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Engagement in learning during times of crisis

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ABSTRACT

Learning engagement is crucial for educational success, but is often negatively impacted during crises. War-induced trauma, leading to post-traumatic stress disorder (PTSD) symptoms, may reduce emotional, cognitive, and behavioral engagement in learning. Understanding the mechanisms underlying this relationship is critical for supporting student learning in crisis settings. This study examines the association between war-induced PTSD symptom endorsement and learning engagement among health profession students. It also explores boredom as a mediator of this relationship. The study included 196 health profession students ($M_{age} = 25.94$, $SD_{age} = 5.34$; 84.2% females) surveyed approximately six months after the onset of a war. Participants completed a cross-sectional survey assessing PTSD symptom endorsement, learning engagement (i.e. emotional, cognitive, and behavioral), and boredom. Regression and path analysis were conducted to examine direct and mediated associations. Approximately half (52.6%) of the students reported PTSD symptom endorsement exceeding the diagnostic threshold. PTSD symptom endorsement was negatively associated with all dimensions of learning engagement and positively associated with boredom. Boredom mediated the relationship between PTSD symptom endorsement and engagement, explaining additional variance in reduced engagement. Face-to-face learning was associated with fewer PTSD symptom endorsement compared to online (e.g. Zoom) formats, but learning format was not directly associated with engagement. War-induced PTSD symptom endorsement predicted reduced learning engagement, primarily via boredom. Addressing boredom through instructional design by fostering real-time social interactions may support learning engagement at times of crisis. Future research should assess the generalizability and possible causal effects of these findings.

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Engagement; Learning; Boredom; PTSD; War

1. Introduction

Learning engagement refers to students' involvement in learning (Christenson, Reschly, and Wylie 2012; Dubovi 2022; Fredricks, Blumenfeld, and Paris 2004; Tight 2020; Zepke 2021). It is a fundamental aspect of education and is widely recognized for affecting students' learning outcomes (Griffiths et al. 2012; Wong et al. 2024). Much research has been devoted to the correlates of learning

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engagement (see Chi and Wylie 2014), with significant attention given to curriculum content, instructional design, and modes of learning (Booth, Bosch, and D'Mello 2023; D'Mello, Dieterle, and Duckworth 2017; Saqr, López-Pernas, and Vogelsmeier 2023), as well as beliefs about competencies and motivation (Mahatmya et al. 2012; Skinner et al. 2008). Although most research has focused on learning engagement at routine times, less has been devoted to learning engagement at times of crisis. The outbreak of the COVID-19 pandemic, an example of one such crisis, has proven that crises can negatively impact student engagement (Dubovi and Adler 2024; Maluenda-Albornoz et al. 2023; Salas-Pilco, Yang, and Zhang 2022; Zhoc et al. 2022). Studies on the effect of crises beyond the COVID-19 pandemic on learning engagement remain relatively rare. In this investigation, we aim to share lessons learned about learning engagement during another form of crisis, a war. We focus on the associations between war-indicated post-traumatic stress disorder (PTSD) symptoms, learning engagement, and the possible mediating role of boredom.

1.1. Learning engagement

Learning engagement is a key factor for learning and is widely recognized as a multidimensional construct (Christenson, Reschly, and Wylie 2012; Skinner 2016). Although researchers do not always agree on the exact definition and operationalization of engagement (e.g. Azevedo 2015), many contend that it involves at least three interrelated yet distinct components: emotional, cognitive, and behavioral. The *emotional* component of learning engagement refers to students' affective involvement during learning activities (Meyer and Turner 2002). For example, positive emotions associated with learning engagement include enthusiasm and enjoyment of studying (Renninger and Bachrach 2015). The *cognitive* component of learning engagement refers to students' inner psychological characteristics and investment in learning that encompasses the use of cognitive and metacognitive strategies (Reeve and Tseng 2011), mental effort (Wang et al. 2018), or cognitive and motivation orientations toward school and learning (Appleton, Christenson, and Furlong 2008). The *behavioral* component of learning engagement is the outward manifestation of engagement (Wong et al. 2024). It includes students' school conduct and compliance (Fredricks et al. 2005), exhibition of effort and persistence in schoolwork (Skinner, Kindermann, and Furrer 2009), or involvement in extracurricular activities (Lam et al. 2014).

