlink to the research study was included in each schools' monthly newsletter, which was available on the schools' website. Year 10 students attended an information session whereby the researcher provided them with an overview of the study and students were invited to take part in the study. It was made clear that students were free to withdraw from the study at any time.

A researcher administered the survey to participants in a group setting over one class period (approximately 40 minutes). Participants were given the opportunity to ask questions before, during and after the survey was administered. Participants were asked to recall the emotions they experience at school. The only guidance they were given was to think about how they felt at school and the causes for those emotions. Where

students sought clarification, an example was given (e.g., *I'm happy when I'm with my friends*, or *I'm nervous when I have a test*).

## Results and discussion

Data from the surveys were reviewed and analyzed for frequency of experienced emotions, as well as frequency of triggers. Next, in keeping with Creswell's (2014) guidelines, all responses were reviewed allowing the researcher to categorize the responses based on similar themes, as well as valence for emotions, and 20 emotion words and 5 triggers were identified for utilization in the application.

### Emotion words

A frequency analysis of the emotion words was completed using Microsoft Excel. The *emotion words* were tracked by frequency of emotion, age and gender of participant. Variations of the same word (e.g., 'happy' and 'happiness'; and 'stressed' and 'stressed out') were grouped together. Table 1 displays a portion of the frequency analysis, presenting the 10 most frequently reported emotions. A total of 200 different words were used to capture the students' perception of emotion.

### Emotion triggers

First, all legible participant responses were transcribed onto a Microsoft Excel workbook. Each row contained the trigger statement; the emotion/s associated with that trigger (as well as the frequency of each emotion); the frequency of the trigger, age, and gender (see Table 2 for an example). There were 2,821 responses, which were reduced by 45% to 1,270 different statements through removing replication of triggers, given that many students wrote the same or similar trigger (e.g., test/exams, good grades/marks, students/classmates).

Sequentially, the researcher followed the guidelines of data analysis for qualitative research as suggested by

Creswell (2014). This involved thoroughly reading through and becoming familiar with the data, organizing the data into similar categories, coding the data into different themes, and interpreting the findings. Therefore, the researcher became familiar with the data, writing down ideas that were generated from reading through several worksheets. The triggers were then coded into multiple categories, based on reoccurring descriptive words.

The eight themes derived from the coding process were: Teacher, Peers, Schoolwork, Self, Health, Home/Family, School in General, and Other (including answers not related to school). To ensure consistency, an *intercoder agreement* (Creswell, 2014) was conducted, which involved four researchers cross-checking the consistency of a randomized 10% of data. The agreement for this process was 91%.

The eight themes resulting from the triggers for students' emotions are in alignment with the literature on antecedents of classroom emotion, making them advantageous for the application. In this study, the *teacher* as a precursor to student emotions encompasses the characteristics of the teacher (Goetz et al., 2013; Pekrun and Linnenbrink-Garcia, 2014b; Pekrun and Perry, 2014; Li et al., 2020), as well as teaching styles (Goetz et al., 2013, 2019, 2020; Pekrun and Linnenbrink-Garcia, 2014b; Pekrun and Perry, 2014; Meyer, 2014). Classmates' emotions as antecedents to student emotions (Goetz et al., 2013; Meyer, 2014; Pekrun and Linnenbrink-Garcia, 2014b; Pekrun and Perry, 2014; Li et al., 2020) encapsulates *peers*. The classroom climate (Klem and Connell, 2004; Goetz et al., 2013, 2019; Meyer, 2014; Pekrun and Perry, 2014; Li et al., 2020) and social interactions (Pekrun and Linnenbrink-Garcia, 2014b; Pekrun and Perry, 2014; Li et al., 2020) are acknowledged within *teacher*, *peer*, as well as *school in general* themes. *Schoolwork* and *self* are linked with achievement, epistemic and topic emotions. Furthermore, *self*, *health*, *peers*, *school in general* and *other* are triggers that may correspond to incidental emotions as external events. Next, the final 20 emotions words and five causes for the  $S^{2*}$  were determined utilizing a two-step process as described below.

TABLE 1 Emotion words.

Emotion	Frequency	Gender unknown	Male	Female	14 years old	15 years old	16 years old	Age unknown
Happy/ness	352	1	143	208	137	193	16	6
Anger/y	274	1	115	158	103	154	12	5
Sad/ness	161	0	58	103	63	91	6	1
Frustrated/ion	156	0	45	111	51	94	10	1
Annoyed/ance	149	1	58	90	58	80	11	0
Stress/ed/ful (stressed out)	133	0	45	88	58	65	10	0
Nervous/ness	128	0	47	81	47	76	4	1
Bored/om	119	0	53	66	43	74	1	1
Confused/ion	85	0	35	50	45	35	4	1
Excited/ment/ing	83	0	31	52	35	45	3	0



TABLE 2 Emotion triggers.

