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The relationship between academic self-efficacy and class engagement of self-reported LD and ADHD in Israeli undergraduate students during COVID-19

Miriam Sarid[1] [ID] · Orly Lipka[2]

Abstract

The present study examined the academic self-efficacy (ASE) of undergraduate students with self-reported learning disabilities (LD), attention deficit hyperactivity disorder (ADHD), and comorbid LD + ADHD compared with non-LD/ADHD students at two time points, before the emergence of COVID-19 (pre-COVID) and during the pandemic (COVID-19). It also examined the relationship between ASE and engagement in remote learning (RL) classes during COVID-19. Participants were 621 undergraduate students with self-reported LD/ADHD (198) and without LD/ADHD (423) who were examined before (291) and during (330) the COVID-19 outbreak. First, we compared the ASE of the pre-COVID group vs. the COVID-19 group. This comparison revealed that ASE of all students (self-defined LD/ADHD and non-LD/ADHD) who studied during COVID-19 by RL was lower than that of students before COVID-19. Next, in-depth analyses among COVID-19 four subgroups (i.e., LD, ADHD, LD + ADHD, and students without disabilities) showed that both subgroups of students with ADHD reported lower ASE to cognitive operations than did students without LD/ADHD. In addition, the subgroup of students with ADHD were less engaged in RL classes than were students without LD/ADHD. Higher ASE to cognitive operations and social interactions was related to higher engagement in RL for all students. The results call for postsecondary institutions to increase their academic support of undergraduates with LD, ADHD, or both and to provide guidance in RL.

Keywords Academic self-efficacy · ADHD · COVID-19 · Engagement in class · Undergraduates · Learning disabilities

✉ Miriam Sarid
miri@sarid-ins.co.il

Orly Lipka
Olipka@edu.haifa.ac.il

[1] Western Galilee College, POB. 2125 Derech Hamichlalot, 24121 Acre, Israel

[2] University of Haifa, Haifa, Israel

Introduction

Learning in higher education presents academic challenges and a new environment for students to adjust to (Ben-Naim et al., 2017). The shift of academic institutions to emergency remote learning (RL) during COVID-19 (Murphy, 2020) and to online remote delivery of courses (Gewin, 2020) presented additional challenges to students in higher education. These challenges included the need to adapt to a new model of learning, fatigue as a result of longer lectures (Lederman, 2020), the need to concentrate in class for a long time to succeed in learning, and higher levels of stress and anxiety (Alemani-Arrebola et al., 2020; Lowenthal et al., 2020; Sahu, 2020). Anxiety is related to academic performance and students' self-efficacy (Gutierrez-Garcia & Landeros-Velazquez, 2018), and university students with a high level of stress have been found to have low levels of self-efficacy.

In particular, populations of college students with learning disabilities (LD) tend to have lower ASE than students without LD (Ben Naim et al., 2017; Hen & Goroshit, 2014), and students with comorbid LD and attention deficit hyperactivity disorder (ADHD) tend to have lower self-efficacy than students with only LD (Budd et al., 2016). Academic self-efficacy may affect students' academic choices and goals (Schunk & Meece, 2006; Sharma & Nasa, 2014), as well as their academic achievements (Caprara et al., 2011; Chemers et al., 2001; Feldman & Kubota, 2015; Hoigaard et al., 2015; Putwain et al., 2013; Zajacova et al., 2005). ASE may also be related to engagement in learning, and students with low ASE may be less engaged in learning than those with high ASE (Linnenbrink & Pintrich, 2003). Engagement may play a significant role in academic achievements (Banna et al., 2015) or graduation from college (Advokat et al., 2011).

The present study explored the ASE of students with LD, ADHD, or both in the shift to RL during the outbreak of COVID-19. We examined the ASE of undergraduate students with self-reported LD, ADHD, or both, compared to undergraduate students without LD/ADHD, and the contribution of ASE to engagement in RL. Undergraduate students in Israel who study in a college or in a university are working toward a bachelor's degree.

Students with LD and/or ADHD in higher education

LD is a developmental disorder defined as significant and unexpected difficulty in academic achievements and related areas of learning, which is not attributed to medical, educational, environmental, or psychiatric disorders (Cortiella & Horowitz, 2014). Students with LD or ADHD in higher education tend to have lower grades and are more likely to face academic probation (Weyandt & DuPaul, 2008). Students with LD face difficulties with regulation such as self-motivation and time management (Heiman, 2006) and they are less likely to graduate from college than are their peers (Advokat et al., 2011; Wagner et al., 2005). The ASE of students with LD was found to be lower than that of their peers (Ben-Naim et al., 2017, Hen & Goroshit, 2014); they procrastinate with respect to their academic tasks more than their peers without disabilities do (Goroshit & Hen, 2021) and report lower self-worth (Shany et al., 2013). A recent study that examined the adjustment of LD/ADHD students in Israel to higher education showed that students with LD/ADHD also face more academic and personal-emotional adjustment challenges in higher education than do students without disabilities (Lipka et al., 2020).