Student engagement in higher education is valued for its positive impact on students' learning, outcomes, and retention (Dubovi 2022; Tight 2020; Zepke 2021). However, a crisis, which can be either a natural disaster or human-made, might impair learning engagement. Natural disasters, such as the COVID-19 pandemic, are known to have a devastating effect on learning engagement (Dubovi and Adler 2024; Maluenda-Albornoz et al. 2023; Salas-Pilco, Yang, and Zhang 2022; Zhoc et al. 2022). Human-made crises could have the same devastating effects on learning engagement. Therefore, in this investigation, we expect to find a similar negative effect of a human-made crisis on learning engagement as seen during natural disasters.

1.2. Post-traumatic stress disorder

Mass trauma experiences include both natural disasters and human-made disasters (Chrisman and Dougherty 2014). The frequency and severity of mass trauma are increasing at an unprecedented rate due to the rapid growth of the population, climate changes, globalization, and the like (Chrisman and Dougherty 2014). Consequently, many people throughout the world are and will be exposed to mass trauma. A war is one form of human-made disaster bringing about mass trauma.

Trauma might induce post-traumatic stress disorder (PTSD). PTSD is a disorder that may develop among people who have experienced a shocking, scary, or dangerous event, such as a war (APA 2013). To be diagnosed with PTSD, according to the DSM-5 (APA 2013), an adult exposed to a traumatic event (Cluster A; e.g. death) must have all of the following for at least one month: at least one re-experiencing symptom (Cluster B; e.g. flashbacks), at least one avoidance symptom (Cluster C; e.g.

avoiding external reminders of the trauma, such as people and places), at least two arousal and reactivity symptoms (Cluster D; e.g. dissociative amnesia, negative emotions related to the trauma), and at least two cognition and mood symptoms (Cluster E; e.g. hypervigilance, angry outbursts). In the present investigation, we measured PTSD symptom endorsement. Morissette et al. (2021), who examined post-9/11 veterans (U.S. service members who served after 9/11, often in Iraq or Afghanistan), suggested that PTSD was the most prevalent mental health status shown to interfere with educational functioning. Likewise, we expect war-induced PTSD symptom endorsement to negatively impact the educational domain.

1.3. Learning during a crisis

Most research on learning has focused on routine times (e.g. Fredricks et al. 2005; Tight 2020), although some research has examined learning during a crisis. Research on crises in the form of natural disasters has mainly investigated the challenging effects the COVID-19 pandemic had on learning (e.g. Pokhrel and Chhetri 2021). Less research has explored the effects of human-made crises, such as wars, on learning.

War, and PTSD resulting from it, have been shown to have a negative effect on educational outcomes. A study conducted among undergraduate students at a large university in the Midwestern United States found that the higher the PTSD symptom endorsement, the lower the student's grade point average (GPA) (Laman-Maharg et al. 2024). A study on the war in Croatia (1991-1995) found that the war had a negative effect on the attainment of higher education for men compared to women not partaking in the war (Kecmanovic 2013). Moreover, the war had a more negative effect on the educational attainment of men in Croatia compared to men in neighboring Slovenia (Kecmanovic 2013). A national study conducted in Sweden demonstrated that a PTSD diagnosis lowers the odds of achieving key educational milestones (Vilaplana-Pérez et al. 2020). Particularly, Vilaplana-Pérez et al. showed that students with PTSD (vs. without PTSD) were 82% less likely to finish compulsory education, 87% less likely to finish upper-secondary education, 68% less likely to start a university degree, and 73% less likely to finish a university degree. A study that evaluated post-9/11 veterans demonstrated that veteran students with a PTSD diagnosis had a higher tendency for class absenteeism, as well as higher dropout rates (Morissette et al. 2021). War appears to negatively impact educational outcomes, with most research focusing on learning achievement and dropout rates. In the present investigation, we will expand the focus beyond learning outcomes toward the learning processes, specifically learning engagement.