Trigger	Emotion and frequency	Frequency	Male	Female	14 years old	15 years old	16 years old
Assessments	Stress/ed (17), frustrated (3), anxious (4), nervous (2), confused(1), happy (1), afraid (1), worried (1)	30	9	21	11	17	2
When my friends make me laugh	Happy (22)	22	6	16	11	11	0
When the teacher doesn't listen to me	Frustrated (5), angry (12), annoy/ed (3), sad (1)	21	5	16	10	11	0

### Step 1 – Selection of 20 emotion words

Using the survey data on emotions and causes, the 200 emotions were examined to determine the 20 most appropriate emotions for the S<sup>2\*</sup>. Twenty words were chosen as it allowed for a relatively equal range of positive, negative, and neutral emotions. It also provided a suitable variety of options for students to choose from without getting distracted from the class lesson and the design on the application itself was easy to navigate.

The frequency analysis from Phase 1 provided the top 20 most frequent expressions of emotions (see Table 3), however, these word choices were not sufficient for inclusion in the application for four reasons. First, several words had very similar meanings (e.g., *annoyed* and *irritated*; and *worried* and *nervous*), and so were combined. Second, there was uncertainty as to whether some of the expressions should be categorized

as emotional states (e.g., *tired* and *hungry*). Third, there were emotions that were often discussed in the literature as relevant to classroom contexts (e.g., *jealous*, *surprised*, and *proud*) (Scherer, 2005; Graham and Taylor, 2014; Shuman and Scherer, 2014) that were not as commonly recalled by participants in Phase 1, but still considered worthy of inclusion. Finally, it was important to ensure a balance of both positive and negative choices to ensure entries were not positively or negatively disposed.

A four-column table was constructed outlining (a) the top 20 most frequent words, highlighting words with similar meaning in similar colors; (b) whether or not the word listed was captured in the seven core literature reviews relevant to emotions and emotions in the classroom (Ekman, 1992; Weiner, 2007; Goetz et al., 2013; Graham and Taylor, 2014; Mazer et al., 2014; Pekrun and Linnenbrink-Garcia, 2014b; Shuman and Scherer, 2014); (c) whether or not the emotion word was captured in the top 20 emotions across all categories measured (i.e., all three schools combined, each individual school, gender, and age); and (d) other words written by students with similar meaning (e.g., “mad” and “pissed off” were both associated with *angry*). The remaining words were grouped into two categories: (a) additional emotional states for consideration; and (b) words not classified as emotional states – this included words that could not be fully deciphered.

Next a team of four researchers in the field of adolescent development performed an inter-judgment reliability (Gay et al., 2012) of the findings to ensure validity of the words chosen for the S<sup>2\*</sup>. Each researcher was given the list of all 200 words generated by the students, a list of emotions discussed in the seven different reviews of the literature, related to the classroom, and the abovementioned spread sheet. Although the words *tired* and *hungry* were frequent responses from the students, collectively, the researchers decided not to include them given that they were the only two experiences that naturally result from a bodily response. Instead, the students would be guided to use them as a cause rather than an emotion (e.g., *I am hungry, however I cannot eat in class therefore I am angry or frustrated*). After reviewing the material, all researchers agreed on 18 out of 20 of their top 20 words for the computer-based application. The final two words were decided following a comprehensive discussion. The researchers agreed that it was important to

TABLE 3 Top 20 frequent emotion responses.

Emotion	Frequency	Frequency (%)
Happy	352	85
Angry	274	66
Sad	161	39
Frustrated	156	38
Annoyed	149	36
Stressed	133	32
Nervous	128	31
Bored	119	29
Confused	85	20
Excited	83	20
Tired	82	20
Anxious/Anxiety	43	10
Scared	39	9
Worried	37	9
Depressed	32	7
Upset	32	7
Hungry	29	7
Calm	25	6
Relieved	21	5
Irritated	20	5

utilize words that were recognizable, as well as a combination of words with both positive, negative, and neutral connotations. The final 20 emotion words were: *happy, angry, sad, frustrated, nervous, bored, confused, excited, scared, calm, proud, lonely, interested, stressed, confident, jealous, embarrassed, surprised, relieved, and hopeful*.