Students with ADHD exhibit a persistent pattern of inattention, hyperactivity, or impulsivity (or more than one of these) that interferes with their functioning (American

Psychological Association, 2013) and lessens their academic achievements (Rabiner et al., 2016). Recent research regarding college students with ADHD shows that they achieved significantly lower GPAs and reported less frequent use of study skills and strategies than did their peers without ADHD (DuPaul et al., 2021). They also withdrew from courses more frequently (Advokat et al., 2011) and were less likely to graduate (Hechtman et al., 2016) than their peers without ADHD. Students with ADHD in higher education reported difficulties in learning, including forgetfulness, difficulties completing assignments, sustaining attention, listening, and organizing tasks (Lewandowsky et al., 2008), and deficits in planning (Marzocchi et al., 2008; Reaser et al. 2007). College students with ADHD may exhibit characteristics that interfere with their success and are related with lower academic performance, such as high levels of procrastination, inadequate learning skills, more challenges in executive functioning, and poor time management (Advokat et al., 2011; Reaser et al., 2007). College students with ADHD who studied by RL during COVID-19 (e.g., the spring of 2020) were found to experience more learning difficulties, distress, and loneliness than their peers without ADHD (Laslo-Roth et al., 2022).

Population with comorbid LD and ADHD

The comorbidity rate of LD + ADHD of students in the K-12 population is about 31 to 45% (DuPaul et al., 2013), and is estimated to be 2 to 8% (Anastopoulos et al., 2018; McKee, 2008) in college students. Despite the high rates of comorbidity, the prevalence of one disorder is independent of the other, and the disorders differ by their etiological factors (Langer et al., 2019).

Little is known about this population of students in college, including the transition to college and the potential effect of this comorbidity on their functioning in higher education (DuPaul et al., 2017). Nevertheless, it was found that students diagnosed with comorbid ADHD and LD have rated a lower perception of their academic ability relative to students diagnosed with ADHD only (DuPaul et al., 2017) and significantly more school disengagement than students with LD alone, where students with ADHD alone spent significantly less time studying or doing homework than the group of LD and LD + ADHD students (DuPaul et al., 2017).

In the younger population of students, comorbid individuals were found to have more severe learning problems than students who had only LD. A study of 119 children aged 8–16 years, who were diagnosed with LD, ADHD, and both LD and ADHD, found that those with comorbid LD + ADHD had more severe attention problems than did students with ADHD only (Mayes et al., 2000). Based on their findings, Mayes et al. suggested that learning and attention problems were on a continuum and were most severe in students with both LD and ADHD. DuPaul et al. (2013) suggest in their review on the comorbidity of LD and ADHD that although both LD and ADHD may exhibit lower academic achievements, these difficulties may be secondary for ADHD symptoms, while they represent actual skills deficits for students with LD.

A study that compared students with LD, ADHD, and LD + ADHD achievements and ASE in postsecondary education (Budd et al., 2016) found that students with ADHD (with or without comorbidity) reported lower grades and less course-related self-efficacy, such as time management and keeping up-to-date with schoolwork, than did students with LD only, while students with only LD exhibit lower grades and graduation rate than that of their peers without disabilities (Jorgensen et al., 2009). Another study that was conducted among college students with LD, ADHD, and LD + ADHD (Sparks

et al., 2005) demonstrated that students classified as both LD and ADHD exhibited cognitive and academic achievement profiles in foreign language similar to those of students classified as only one disability, ADHD or LD.

In light of the difficulties that students with LD, ADHD, or both, face in routine academic work, the present study examined their ASE during RL compared to that of students without LD or ADHD.

Academic self-efficacy

Academic self-efficacy (ASE) refers to a person's belief in their ability to carry out the actions required to achieve desired outcomes in an academic field (Bandura, 1977). Students with high ASE set high goals, exert great effort, and display high motivation when facing difficulties (Mana et al., 2020). By increasing motivation and persistence in mastering academic tasks, ASE encourages the use of acquired knowledge and skills (Bandura, 1993), engagement, and learning (Bandura, 2018; Linnenbrink & Pintrich, 2003). Students who are confident in their capacity to meet academic requirements and to plan and organize their learning persist in their efforts and avoid distractions (Bandura, 1997).