In regard to health profession students studying under fire, the negative effects war has on their educational outcomes are even more devastating. Health professionals are a vital part of the present and future local health system, particularly during times of crisis. Their training, therefore, is paramount for the health system. Health profession students and staff in conflict zones are in constant threat of violence, displacement, and exposure to trauma, which deeply affect their mental health (Dobiesz et al. 2022). The negative impact of war on medical education has a long history, starting with the First World War until this very day (Dobiesz et al. 2022). In their review of global conflicts, Dobiesz et al. (2022) found war-induced curriculum-related barriers, such as the loss of clinical rotations and didactic teaching. The scarcity of essential resources, including medical supplies, equipment, and even safe learning spaces (e.g. shelters), further exacerbates these challenges (Dobiesz et al. 2022).

During the First Gaza War (2008-2009) many students reported experiencing psychological difficulties (e.g. stress, anxiety, depression) (Madsen et al. 2013). A week of classes was canceled for 165 international medical students, which led students to miss classes and crucial clinical experiences as well as reduced access to resources (e.g. textbooks and medical supplies), creating academic challenges (Madsen et al. 2013). Thus, it appears that wars affect the learning outcomes of health profession students, specifically, the availability of learning resources. In the present investigation, we likewise expect that higher war-induced PTSD symptom endorsement will predict

reduced learning outcomes. Furthermore, we will expand the focus from external factors (e.g. availability of equipment) to address internal factors impacting learning by focusing on learning engagement.

1.4. Learning-Related boredom

The opposite of learning engagement is disaffection (Skinner et al. 2008). A growing number of studies have indicated that boredom is a precursor to prolonged disaffection (Booth, Bosch, and D'Mello 2023; Pekrun et al. 2010; Skinner et al. 2008). Boredom comprises unpleasant feelings, reduced physiological arousal, perceived lack of cognitive stimulation, task-irrelevant thinking (e.g. daydreaming), and more (Pekrun et al. 2014). These feelings often trigger impulses to escape the situation in which boredom is experienced (Sharp et al. 2017).

The control-value theory (CVT) offers a framework for understanding how instructional design can inadvertently trigger boredom (Pekrun et al. 2010). According to CVT, subjective perceptions of control and value are pivotal determinants of achievement emotions. Control appraisals reflect an individual's perceived ability to successfully complete tasks and achieve desired outcomes, while value appraisals pertain to the perceived importance and relevance of these activities and outcomes. These appraisals shape achievement behaviors and performance by influencing cognitive resources, motivation to learn, and the use of learning strategies. CVT posits that boredom emerges when achievement-related activities are perceived as lacking value or task demands are seen as exceeding an individual's capabilities. Consequently, perceptions of control and value act as antecedents to boredom, significantly impacting students' emotional and cognitive engagement in learning (Pekrun et al. 2010).

Generally, boredom prevails in higher education at routine times (Sharp, Sharp, and Young 2020). During a crisis, such as a natural disaster like the COVID-19 pandemic, boredom plays a role as well (Bambrah, Wyman, and Eastwood 2023; Dubovi and Adler 2024). This investigation will take place during another form of crisis, a human-made crisis in the form of war. Specifically, we will examine boredom as a mediator associated with war-induced PTSD symptom endorsement, on the one hand, and learning engagement, on the other. Previous research during COVID-19 found that more PTSD symptom endorsement were associated with greater academic boredom (Bambrah, Wyman, and Eastwood 2023; Shen et al. 2021). Therefore, we expect that greater endorsement of PTSD symptoms will be associated with higher levels of boredom. Furthermore, boredom comprises the impulse to escape the boredom-inducing situation through disengagement (Pekrun et al. 2014). Consequently, we expect that more boredom will be associated with lower learning engagement. Finally, we hypothesize that boredom will mediate the association between war-induced PTSD symptom endorsement and learning engagement. More PTSD symptom endorsement will be associated with greater boredom, which, in turn, will be associated with less emotional, cognitive, and behavioral learning engagement.