An important feature of the S<sup>2\*</sup> is the ability to select more than one emotion and cause at a time. This option allowed for more flexibility in student responses and greater coverage of emotional experiences (e.g., irritated can be encompassed by selecting angry and frustrated). While enjoyment of learning is commonly cited in the literature (see Pekrun et al., 2002), only two students wrote the word enjoyment, and it was decided not to use it for the application as the concept of enjoyment could be comprised through a combination of *happy* and *interested*.

## Step 2 – Selection of five triggers

The team of researchers from Step 1 completed an intercoder agreement (Creswell, 2014) on the eight themes derived from the coding process. An intercoder agreement entails employing other researchers to cross check a sample of the data to ensure qualitative reliability (Creswell, 2014). This provided us with a frequency response rate. The researchers were provided with 10% of randomized data. They were to read through the list of participant responses of triggers (i.e., causes for classroom emotions), along with the associated emotion, and select which of the eight themes they believed best described the trigger (i.e., *teacher, peer, schoolwork, self, family/home, school in general, other*). Coders were instructed to select one of the eight options; however, they could choose more than one only if they felt it absolutely necessary (e.g., “when I don’t understand the schoolwork,” while all coders felt this was triggered by *schoolwork*, several also categorized it as triggered by *teacher* or *self*). The following explanations were given to coders to define each trigger:

Teacher – anything related to the teacher (e.g., behavior, interaction, personality);

Peers – anything related to classmates, friends, bullying;

Schoolwork – anything related to assignments, classwork, specific classes;

Self – anything that is a direct response to oneself, or internalized;

Family/home – anything related to the home environment (e.g., parents, siblings, family members, events that specifically occurred at home);

Health – anything related to personal health, including tiredness and hunger (as noted in the trigger, not the emotion);

School in general – non-class/teacher/peer related causes within the school (e.g., policy, rules, lunchtime, etc.);

Other – anything that does not fit in another category

As displayed in Table 4, the most frequent triggers include: *teacher, peer, schoolwork, and self*. It was decided that these four triggers would appear on the application, along with *other*, which when selected would present a text box, allowing the participant to provide more detailed information, if they chose. Although *school in general* was more frequently reported than *other*, the majority of these triggers involved situations outside of the classroom environment (e.g., lunchtime, detention, assembly). Given that the application has been designed for use within a classroom setting, *other* was determined to be a more suitable option.

The S<sup>2\*</sup> (see Figure 1), is a tool that quickly captures the real-time dynamic of emotional states and causes of these states. This is a beneficial instrument to use in a classroom setting as it allows for instantaneous measurement, reducing recall bias. The use of this type of technology is very familiar to adolescents (Reid et al., 2009) and the emotion words listed on the application were derived from the language of the participants, which Creswell (2014) contends is advantageous.

## Phase 2 trial of the S<sup>2\*</sup> emotion application

In the second phase, the S<sup>2\*</sup> was trialed in classroom settings to address the third research question and to test the usability of the application, to ensure all functions worked properly and to collect student feedback. This process allowed us to verify the functionality and accuracy of the S<sup>2\*</sup> in collecting data. It also ensured that participants were familiar with the application before utilizing it in Phase 3 to examine emotions and causes for these experiences in low SES Year 10 classrooms.

The S<sup>2\*</sup> emotion application was trialed in six Math and six English classes from one of the participating secondary schools from Phase 1. Only one of the three schools was selected due to substantial complexity of the study and to allow for rigorous confirmation of the instrument. Three criteria were used to select the school for the trial: (1) There had to be enough participating students in the same Math and English classes; (2) class schedules had to allow for alternating days of data collection and time to upload the data, recharge and sync the tablets; (3) Teachers had to consent to the research being collected in their classroom. While all three schools expressed interest, only one school met all three criteria.

## Method

### Participants

There were 89 Year 10 student participants (47% male, and 53% female) from one of the low SES schools who participated in Phase 1 as outlined above. Each student had the opportunity to participate twice, once in Math and once in English. The class

TABLE 4 Frequencies of emotion trigger.

Triggers:	Teacher	Peer	Schoolwork	Self	Family/Home	Health	School in general	Other
Response rate:	100	181	212	106	23	34	73	42

FIGURE 1  
Interface of the S<sup>2</sup>\* emotion application.

sizes ranged from 11 to 22 students, and a total of 68% of all Year 10 students participated.

## Instruments

### The S<sup>2</sup>\* emotion application

The S<sup>2</sup>\* is a computer-based application, which was accessed on Acer tablets, independent of an internet connection.