ASE relates to academic performance through other variables as well, such as effort regulation, which can in turn lead to higher academic performance. Bandura and Wood (1989) found that ASE influences performance both directly and indirectly, through its effects on analytical strategies, which suggests a mediating effect of metacognition on the relationship between ASE and performance (Hen & Goroshit, 2014).

ASE also has been shown to act as a negative moderator on variables that correlate with academic performance, such as academic procrastination (Honicke & Broadbent, 2015). A higher level of ASE was related to less academic procrastination, and subsequently to higher achievement (Balkis, 2013).

Another aspect of self-efficacy is manifest in online learning, where self-efficacy is individuals' perceptions of their abilities to successfully complete tasks required of online learners (Zimmerman & Kulikowich, 2016). During online learning, students are not present physically in the classroom and have no face-to-face interaction with the instructor or with their classmates. They can decide when and for how long to access learning materials; therefore, they need more self-regulation in learning (Wang et al., 2013). Students who do not believe that they possess the necessary skills to be successful in an online course may choose not to enroll, or may be less likely to complete an online course in which they enroll (Moore and Kearsley, 2011), whereas those who are high in online self-efficacy perform better in online courses (Hodges, 2008) and display greater motivation (Artino, 2009).

A recent study that examined the online self-efficacy and motivation of college students during COVID-19 found a decrease in skills related to online self-efficacy, such as time management, completion of assignments on time, ability to be successful in class, and ability to discuss topics with classmates and instructors (Aguilera-Hermida, 2020). The authors reported a positive effect of the students' self-efficacy on their cognitive engagement in class. Another study conducted among more than 2000 undergraduate and graduate students (Wang et al., 2013) found that technology self-efficacy, which included general computer efficacy and online learning efficacy, was predicted by previous experience with online courses.

Engagement and participation in higher education learning

Engagement in learning encompasses behavioral, cognitive, and motivational aspects (Linnenbrink & Pintrich, 2003). Behavioral engagement refers to observable behavior in class, such as seeking help, investing greater effort in tasks, and persisting longer at completion of tasks.

In an extensive literature review, Rocca (2010) defined the term "class participation" in traditional learning as active engagement in class. It requires attendance, contribution to class discussion, and group and communication skills. Participation in class also includes students asking questions and commenting in class discussion. Ideally, almost all students participate, show interest, learn, and listen to others' comments and suggestions (Wade, 1994). In online learning, learner participation is often related to the percentage of the grade assigned to online discussion (Jiang & Ting, 2000). Learner interaction in class can be learner-to-learner, learner-to-instructor, or learner-to-content (Moore, 1993). Interactions with content, peers, and instructors are essential during online learning (Lear et al., 2010), as they help learners become active and more engaged in their courses. Developing a sense of community and interactivity in class results in higher-quality instruction and more effective achievement of learning outcomes.

A recent study of college students' engagement found that the emotional engagement of university students during COVID-19 decreased, probably because of reduced interest in learning (Daniels et al., 2021). Another study involving a group of young adults with ADHD during COVID-19 examined the problems of adolescents with ADHD during the pandemic and found that difficulty engaging in online learning was one of the common problems reported by the adolescents and their parents, and that it was reported more during the pandemic than in the months preceding it (Sibley et al., 2021).

Engagement in online learning is important because it may decrease learner isolation and improve college retention and graduation rates (Banna et al., 2015). Because of the shift to RL during COVID-19, we examined students' engagement in class when learning from home. We measured engagement using students' self-reports on participation in RL classes.

The present study

ASE contributes to success in higher education, as manifested in students' achievement or in college persistence (Wright et al., 2013; Zajacova et al., 2005). Students with high ASE devote greater effort to their studies, set higher goals, and are also motivated when facing academic difficulties (Mana et al., 2020). By increasing motivation and persistence in mastering academic tasks, ASE encourages engagement and learning (Bandura, 2018; Linnenbrink & Pintrich, 2003; Zhen et al., 2017).

Research shows that students with LD/ADHD exhibit ASE lower than students who are not LD and/or ADHD (Ben-Naim et al., 2017, Hen & Goroshit, 2014; Mana et al., 2020). They also face academic challenges in college more than other students (Advokat et al., 2011; Wagner et al., 2005). Therefore, a decrease of academic self-efficacy may negatively affect their learning outcomes, such as engagement in learning, academic achievements, or graduation from college/university (Bates & Khasawneh, 2007). There are a few studies that examined the ASE among students with LD/ADHD during RL. Investigating the ASE of students with LD/ADHD during RL may contribute to the limited body of knowledge

and help in understanding the needs of this population in higher education. In the current study, we aimed to examine how the shift to RL affected students with LD/ADHD academic self-efficacy and determine the relation of this transition to engagement in learning.