1.5. The present investigation

In this study, we will investigate health profession students learning in higher education during a war. Given the importance of the health profession students in the health system, an effort was made to begin the 2023–2024 academic year as soon as possible, despite the ongoing war in Israel. Therefore, the semester started for health profession students earlier than other disciplines, in a hybrid format (face-to-face and online Zoom instruction). Approximately six months after the beginning of the war, during the first semester of the academic year, our research team virtually approached health profession students, asking them to complete a cross-sectional survey. First, we examined health profession students' mental health by focusing on their PTSD symptom endorsement. Given the ongoing war, we expected students to report a high level of PTSD symptom endorsement. Second, we examined health profession students' learning engagement. Given the distractions the war

generated, we expected them to report lower learning engagement compared to before the war. Third, we hypothesized that more war-induced PTSD symptom endorsement would predict lower learning engagement. Finally, we hypothesized that the association between war-induced PTSD symptom endorsement and students' engagement would be mediated via boredom.

2. Materials and methods

2.1. Participants

We received responses from 196 health profession students (M_{age} = 25.94, SD_{age} = 5.34, 6 missing; 84.2% female, 6 missing; Nursing = 56.1%, Dentistry = 18.9%, Medicine = 11.7%, Other = 9.7%, 7 missing). A power analysis using G*Power 3.0 (Faul et al. 2007) indicated that a sample of 193 participants was required to detect a small effect size (r = .20; α = .05; 1-β = .80).

2.2 Materials

2.2.1. Learning formats

Students rated (−3 = less than before the war, 0 = the same, and 3 = more than before the war) the extent to which they typically experienced the use of three learning formats: face-to-face, via Zoom synchronously, and via Zoom asynchronously (e.g. Zoom recording).

2.2.2. Change in learning engagement

Students rated their learning engagement during the war compared to before the war (i.e. 'my leaning engagement'; – 3 = less than before the war, 0 = the same, and 3 = more than before the war).

2.2.3. Emotional learning engagement

Students rated (1 = not at all; 7 = very much) the 'Engagement Versus Disaffection with Learning: Student-report' (Skinner et al. 2008) 5-item emotional engagement subscale, adapted to higher-education and Hebrew (Dubovi and Adler 2024; e.g. 'When we work on something in class, I feel involved'; α = .86).

2.2.4. Cognitive learning engagement

Students rated (1 = not at all; 7 = very much) the 4-item 'deep learning' measures to assess cognitive learning engagement Senko and Miles 2008; e.g. 'When thinking about concepts in this class, I try to generate examples to help me understand them better'; (α = .75).

2.2.5. Behavioural learning engagement

Students rated (1 = not at all; 7 = very much) the 'Engagement Versus Disaffection with Learning: Student-report' (Skinner et al. 2008) behavioral engagement subscale, adapted to higher-education and Hebrew (Dubovi and Adler 2024; e.g. 'When studying, I work as hard as I can'). Students completed 4 out of the 5 items of the subscale (α = .72). One item was excluded that was irrelevant to the learning context of all students ('When I'm in class, I participate in class discussions').

2.2.6. Boredom

Students rated (1 = not at all; 7 = very much) two items concerning boredom from the 'Achievement Emotion Questionnaire' (Pekrun et al. 2011; e.g. 'The class material bores me to death'; α = .75).

2.2.7. PTSD symptom endorsement

Students rated (0 = not at all; 4 = extremely) the 20-item 'PCL-5' to assess their PTSD symptom endorsement (Bovin et al. 2016; e.g. 'In the past month, how much were you bothered by: Irritable

behaviour, angry outbursts, or acting aggressively?'). Following Bovin and colleagues (2016), and to enable the interpretability of our findings, items rated as moderate or high (i.e. 2, 3, 4) were regarded as symptom-endorsed (recoded as 1) and the rest as unendorsed (i.e. 0, 1, recoded as 0). Following the recoding, we summed the endorsed symptoms ($\alpha = .87$).

2.3. Procedure

This cross-sectional study was conducted following the approval of Tel Aviv University ethics committee (#0007700-1). Data was collected between January 20 and April 22, 2024, four to six months after the beginning of the war. The study was advertised for health profession students. They were informed that the study was voluntary and anonymous, aimed at learning about health profession students' learning during the war and taking approximately 15 min to complete. At the end of the survey, students could choose whether to enter a draw, in which four randomly selected students were granted bonuses of approximately US$68. Participants gave their informed consent to complete the research questionnaire. They first completed a set of randomized items pertaining to emotional, cognitive, and behavioral learning engagement, and the boredom scales. Next, they completed the PTSD symptom endorsement scale. Finally, they reported their demographics.