Participants logged in with an identification code and their date of birth. Once logged in, students selected the S<sup>2</sup>\* function and were then taken to a screen (see [Figure 1](#)) which asked the question “How are you feeling right now?” presenting 20 different options (e.g., *happy, angry, frustrated, bored*). The question “What was the cause?” was asked at beneath the list of emotions with five entry options: *Teacher, Peers, Schoolwork, Other...*



*Self*, and *Other*, with *Other* allowing the option to provide more information in a text box. At the bottom of the screen there was a *submit* button. Once an entry was submitted the screen refreshed. Users were allowed to select the emotion or emotions they were currently feeling along with the cause or causes of that experience. This process is done quickly with an unlimited number of entries.

### The S<sup>2\*</sup> emotion application feedback form

The S<sup>2\*</sup> emotion application Feedback Form was a short questionnaire obtaining the students' gender, age and year level. The students answered the following three questions with yes or no responses, and the ability to explain in greater detail if answering yes: *Did you have any problems with the S<sup>2\*</sup> emotion application?*; *Were there any words you did not understand?*; and *Do you have any concerns about using this app in the future?* Additionally, students were given the opportunity to provide extra feedback.

### Procedure

Phase 2 preserved the same ethical approval as Phase 1 of this study and the S<sup>2\*</sup> was trialed with students in their Math and English class (12 classes total, 6 Math and 6 English). At the start of the first class the researcher explained to the students how the S<sup>2\*</sup> worked. Tablets and feedback forms were distributed to students. The students were given confidential identification codes with which to log in. The students had a few minutes to explore the S<sup>2\*</sup> and ask any clarifying questions. Once the students were settled, class proceeded as normal and the students had the opportunity to use the S<sup>2\*</sup> to capture their emotions, and causes for these emotions, throughout the remainder of class. There were no fixed time points, emotion entries were made at the discretion of the student. At the start of the second class, students entered the room, collected a tablet and logged in from their seats, requesting help if necessary. Students completed feedback forms at the end of their first class session, with the option to fill out an additional form after their second trial.

## Results and discussion

Seventy-three of participating students (82%) submitted a feedback form, 38% male, 51% female, 11% unidentified, with the average age being 14.8 years. Ninety percent of participants returned their feedback forms without any concerns. Ten percent of students reported having a problem with the application, which consisted of the *other* button not working properly, the application crashing when trying to submit, and one of the students thought the application was boring. Only one student reported not understanding one word, however when followed up, this student did not have any concerns. Additional feedback was provided by 17.8% of students, primarily with

positive responses including statements such as “*the app is really easy to use*,” “*it was absolutely amazing to have this beside me as it helped let go of all my emotions*.” The only critical responses were requests to add more emotions. All technical issues with the S<sup>2\*</sup> were amended by the web developer prior to using the application in Phase 3.

This trial provided the opportunity for students to familiarize themselves with the technology and report any errors with the application. The trial of the S<sup>2\*</sup> successfully demonstrated this tool as a beneficial instrument to capture emotions and causes for emotional experiences in a Year 10 classroom.

## Phase 3 measuring real-time emotions and their causes

In the third phase, we used the S<sup>2\*</sup> to answer the fourth research question: What are the real-time emotions and causes for these emotions of disadvantaged Year 10 Math and English students? To ensure that the participants were familiar and comfortable with using the S<sup>2\*</sup> we conducted Phase 3 with the same students from Phase 2.

## Method

### Participants

The second study involved 81 of the 89 Year 10 participants from Phase 2. Participants included 43% males, 57% females, ranging from 14 to 16 years old ( $M = 15.09$  years). This comprised 57% of the 143 actively enrolled Year 10 students, all who were invited to participate at the start of the semester. All Year 10 students were divided by the school into six cohorts, with each cohort attending the same Math and English classes together. Only one of these cohorts was streamed for mathematic ability.

### Instruments

#### The S<sup>2\*</sup> emotion application

The S<sup>2\*</sup> as described above was used to capture the real-time emotions and causes for emotions.

### Procedure

Phase 3 of the study took place over the fourth term of the academic calendar which consists of 8 weeks. The researcher collected data on real-time emotions and causes for those experiences from a total of 36 class sessions. This was achieved by collecting data at three different time-points from each of the 12 (six cohorts of both Math and English) Year 10 classes.