Therefore, the hypotheses of the study (Fig. 1) were as follows: (1) because ASE of students in online studies was reported as lower than the ASE of students during face-to-face learning (Alemani & Arrebola, 2020), we hypothesized that the ASE (total score) of students in RL would be lower than their ASE during face-to-face learning; (2) based on previous findings of studies that compared populations of students with LD/ADHD to students without disabilities (Ben-Naim et al., 2017, Niazov et al., 2022), we hypothesized that the ASE (total score) of students with LD/ADHD (as a unified group) would be lower than that of students without LD/ADHD, regardless of the method of learning (face-to-face or RL); and (3) based on previous studies indicating that comorbid LD + ADHD students face more learning challenges than do students with LD or ADHD only (DuPaul et al., 2017; Mayes et al., 2000), we hypothesized that the ASE (i.e., cognitive engagement, social interactions, technical efficacy, and total ASE score) and engagement in RL during the outbreak of COVID-19 of undergraduate students with LD + ADHD would be lower than those of their peers with LD only or with ADHD only, and lower than those of students without LD/ADHD. (4) Finally, based on the association reported in the literature between ASE and engagement (Aguilera-Hermida, 2020, Bandura, 2018), we hypothesized that the ASE (i.e., cognitive engagement, social interactions, technical efficacy, and efficacy beliefs to remote learning) during RL would predict the engagement of students in RL.

Method

Participants

The sample included 621 native Hebrew-speaking undergraduate students from 30 universities and colleges in Israel, including 291 participants who were recruited shortly before the COVID-19 pandemic (pre-COVID sample) as part of previous research
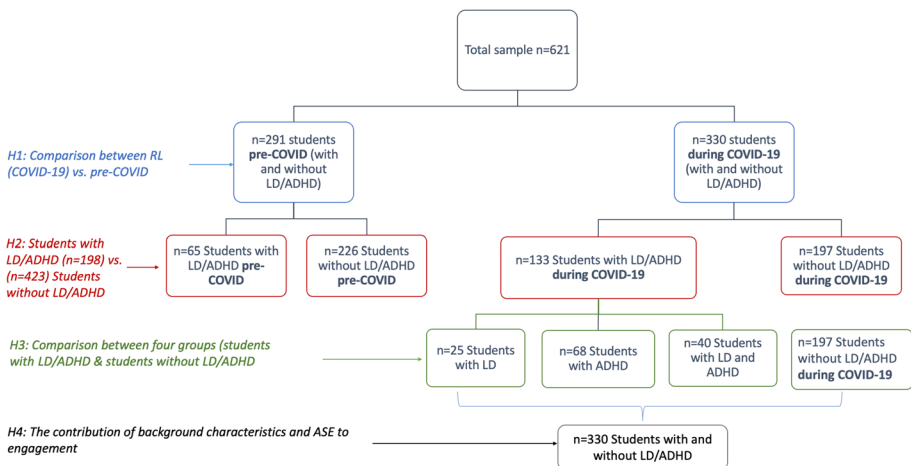

Fig. 1 Research design

(Lipka et al., 2020), and 330 students who were recruited during COVID-19 (Covid-19 sample; see Fig. 1) (the spring of 2020).

Pre-COVID sample ($n = 291$) In this sample, 215 (75%) of the students were female, and 76 (26%) were male. When filling out the demographic questionnaire, 65 (22%) of the students reported having LD, ADHD, or both; in this group, the respondents were not asked to report on a particular disability that they were diagnosed with (e.g., LD or ADHD). A full 226 (78%) students did not report any disabilities.**Fig. 2** Demographic questionnaire of the students reported having LD, ADHD, or both

COVID-19 sample ($n = 330$) In this sample, 246 (74.5%) of the students were female and 84 (25.5%) male. The male/female ratios of participants in both samples (pre-COVID and COVID-19) were similar ($x^2 = 0.04$, $p = 0.85$).

On the demographic questionnaire, 68 (21%) students reported having a diagnosis of only ADHD, 25 (8%) students reported having a diagnosis of LD, and 40 (12%) students reported having LD + ADHD. A total of 197 (60%) undergraduate students did not report any learning disabilities or ADHD. In this sample, the respondents who reported a disability were asked to name the particular disability that they were diagnosed with (e.g., LD, ADHD, or both). A higher ratio of students with LD/ADHD was found in COVID-19 sample ($x^2 = 22.98$, $p < 0.001$). This difference reflects the efforts by researchers to continue to recruit students with LD/ADHD during COVID-19, in order to increase the representation of these students in the sample.

The probability of students participating in both the pre-COVID and COVID-19 samples was very low, as most participants in the pre-COVID sample had probably received their bachelor's degree by the time of data collection during COVID-19.