3. Result

3.1. Descriptive statistics

Descriptive statistics and correlations among key research variables are presented in Table 1. Students reported studying less face-to-face compared to before the war (one sample's t-test comparing mean change to 0 (the same), $t(195) = 7.25$, $p < .001$, $d = 0.52$) and studying more via Zoom, both synchronously ($t(195) = 3.11$, $p = .002$, $d = 0.22$) and asynchronously ($t(195) = 3.15$, $p = .002$, $d = 0.23$). Health profession students reported scores above the scale's midpoint of boredom and above the scale's midpoint of emotional, behavioral, and cognitive learning engagement.

The Pearson correlations in Table 1 show that learning format was unrelated to learning engagement and boredom. However, more face-to-face teaching was associated with fewer PTSD symptoms. Additionally, the Zoom learning formats were not associated with PTSD symptom endorsement.

3.2. PTSD symptom endorsement

The sample's PTSD symptom endorsement mean was relatively high (see Table 1). For each DSM-5 PTSD symptom cluster (APA 2013), the mean number of symptoms was above the threshold for all clusters (Cluster B – re-experiencing: $M = 2.16$, $SD = 2.00$, threshold ≥ 1 reported by 75.0% of the sample; Cluster C – avoidance: $M = 1.13$, $SD = 1.00$, threshold ≥ 1, 68.9%; Cluster D – arousal and reactivity: $M = 3.30$, $SD = 3.00$, threshold ≥ 2, 78.6%; Cluster E – cognition and mood: $M = 3.35$, $SD = 4.00$, threshold ≥ 2, 85.7%), with 52.6% of the students reporting symptoms exceeding the threshold in all four PTSD clusters. Next, we ran a repeated-measures ANOVA, comparing cluster scores. We found a significant difference among cluster scores (Wilks' $\Lambda = 0.23$, $F(3,193) = 155.25$, $p < .001$, $\eta_p^2 = .21$), such that cluster C (avoidance) was significantly lower than all of the other clusters, followed by cluster B (re-experiencing) which was also significantly lower than cluster D (arousal and reactivity) and E (cognition and mood). Clusters D and E did not differ significantly.

3.3. Change in learning engagement

As expected, the students reported that their learning engagement was lower compared to before the war (one sample's t-test comparing the mean change to 0 (the same), $t(189) = 8.50$, $p < .001$, $d = 0.61$).

Table 1. Descriptive statistics and correlation among key research variables (N = 196).

		Mean	SD	Range	α	1	2	3	4	5	6	7	8
1	Learning format – Face-to-face	−0.84	1.61	−3–3	NA	1							
2	Learning format – ZOOM synchronously	0.40	1.82	−3–3	NA	−.38*	1						
3	Learning format – ZOOM asynchronously	0.39	1.72	−3–3	NA	−.30*	.62*	1					
4	Change in learning engagement	−0.81	1.32	−3–3	NA	.34*	−.17*	−.19*	1				
5	Learning engagement – Emotional	4.42	1.21	1–7	.86	.09	−.04	−.02	.30*	1			
6	Learning engagement – Cognitive	4.74	1.36	1–7	.75	−.10	.13	−.04	.12	.55*	1		
7	Learning engagement – Behavioral	5.00	1.08	1–7	.72	.10	.06	−.01	.33*	.63*	.64*	1	
8	Boredom	3.80	1.36	1–7	.75	.04	−.05	−.14	−.20*	−.50*	−.23*	−.30*	1
9	PTSD symptom endorsement	9.93	5.08	0–20	.87	−.18*	.04	.00	−.27*	−.37*	−.17*	−.32*	.19*

Note. * $p < .05$.

3.4. PTSD symptom endorsement and learning engagement

As can be seen in Table 1, correlations among emotional, behavioral, and cognitive learning engagement were positive and high. The greater the learning-related boredom, the lower the emotional, behavioral, and cognitive learning engagement. The more PTSD symptoms the health profession students endorsed, the lower their emotional, behavioral, and cognitive learning engagement. The more PTSD symptoms the health profession students endorsed, the greater their boredom.