Prior to use, tablets were synchronized to the same server to ensure they all displayed the same accurate time. Just before the start of class, the researcher turned on all tablets and

opened the S<sup>2</sup>\*, so the login screen was displayed. As students entered class, they collected their tablets and logged in to the S<sup>2</sup>\* using a unique identification number. During class time, students were (at any time) able to report their emotions and causes for these emotions on their S<sup>2</sup>\*, while class proceeded as normal. The researcher was discreetly present during all class sessions, providing assistance if needed. Data were collected during regular Math and English lessons. The majority of the lessons were conducted in the same room at each time point; however, some lessons were moved to familiar computer laboratories when necessary for the classroom lesson activity. There was no active engagement from the researcher with the students during class sessions; lessons were authentically conducted during class time. The confidentiality of participants was maintained at all times.

## Results and discussion

Of the 81 participants, 72 were included in this analysis. Nine students were excluded from the analysis because they did not report emotions in both their Math and English classes. Only students who reported emotions in both their Math and English classes were included in analysis to ensure equal representation. While the number of entries varied, all students reported at least one emotion in all 36 Math and English classes (i.e., six different groups of students over three Math lessons and three English lessons). The analysis focused on the sum of the reported 20 emotions, based on the five possible causes (*teacher*, *peers*, *self*, *schoolwork*, and *other*). The percentage of entries per cause (i.e., submitted emotion and cause of emotion, as reported by each student) were calculated by dividing the total number of entries per cause (i.e., *teacher*, *peers*, *self*, *schoolwork*, and *other*), by the sum of all entries ( $n = 2,024$ ). **Table 5** presents a summary of the number of entries for each cause, as well as the calculated percentage. *Peers*, *schoolwork* and *self* were the most frequently reported causes for emotions, followed by *teacher* and *other*.

Student emotions caused by *peer* accounted for 27.77% of all reported emotions and was the most frequently reported cause. As seen in **Figure 2A**, the most commonly reported *peer* induced emotions include *happy* at 26%, followed by *calm* at 13%, and *bored* at 12%. Emotions caused by *schoolwork* accounted for 24.06% of all reported emotions. As seen in **Figure 2B**, the most frequently reported *schoolwork*-provoked emotions included *bored* at 33%, followed by *happy*, *stressed* and *calm* all at 9% and *frustrated* at 8%. *Self*-caused emotions accounted for 24.01% of all reported emotions. As seen in **Figure 2C**, the most frequently reported *self*-caused emotions include *happy* at 24%, followed by *calm* at 20% and *bored* at 14%. Emotions caused by *teacher* accounted for 14.33% of all reported emotions. As seen in **Figure 2D**, the most frequent reported *teacher* induced emotions include *bored* at 32%, followed by *frustrated* at 14% and *angry* at 8%. Finally, *Other* induced emotions accounted

TABLE 5 Total entries per cause.

Cause	Number of entries	Percentage (%)
Peers	562	27.77
Schoolwork	487	24.06
Self	486	24.01
Teacher	290	14.33
Other	199	9.83

Total number of entries  $n = 2,024$ .

for 9.83% of all reported emotions. As seen in **Figure 2E**, the most frequently reported *other* induced emotions include *sad* and *frustrated* at 13%, followed by *bored* at 12%, and *happy* and *stressed* at 9%.

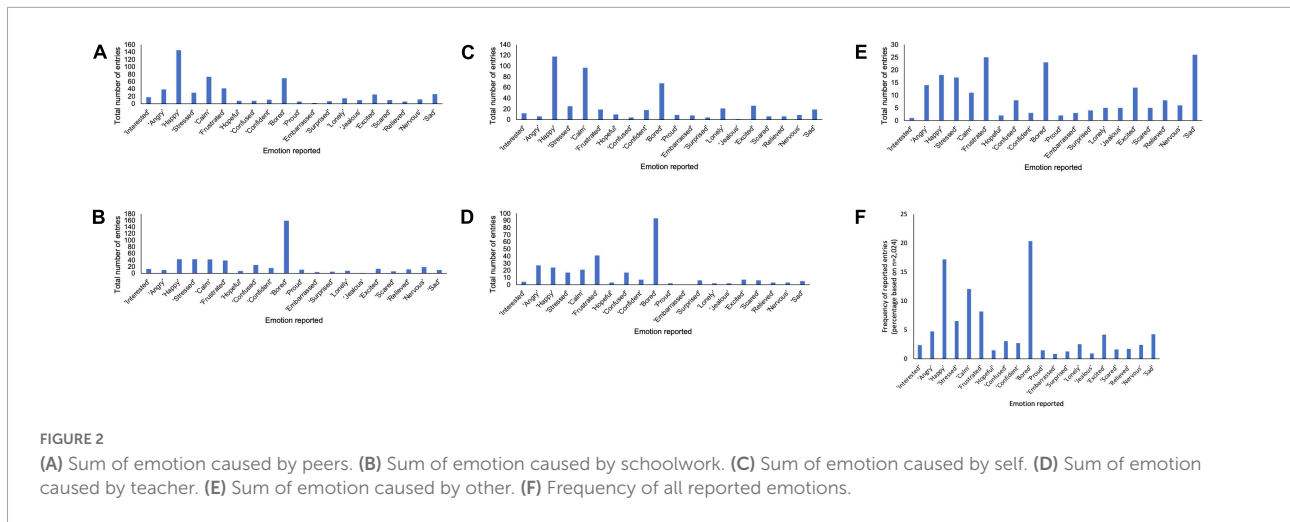
**Table 6** presents the top 10 most frequently reported emotions and causes for those emotions, out of all 100 possible emotion and cause combinations (i.e., five possible causes  $\times$  twenty possible emotions = 100 possible combinations).