The ratio of students who studied in a college as opposed to a university and the ratio of students in their first and second years of studies were higher in the sub-sample of students with self-reported LD, ADHD, or both than in the control group. Table 1 describes the characteristics of the sample.

Procedure

The questionnaire for both samples was administered online in electronic form, over a period of 12 months before the pandemic for the pre-COVID-19 sample and over a period of three weeks during April–May 2020 for the COVID-19 sample. Each participant signed an informed consent that promised anonymity.

Pre-COVID sample To capture a representative sample of students in Israel, most of the institutions of higher education in the country were asked to send their students electronic questionnaires assessing suitability for participation in the study. All students expressing willingness to participate were contacted by phone or online and provided with information about the objectives, significance, and procedure of the study. After providing verbal consent, students were asked to sign informed consent forms and to complete the study questionnaires online, which took approximately 40 min. Participants who submitted the questionnaires received the equivalent of approximately $20. The study received the approval of the University of Haifa Faculty of Education ethics committee and of Western Galilee College ethics committee.

Table 1 Demographic characteristics of the sample

	Pre-COVID	COVID-19 total sample	χ^2	COVID-19 sample				χ^2
				Only LD	Only ADHD	LD+ADHD	Students without LD/ADHD	
	n (%)	n (%)		n (%)	n (%)	n (%)	n (%)	
With LD/ADHD	65	133	22.98***					
Without LD/ADHD	226	197						
Male	76 (26%)	84 (25%)	0.04	3 (12%)	18 (26%)	7 (18%)	56 (28%)	4.67
Female	215 (74%)	246 (75%)		22 (88%)	50 (74%)	33 (83%)	141 (72%)	
College students	106 (36%)	161 (49%)	9.85**	16 (64%)	34 (51%)	24 (60%)	87 (44%)	6.11
University students	185 (63%)	168 (51%)		9 (36%)	33 (49%)	16 (40%)	110 (56%)	
First year of studying	17 (6%)	102 (32%)	94.78***	6 (26%)	22 (32%)	20 (53%)	54 (29%)	14.72*
Second year of studying	65 (22%)	101 (32%)		11 (48%)	25 (37%)	10 (26%)	55 (29%)	
Third year of studying	209 (72%)	115 (36%)		6 (26%)	21 (31%)	8 (21%)	80 (42%)	

*$p < .05$, **$p < .01$, ***$p < .001$

COVID-19 sample Participants were recruited through an online panel and received a link to the questionnaire by email. Those who declared that they were studying at an institution of higher education and agreed to participate in the study were contacted by the research coordinator and received a link to the full research questionnaire by email. They also received a link to a short preliminary screening questionnaire that was posted on the Facebook pages of institutions of higher education for designated groups of students. Individuals who agreed to take part in the study underwent the same screening process as those recruited through the online panel. Data collection was completed over a period of a week for participants without disabilities and continued for additional two weeks for students who reported having LD/ADHD in order to achieve a sufficient number of students with LD/ADHD. Participants who completed the questionnaire received the equivalent of approximately $7. No differences were found between the groups recruited on Internet panels and on social networks in the male/female ratio, year of studies, and type of institution (college/university).

Measures

Background and demographic questionnaire

The questionnaire included demographic information regarding gender, year of study, and institution of study (university or college). Respondents were asked to report whether they had been diagnosed with LD, ADHD, or both in the preceding five years. Participants in COVID-19 group were asked to note the exact diagnosis that they had received in the preceding five years, while participants in the pre-COVID group were asked to note in general whether they were diagnosed with either LD or ADHD in the preceding five years.

College academic self-efficacy scale (CASES) (Owen & Froman, 1988)

The original version of the ASE questionnaire in English includes 33 items (Owen & Froman, 1988). For the purposes of the current study, the ASE scale was adapted from a version that was translated to Hebrew by Hen and Goroshit (2014) and includes a 26-item self-report questionnaire. The questionnaire was scored on a Likert scale ranging from 1 (do not feel confident) to 5 (feel very confident), with a higher score representing higher ASE. After examining the items of the scale, we included 23 items that were appropriate for the RL context in the current study. Items such as "running for student government office" or "participation in social events" were excluded, as all face-to-face activities in academic institutions during were suspended during COVID-19. Each item is related to one of three subscales, all of which are sufficiently reliable. The subscale of cognitive operations (e.g., listening carefully during a lecture on a difficult topic) includes 14 items, Cronbach alpha in the current study = 0.83; Overt, social situations (e.g., participating in a class discussion) includes seven items with high internal consistency, Cronbach alpha in the current study = 0.93; and technical skills (i.e., using computers to look for library resources) includes two items; because of low correlation between the items in this subscale, we used only the item concerning the ability to use computers to look for library resources. In addition, a total score of all items was calculated, representing total ASE. The questionnaire was administered to both pre-COVID and COVID-19 participants.