3.5. The mediating role of boredom

To test the possibility that the association between PTSD symptom endorsement and emotional, cognitive, and behavioral learning engagement was mediated through boredom, we performed a multivariate linear regression analysis. As Table 2 demonstrates, PTSD symptom endorsement explained 15% of the variance in reduced emotional learning engagement ($F(1, 194) = 35.69$, $p < .001$), 2% of the variance in reduced cognitive learning engagement ($F(1, 194) = 5.85$, $p = .016$), and 9% of the variance in reduced behavioral learning engagement ($F(1, 194) = 21.12$, $p < .001$). The incorporation of boredom in model 2 explained an additional 17% of the variance in reduced emotional learning engagement ($F(2, 193) = 47.24$, $p < .001$), 4% of the variance in reduced cognitive learning engagement ($F(2, 193) = 7.04$, $p = .001$), and 6% of the variance in reduced behavioral learning engagement ($F(2, 193) = 17.78$, $p < .001$).

Based on the results, we used path analysis to test the simultaneous direct and indirect associations between PTSD symptom endorsement, learning engagement, and boredom. The model is presented in Figure 1. The path analysis results were consistent with the multivariate linear regression results (Table 2), showing an indirect effect of boredom on the association between PTSD symptom endorsement and emotional ($b = -0.02$, $SE = 0.01$, $p = .011$), cognitive ($b = -0.01$, $SE = 0.01$, $p = .046$), and behavioral ($b = -0.01$, $SE = 0.01$, $p = .027$) learning engagement.

4. Discussion

Most research on learning engagement has been done during routine times. When learning engagement during a crisis has been studied, it was in the context of natural disasters, such as the COVID-19 pandemic (Dubovi and Adler 2024; Koenen et al. 2017; Maluenda-Albornoz et al. 2023; Morissette et al. 2021; Salas-Pilco, Yang, and Zhang 2022; Zhoc et al. 2022). By addressing engagement in the context of a human-made crisis, namely, a war, we contribute to the growing literature on crisis and learning engagement. Specifically, we evaluated the association between war-induced PTSD symptom endorsement of health profession students and their engagement in learning, as well as the mediating role of boredom.

Our findings showed that approximately half (52.6%) of the health profession students reported PTSD symptom endorsement, exceeding the threshold for diagnosis in PTSD according to the DSM-5 (APA 2013) approximately six months after the onset of the war. This rate is consistent with the literature showing that 15%–55% of individuals exposed to traumatic events are ultimately diagnosed with PTSD, compared to approximately 3.9% in the general population (Koenen et al. 2017; Morissette et al. 2021; Vilaplana-Pérez et al. 2020). Not surprisingly, health profession students reported lower learning engagement during the war compared to before the war. This finding aligns with studies during the COVID-19 pandemic, showing a negative impact of the crisis on students' learning engagement (e.g. Dubovi and Adler 2024).

As expected, we showed that more war-induced PTSD symptom endorsement predicted lower emotional, cognitive, and behavioral learning engagement. Previous research has suggested that PTSD symptom endorsement resulting from exposure to traumatic events might affect learning, with studies focusing primarily on learning achievement (Laman-Maharg et al. 2024) and dropout rates (Kecmanovic 2013; Morissette et al. 2021; Vilaplana-Pérez et al. 2020). By doing so, this line

Table 2. Multivariate linear regression models predicting learning engagement from PTSD symptom endorsement (N = 196).

	Predicted variable	Emotional learning engagement			Cognitive learning engagement			Behavioral learning engagement		
	Predictors	*B (SE)*	*Beta*	*Adj. R^2*	*B (SE)*	*Beta*	*Adj. R^2*	*B (SE)*	*Beta*	*Adj. R^2*
Model 1	PTSD symptom endorsement	−0.03 (0.01)	−.39*	.15*	−0.02 (0.01)	−.17*	.02*	−0.02 (0.01)	−.31*	.09*
Model 2	PTSD symptom endorsement	−0.02 (0.01)	−.30*	.32*	−0.01 (0.01)	−.12	.06*	−0.02 (0.01)	−.26*	.15*
	Boredom	−0.38 (0.05)	−.43*		−0.20 (0.07)	−.20*		−0.19 (0.05)	−.25*	

Note. * $p < .05$.