While the cause of the emotion provides context and insight to the students' classroom experience, the frequency of each emotion also provides fruitful insight. These data are displayed in **Figure 2F**, revealing that the most commonly reported emotions include *bored*, *happy*, and *calm*.

## General discussion

The emotional experiences and causes for these experiences of disadvantaged adolescents have been explored and measured in the present study and a new tool has been developed. Phase 1 provided greater clarity on the emotional experiences of young people in three schools in low socioeconomic communities allowing for the development and trial of the S<sup>2</sup>\* emotion application in Phase 2. Phase 3 utilized the S<sup>2</sup>\* to examine real-time emotions and causes for emotions of Year 10 students across Math and English classes at multiple time points over an entire academic term, contributing to the existing literature.

The findings reveal that boredom was the most commonly reported emotion amongst this sample of participants, accounting for 20% of all entries. *Schoolwork* and *teacher* expectedly were the top two causes for boredom. Noteworthy results indicate that boredom was one of the three most commonly reported emotions provoked by all possible causes (i.e., *teacher*, *schoolwork*, *peers*, *self*, and *other*). These findings are in line with other research, which reports boredom as a commonly reported emotion in the classroom setting (Pekrun et al., 2002, 2014; Goetz et al., 2007, 2019, 2020; Goetz and Hall, 2014; Moeller et al., 2020). Goetz et al. (2007) found ninth grade students reported boredom nearly half of class time on average. Middle school students have reported the experience of boredom 32% of class time (Larson and Richards, 1991).



Likewise, a study conducted with 11th graders in math classes reported some level of boredom 58% of the time (Nett et al., 2011). More recently, Moeller et al. (2020) found that high school students report feelings of boredom at school 69.51% of the time. The results from this present study provide further insight to the antecedents of boredom in the classroom (i.e., *teacher, peers, schoolwork, self,* and *other*), which is lacking in educational research (Nett et al., 2011; Goetz and Hall, 2014).

Although intensity of emotion was not measured in this study, the high reports of boredom imply that these students may be considerably lacking a connection to the classroom. These findings have fundamental implications on student success. Students need to be emotionally invested, and engaged, to ensure their learning is meaningful and understood (Immordino-Yang and Damasio, 2016). The implications of these findings suggest a strong lack of motivation amongst

participants, which is critical to their academic success. These results suggest a need for teachers to develop stimulating lesson plans, and work with students to find ways to motivate and engage them in the learning process. It may be beneficial for teachers to collect feedback and work with their students to minimize classroom boredom.

While the second most frequent reported emotion is *happy*, it is essential to focus on the context. Nearly as many students reported happiness, provoked by their peers (7.16%), as boredom provoked by schoolwork (7.86%). Appraisal theory (Lazarus, 1991), along with the theoretical models related to boredom as discussed above, imply that emotions in the classroom transpire from students' cognitive evaluations of the current situation. Furthermore, Goetz and Hall (2014) contend that boredom presumably causes students to shift their attention toward a more stimulating interest. Therefore, based on the findings of the present study, it may be inferred that students find more interest in their classroom peers than the teacher and schoolwork. Supportive reasoning for this proposition is reinforced by limited entries of *interest* induced by the *teacher* and *schoolwork*, combined making up just 1.04% of all entries, which is less than students' reported *interest* induced by *peers* and *self*, combined (1.6%).

This suggestion is further supported by the results demonstrating that the greatest cause for all reported emotions in this study was *peers*. The majority of students find happiness and a sense of calmness with their peers in the classroom environment. However, participants also reported a notable response of *boredom, frustration, anger,* and *stress* instigated from their peers. These findings are of great concern, given the large impact that social emotions can have on student engagement (Pekrun and Linnenbrink-Garcia, 2014b) and cognition (Li et al., 2020). Student engagement, as well as student motivation, have been attributed to the social environment of the classroom (Patrick et al., 2007). Therefore, it is essential that teachers conduct lessons that engage

TABLE 6 Top 10 most frequent emotions and cause for emotion.