Self-efficacy beliefs to distance learning (DL) (Zhang et al., 2001), in the current study named as SE beliefs to RL

This questionnaire comprises seven items scored on a Likert scale ranging from 1 (lowest self-efficacy) to 5 (highest self-efficacy), where respondents are asked to rank their beliefs about the efficacy of distance learning. The reliability of the questionnaire in the current study was alpha = 0.94. The questionnaire was adjusted by the authors to RL during COVID-19 by asking the respondents to rank their response with reference to their online learning experience during the pandemic. Two items adjusted to the efficacy of synchronous RL were added to the questionnaire, referring to the students' belief that RL contributes to their academic success and to their learning experience. The questionnaire was administered only to participants in COVID-19 group.

Engagement during RL

Engagement in RL was measured by six items ranked on a Likert scale of agreement from 1 (lowest agreement) to 5 (highest agreement). The questions were composed by the authors, asking the students to refer specifically to RL during the COVID-19 pandemic. The questions focused on the student's behavior during the lesson, for example: "In how many of your online classes are you performing activities not relevant to the lesson?" ranging from 1 (none) to 5 (all), and "I have difficulty sitting in one place during an entire lesson by RL", ranging from 1 (lowest agreement) to 5 (highest agreement). The items of the scale underwent content validation by the authors and by an additional educational specialist who agreed on the relevance of the scale to class engagement. The reliability of the questionnaire was alpha = 0.72. This questionnaire was administered only to participants in COVID-19 group.

Statistical analyses

Hypotheses 1 and 2 referred to group differences in ASE total score between pre-COVID and COVID-19 groups, and students with LD/ADHD vs. students without LD/ADHD. In order to incorporate the information of the interrelated dependent variables (Field, 2013), a two-way (group × LD/ADHD) analysis of variance (ANOVA) was conducted for the total score of ASE. As the first hypothesis posed for differences in ASE between pre-COVID and COVID-19 groups regardless of LD/ADHD, the results were inferred from the main effect of group (pre-COVID vs. COVID-19 all participants). The second hypothesis, which referred to differences between students with LD/ADHD (that includes LD, ADHD, and LD + ADHD subgroups as one unified group) and students without a reported LD/ADHD, was inferred by the main effect of LD/ADHD groups, regardless of time of measurement (i.e., both pre-COVID and COVID-19 groups).

The third hypothesis proposed that there would be differences in ASE subscales between the LD + ADHD group and each of the other subgroups of students (i.e., LD, ADHD, students without LD/ADHD) who studied by RL during COVID-19. As this hypothesis referred to differences in several dependent variables of ASE subscales (i.e., cognitive operations, social interactions, management of online resources, beliefs to RL, and engagement), we used one-way multivariate analysis (MANOVA). One analysis for these dependent variables reduces the familywise type I error and takes into account any relationship between the dependent variables (Field, 2013). The MANOVA was followed

by univariate ANOVAs for these subscales. Significant differences between the four groups were followed by the Tukey pairwise post hoc procedure, a test suitable for the comparison of groups of non-equal sample size (Sauder & DeMars, 2019). We conducted Levene's test for equality of variances between groups in all analyses of variance.

Because the ratio of female participants was higher than male participants in both pre-COVID and COVID-19 groups, all the above comparisons were repeated with gender as a covariate, with the aim of testing whether the differences found were consistent when controlling for gender.

The fourth hypothesis aimed to examine the contribution of ASE to students' engagement in learning. In order to examine this hypothesis, a forced-step hierarchical linear regression was conducted. In the first step, background characteristics were included (i.e., gender as a dummy variable, year of studying, ADHD as a dummy variable, LD as a dummy variable, comorbid LD + ADHD group as a dummy variable, type of study institution as a dummy variable). In the variables of LD/ADHD, the comparison category of subgroups was the largest group (Field, 2013) of students without LD/ADHD. In the second step, ASE subscales were added. This analysis enabled us to explore the explained variance of background data and the additive explained variance of ASE, on top of background data.

Results

Hypothesis 1: The ASE of students who studied during RL (with or without LD/ADHD) will be lower than the ASE of students in face-to-face learning (COVID-19 vs. pre-COVID).

The two-way ANOVA revealed that the ASE of all students (self-reported LD/ADHD and non-LD/ADHD) who studied during COVID-19 by RL ($n = 330$) was lower than that of students before COVID-19 ($n = 291$). The students reported a lower total score of ASE during COVID-19 than before COVID-19, $F(1,617) = 33.12$, $p < 0.001$, and these differences were consistent when adding gender as a covariate to the analysis, $F(1,616) = 32.98$, $p < 0.001$ (see Table 2).