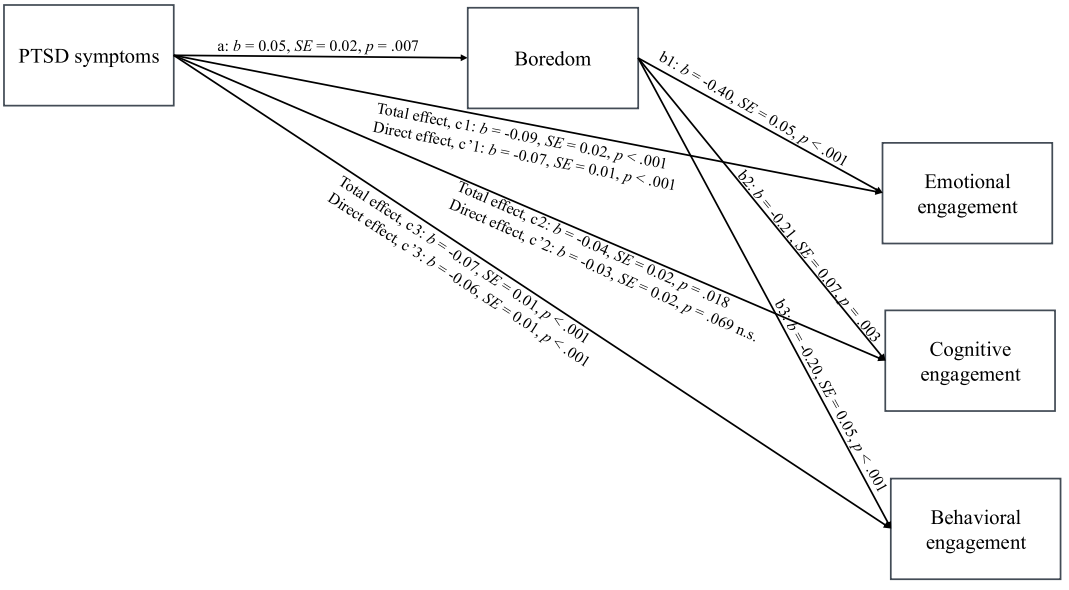

Figure 1. Mediation with multiple outcomes: PTSD symptom endorsement predicted emotional, cognitive, and behavioral learning engagement via boredom.

of research has concentrated mainly on education outcomes (e.g. GPA, dropout). Regarding health profession students, most studies have examined the availability of resources (Dobiesz et al. 2022; Madsen et al. 2013). The current investigation offers an important contribution to the literature by expanding beyond learning outcomes to include the learning processes and from external factors (e.g. availability of equipment) to address internal factors, in particular, learning engagement (e.g. cognitive, emotional, and behavioral engagement).

The results of the current investigation demonstrated an association between war-induced PTSD symptom endorsement and emotional, cognitive, and behavioral learning engagement. This is not surprising, given that some PTSD symptoms, for example, the arousal and reactivity symptoms cluster, resemble ADHD symptoms (e.g. problems concentrating) known to interfere with learning. Interestingly, our findings indicated that PTSD symptom endorsement had the greatest association with emotional engagement, accounting for 15% of its variance, followed by 9% for behavioral engagement and 2% for cognitive engagement. This could stem from the fact that PTSD is primarily an emotional condition that is more similar to the emotional aspect of engagement, therefore predicting it to the greatest extent.