	Emotion	Trigger	Number of entries	*Frequency (%)
1	Bored	Schoolwork	159	7.86
2	Happy	Peers	145	7.16
3	Happy	Self	118	5.83
4	Calm	Self	97	4.79
5	Bored	Teacher	93	4.59
6	Calm	Peers	73	3.61
7	Bored	Peers	69	3.41
8	Bored	Self	68	3.36
9	Happy	Schoolwork	43	2.12
9	Stressed	Schoolwork	43	2.12
10	Frustrated	Peers	42	2.08
10	Calm	Schoolwork	42	2.08

\*Frequency is based on the total entries (n = 2,024).

students emotionally and minimize negative peer interactions whenever possible.

Teachers in disadvantaged schools have reported that it is difficult to create a caring classroom atmosphere due to challenging family backgrounds, and a lack of social and emotional skills amongst the students (Bower et al., 2015). In one study on making a difference in high poverty schools and the role of leadership, an Australian principal stated, “In the first couple of years I had to forget about curriculum. I mean literally I had to get kids sitting in classrooms. And that was an enormous task.” (Ylimaki et al., 2007, p. 373). This study supports the findings of the present study and suggests that teachers in disadvantaged communities are unlikely to be successful in teaching academic curriculum without first gaining the interest of student peer groups. Furthermore, evidence suggests an association between problematic behavior and schools located in disadvantaged communities (Gottfredson, 2011). Given the responses from participants in this study, along with validation within the literature regarding disadvantaged youths, it may be assumed that the Year 10 students in the present study were disengaged and unmotivated by their teachers and schoolwork, therefore seeking out amusement from their peers.

Interestingly, the present study revealed that the top two emotions reported as caused by the students’ *self* were *happy* and *calm*. DeCuir-Gunby and Williams-Johnson (2014) contend that “the key issue that impacts the nature of the development of the self is the relationship between the self and others. It is within these relationships that emotions are experienced and expressed” (p. 541). Therefore, given the context of this study, it would make sense that *self-induced* reports of *happy* and *calm* are likely to be a result of the self in relation to the classroom environment. Keeping context in mind, while a student might have selected *happy* because they answered a question correctly, it is also possible that the feeling of happiness was caused because the student made one of their friends laugh.

This study provides insights to classroom emotions caused by a variety of antecedents. Emotions triggered by things other than the *teacher*, *schoolwork*, *peers* and *self* made up 9.83% of student entries. The highest reported emotions resulting from other causes include *sad*, *frustrated* and *bored*. Some of the frequent responses, provided with the option to enter ‘more information’ include family/home, as well as being tired, hungry, and not feeling well. While literature is minimal, incidental emotions and moods in the classroom have been associated with student motivation and engagement (Pekrun and Linnenbrink-Garcia, 2014b). It may be postulated that incidental emotions and moods have a more significant role in disadvantaged classrooms, due to the greater quantity of challenges at home and in the community, yet more research is needed to foster the potential academic and life-long success of these young people.

The implications of this research are two-fold. Theoretically, a new tool has been developed to measure real-time emotions

and causes for these emotions. This tool has the potential to be used in similar school or related contexts. In addition, these findings add to the call for further research on classroom emotions that present collective evidence toward a meta-analysis, which will inform educators of valid strategies on how to best channel student emotions (Pekrun and Schutz, 2007; Pekrun and Linnenbrink-Garcia, 2014a). Feyzi Behnagh (2019) argues that “understanding when certain emotions are expressed by students, who shows those emotions, and what triggers them, could help the teacher intervene in time and deploy effective tactics to address negative emotions that could lead to disengagement and hinder learning” (p. 313).

While the breadth of knowledge on achievement emotions has grown substantially over the past 20 years, the findings of this study provide an extension to the literature around classroom emotional experiences beyond that of achievement emotions. This includes emotions directly linked to peers, the teacher, self and further recognition that there are a variety of emotions triggered by “other” unknown factors that still have an influence on the student. Furthermore, it provides greater insights to emotions in the secondary classroom, as well as an initial knowledge around these experiences for disadvantaged adolescents. This study implies a greater need to address boredom in the classroom, due to the frequent reports of boredom caused by schoolwork. This suggests a strong need for emotional engagement in disadvantaged classrooms. An expansion of theoretical frameworks, inclusive of all types of emotions, and causes for emotions is necessary to demonstrate to educators the core link between emotions and learning, as we know that the quality of learning is influenced by emotions (Goetz et al., 2006; Immordino-Yang and Damasio, 2016).