Hypothesis 2: The ASE of students with LD/ADHD will be lower than that of non-LD/ADHD students, regardless of the method of learning.

To examine hypothesis 2, we compared students in the LD/ADHD ($n = 198$) and non-LD/ADHD ($n = 423$) groups. We found that students with self-reported LD/ADHD had lower ASE scores than did those in the non-LD/ADHD group. The students with self-reported LD/ADHD had lower scores on total ASE, $F(1,617) = 35.71$, $p < 0.001$, also when adding gender as a covariate to the model, $F(1,616) = 35.35$, $p < 0.001$. As shown in Table 2, the efficacy of all students (i.e., with and without LD/ADHD) decreased between the two measurements.

Hypothesis 3: The ASE (i.e., ASE to cognitive operations, ASE to social interactions, ASE of technical skills, and beliefs in efficacy to RL) and engagement in remote learning (COVID-19 groups) of undergraduate students with LD + ADHD will be lower than those of other groups of students (i.e. LD, ADHD, students without LD/ADHD).

Table 2 Means and standard deviations of total ASE and ANOVA results of students with and without LD/ADHD pre-COVID-19 and in RL during COVID-19

	Pre-COVID	COVID-19	Total
LD/ADHD	3.14 (0.67)	2.91 (0.72)	2.98 (0.71)
Students without LD/ADHD	3.61 (0.59)	3.15 (0.71)	3.40 (0.69)
Total	3.51 (0.64)	3.05 (0.72)	3.27 (0.72)
F (Group: LD/ADHD vs. Without LD/ADHD)	F=35.71***, ($\eta^2 = .06$)		
F (Sample: Pre-COVID vs. COVID-19)	F=33.12***, ($\eta^2 = .05$)		
F Group×sample	F=3.42, ($\eta^2 = .01$)		

To examine the hypothesis, we conducted a multivariate analysis of variance (MANOVA) for subgroups, which revealed significant differences between the four groups (Table 3), $\Lambda F(15,889)=4.01$, $p<0.001$ (see Table 3). A univariate ANOVA indicated that the differences between the four groups were in ASE in cognitive operations, $F(3,326)=6.39$, $p<0.001$; social interactions, $F(3,326)=2.4$, $p=0.04$; and beliefs in RL, $F(3,326)=4.31$, $p=0.005$. The groups also differed in engagement in learning, $F(3,326)=9.39$, $p<0.001$. The findings of pairwise comparisons (Tukey test) showed that students without LD/ADHD scored higher in ASE to cognitive operations than did both groups of students with ADHD (ADHD only and LD+ADHD). Students with self-reported LD scored higher in beliefs in RL than did all three other groups. Finally, students without LD/ADHD reported on higher engagement in learning than did both students with ADHD only and students with LD+ADHD. The differences between the four groups in ASE to social interactions were found with a significant main effect but did not reach significance in Tukey post hoc comparisons.

> Hypothesis 4: It was hypothesized that the ASE during RL will predict the engagement of students in RL. The regression model (see Table 4) revealed that having ADHD and studying in a university explained about 6 percent of the variance of engagement in class. Students with ADHD were less engaged in RL than were students with only LD or students without disability. Students who study in a university were less engaged in learning than college students. In the second step, ASE as exhibited in social interactions, technical ability, and beliefs in efficacy to RL added about 42 percent of variance to the explained variance of engagement. The results revealed that higher efficacy to social interactions, lower efficacy of technical skills, and higher beliefs in the ability to RL were associated with more engagement in RL. The total explained variance accounted for by the variables in the regression was 48 percent.

Discussion

The present study examined the ASE of undergraduate students with self-reported LD and/or ADHD and of students with LD+ADHD in RL during COVID-19, and to broaden the limited knowledge in this area. At the time of the pandemic, institutions of higher education worldwide, including Israel, switched to RL without being able to prepare students for it. In light of the academic challenges that students with LD/ADHD face in higher education, and their lower academic self-efficacy, we examined the ASE of students with LD,

Table 3 Means, standard deviations, and ANOVA results of ASE and RL engagement by groups, during COVID-19 (sample 2)

		LD $n=25$	ADHD $n=68$	ADHD+LD $n=40$	Non-LD/ADHD $n=197$	F $(3326)(\eta^2)$
ASE—cognitive operations	Mean	3.21	2.93	2.85	3.28	6.39*** (.06)
	SD	0.78	0.69	0.88	0.78	
ASE—social interactions	Mean	3.05	2.60	2.86	2.92	2.84* (.02)
	SD	0.82	0.81	0.97	0.87	
ASE—technical efficacy	Mean	3.29	2.99	3.07	3.14	0.63 (.01)
	SD	0.93	1.08	1.14	1.00	
ASE belief in RL	Mean	4.52	3.47	3.37	3.73	4.31** (.04)
	SD	1.37	1.64	1.78	1.53	
Engagement in RL	Mean	2.97	2.53	2.59	3.05	9.39*** (.08)
	SD	0.76	0.81	0.83	0.82	
Multivariate ΛF(df $=15,889$)						4.01***