A key finding of the current investigation was that the association between war-induced PTSD symptom endorsement and students' learning engagement (i.e. emotional, cognitive, and behavioral) was mediated through boredom. In other words, boredom helped explain the link between PTSD and poor learning engagement. Thus, in accordance with previous research (Bambrah, Wyman, and Eastwood 2023; Shen et al. 2021), PTSD symptom endorsement and boredom were positively associated as expected. In addition, the negative association between boredom and learning engagement was also consistent with earlier studies (Pekrun et al. 2014). Specifically, more war-induced PTSD symptom endorsement predicted greater boredom, which in turn predicted lower emotional, cognitive, and behavioral engagement. The mediating role of boredom, although not tested in a causal fashion here, suggests that by reducing the levels of boredom, it is possible to blur the negative effect of PTSD symptom endorsement on students' engagement. Reduced boredom may serve as a protective factor against disengagement. This finding concurs with previous experimental research on crises in the form of natural disasters, showing that, indeed, lower

boredom plays a causal protective role against diminishing learning engagement (Dubovi and Adler 2024).

Boredom-free instructional designs may be used to support students' engagement in academic endeavors during times of crisis and uncertainty (Sharp et al. 2017). To counteract the adverse effects of PTSD symptom endorsement on learning engagement, we recommend focusing on reducing educational boredom. Aligned with the control-value theory (Pekrun et al. 2010), one effective approach to reduce boredom might be to assign tasks that increase students' value appraisals or their perceived importance of activities and outcomes. This can be achieved by providing tasks that are relevant to their lived experiences, incorporating concrete examples linked to prior knowledge, and thus perceived as highly relevant and meaningful (Goetz and Hall 2014; Sharp et al. 2017). Simultaneously, it might be effective to bolster students' control appraisals – their belief in their ability to successfully perform tasks and achieve outcomes – especially given PTSD symptom endorsement during an ongoing war. Therefore, in addition to providing authentic and meaningful tasks, appropriate scaffolding should be integrated to support learners, particularly when dealing with complex tasks.

Interestingly, our results did not reveal a significant association between Zoom-based instruction, either in synchronous or asynchronous formats, and PTSD symptom endorsement. However, we found that more face-to-face learning was associated with fewer PTSD symptom endorsement. These results suggest that while online learning platforms like Zoom are valuable, they may not replace the psychological benefits of in-person education, especially in times of crisis. This highlights the importance of designing educational environments that support mental health, perhaps by integrating elements of face-to-face interaction even in predominantly online formats.

4.1. Limitations and future directions

This study's findings contribute to the literature, however, its limitations must be considered. First, this was a cross-sectional survey. Although the proposed model was previously supported by a causal design (Dubovi and Adler 2024), the present investigation's research design did not allow us to make causal inferences. Although manipulating the independent variable might have supported the suggested model, inducing PTSD in students would be unethical, therefore, a correlational design was necessary. Nevertheless, future research should find creative ways to test the proposed model causally.

Second, although we used a validated scale based on the DSM-5 to assess PTSD symptom endorsement, a self-report online questionnaire is not sufficient to accurately diagnose PTSD. Still, many students reported a substantial number of symptoms, with symptom endorsement possibly reaching the level of PTSD diagnosis. More research is needed to corroborate this finding. Third, the health profession students at Tel Aviv University are not in close proximity to the active war zones. The war has taken place in the west and north of Israel, which are geographically distant from the center. Nevertheless, their PTSD symptom endorsement levels were high. Future research should try to replicate the results among students at academic institutions with greater proximity to the war zones.

Fourth, the change in learning engagement was based on health profession students' self-reports. As the war started with a surprise attack before the beginning of the first semester, a baseline evaluation of students' engagement was not possible. Moreover, the broader context of prolonged conflict in the region may have led to anticipatory stress affecting students' emotional states and academic boredom and engagement even before the formal onset of the war, thereby limiting our ability to identify a clear 'baseline.' Therefore, we asked students to report on whether they *perceived* themselves as less engaged in learning than before the war. This kind of self-report might not be reliable. Future research would benefit from a pre – and post-crisis evaluation of learning engagement. Likewise, future research should go beyond self-reports and examine engagement in other forms and in real-time. Fifth, future research should test the generalizability of the findings of this research beyond the present context of the war while using larger samples.

4.2. Conclusion

Health profession students reported high endorsement of PTSD symptoms. They also reported being less engaged in learning compared to before the war. War-induced PTSD symptom endorsement predicted reduced learning engagement, primarily via boredom. Addressing boredom through instructional design by fostering real-time social interactions may support learning engagement at times of crisis.

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Research data

Research data will be available upon request.

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