Moreover, the  $S^{2*}$  provides a new form of measurement that can be used by researchers to gain a greater understanding of classroom emotions of different antecedents. This tool can be used in future studies to build on these theoretical frameworks. Through the use of the  $S^{2*}$ , researchers are presented with a new tool to utilize in investigations of real-time emotional experiences and causes for these experiences in the academic setting. Future studies may consider using this tool to examine correlations between emotions and student–teacher relationships, achievement, and self-efficacy in domain specific classes.

Finally, worldwide, we are still learning how to best navigate educating our students during the COVID-19 pandemic. There have been shifts to remote or hybrid learning, adjustments to classrooms or school-wide policies including social distancing and mask wearing. While the evidence is rapidly growing, recent research on social and emotional wellbeing suggests a decline in wellbeing and an increase in mental health issues due to restrictions initiated from the pandemic (Ellis et al., 2020; Wang et al., 2020; Yang et al., 2020; Berger et al., 2021; Breaux et al., 2021; De France et al., 2021; Hu and Qian, 2021; Hough et al., 2021; Magson et al., 2021).

Knudson and Cantor (2020) argue that as school systems continue to adapt to the challenges inflicted from COVID-19, they “can position students for academic success by prioritizing physical and emotional wellbeing; social, emotional, and cognitive development; and academic supports and strategies, all combined in a web of consistent and caring relationships” (p.11). Utilizing the S<sup>2\*</sup> now, either in person or during remote learning could be a powerful tool in further supporting our students during these unprecedented times.

## Limitations and directions for future research

While this study has provided greater insights to the real-time emotional experiences of disadvantaged adolescents it is not without limitations. Firstly, while students were briefed on how to use the S<sup>2\*</sup> they were not forced at specific time to report their experiences. For some, participants may have made a number of entries, while others may have rarely entered anything, or only made entries if their emotional experiences were quite intense. Therefore, it was assumed that the emotions reported by students provided a general overview of students’ experiences in class regardless of how many times they submitted an entry.

Secondly, students were allowed to enter as many emotions and causes for emotions as they deemed appropriate. This meant interpretation relied on the discretion of the researcher. While excessive entries (five or more emotions reported at a time) were removed from the data, assumptions were still made. For example, if a student reported they were *Angry* and *Frustrated*, because of the *Teacher* and *Schoolwork*, this entry would account for each emotion to be triggered by each cause. Future research using a similar computer-based application may want to consider only allowing one emotion and/or one cause per submission to minimize postulation. Researchers may also want to control for the time-points that students enter emotions. While this option allows for more straight forward approaches to analysis, this may also force emotional responses, rather than allowing for genuine reports. Finally, Phase 3 was also conducted in the final term of the school year, therefore, it is plausible that the timing influenced the students’ experiences (i.e., anticipation of summer holidays, end of year events, exams, etc.). Future studies would benefit from investigating student emotional experiences throughout the school year for comparison.

## Conclusion

The S<sup>2\*</sup> provides a quick and easy method of capturing both emotional experiences and the causes for these experiences in a classroom context. Given the continual advancements in

technology and use of technology in the classroom, the S<sup>2\*</sup> provides an exciting opportunity for students to express their emotions in a safe and confidential space through the use of a familiar device. This instrument has the potential to make a progressive contribution to the field by adding to the limited tools currently available to effectively measure emotions in an education context. The findings from the present study, in collaboration with future research using the S<sup>2\*</sup> are instrumental to building theoretical frameworks and informing successful teaching practices.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors upon reasonable request.

## Ethics statement

The studies involving human participants were reviewed and approved by Behavioural and Social Sciences Ethical Review Committee (BSSERC) at The University of Queensland and Queensland Department of Education and Training (QDET). Written and informed consent from the schools’ principals and participants were obtained. Participants’ legal guardian/next of kin were notified of the study and able to withdraw at any time.

## Author contributions

This work was part of AB’s doctoral thesis, which was supervised by AC (primary) and JB (secondary). AB was responsible for the conceptualization, project administration, and data collection. AC and JB assisted AB with project design, methodology, and analysis. The original draft preparation was prepared by AB with reviewing and editing from all three authors for the final manuscript. All authors intellectually contributed to this work for conceptualization and development of the S<sup>2\*</sup> and for submission of publication.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.959673/full#supplementary-material>

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