*$p<.05$, **$p<.01$, ***$p<.001$; ASE refers to academic self-efficacy; RL refers to remote learning

Table 4 Contribution of background characteristics and ASE to the prediction of engagement in RL of students during COVID-19 ($n=330$): results of the hierarchical linear regression

	First step			Second step		
Predictors	B	SE B	Beta	B	SE B	Beta
Studying at a university	−.21	.09	−.13*	−.19	.07	−.12**
Year of study	.05	.05	.05	−.03	.04	−.03
Gender (female coded as=1)	−.03	.10	−.02	.03	.08	.01
LD	−.01	.18	−.01	−.16	.14	−.08
ADHD	−.37	.11	−.22***	−.17	.08	−.10*
LD+ADHD	.13	.23	.06	.12	.18	.05
ASE in cognitive operations				.10	.07	.10
ASE in social interactions				.54	.05	.60***
ASE in technical skills				-.11	.04	−.15**
Belief in RL				.07	.03	.15**
Total R^2 (change)				0.06**	0.48***	(0.42***)

*$p<.05$, **$p<.01$, ***$p<.001$; LD, ADHD, and LD+ADHD were coded as dummy variables compared to the largest category of non-LD/ADHD

ADHD, and LD+ADHD and students without LD/ADHD, during the emergent shift to RL. In order to examine the changes in ASE due to the COVID-19 situation, we also compared the students with LD/ADHD as a unified group to a group of students who were studied shortly before COVID-19.

Hypothesis 1

The first hypothesis aimed to examine the ASE of all students (with and without) during RL compared to students with LD/ADHD in face-to-face learning. All students (LD/ADHD and students without LD/ADHD) in our study who were examined during RL (COVID-19) had lower ASE than did the sample before the pandemic. These findings suggest that the decrease of ASE may be related to the sudden change in the learning environment and the academic requirements of RL, which forced students to adjust to RL without preparation. Students were required to deploy new learning strategies and self-regulation skills to stay on track. A recent study of students without LD/ADHD provides support to these findings, by showing a decrease in online ASE for all students in such skills as time management, completion of assignments in time, ability to succeed in class, and ability to discuss topics with classmates and professors (Aguilera-Hermida, 2020). Therefore, it is reasonable to assume that applying new methods of learning may require students to develop the belief that they can adjust their strategies to the new academic requirements.

Hypothesis 2

The second hypothesis referred to differences between students with LD/ADHD (as a unified group) and students without LD/ADHD in their ASE, in general, regardless of RL (i.e., during COVID-19). Consistent with other studies (Ben-Naim et al., 2017; Hen & Goroshit, 2014; Niazov et al., 2022), students with LD/ADHD as a unified group scored lower in ASE than did students without LD/ADHD. Extension of these findings to RL suggests that ASE is not specific to the way knowledge is delivered, whether face-to-face or by RL. A low ASE may reflect cumulative academic challenges that students with LD/ADHD face throughout their years of study, before and in the course of higher education.

Hypothesis 3

We hypothesized that students with LD + ADHD will report lower ASE (i.e., ASE to cognitive operations, ASE to social interactions, ASE of technical skills, and beliefs in efficacy to RL) and lower engagement in remote learning (COVID-19 group) than students with LD, ADHD, or students without LD/ADHD. Our findings indicated that both ADHD groups (i.e., LD + ADHD and ADHD) were lower in their efficacy to cognitive operations than the non-LD/ADHD group, a domain that may represent the efficacy of learning and cognitive activities more than the others. These results support findings reported by Budd et al. (2016) who found that students with ADHD (with or without comorbidity) reported lower grades and course-related self-efficacy reflected in time management and keeping up to date with schoolwork than students with only LD. Another study involving students with LD + ADHD (Marzocchi et al., 2008) found greater impairment in students with ADHD than in their peers without ADHD on objective measures such as planning, time management, concentration, use of study aids, and selecting main ideas (Reaser et al., 2007). A recent study of DuPaul et al. (2021) reported that college students with ADHD challenges exhibited lower GPAs and less frequent use of study skills and strategies than did their peers without ADHD (DuPaul et al., 2021). Students who studied by RL during COVID-19 (Lipka & Sarid, 2020) reported on decrease of skills such as time management and difficulties in focusing attention and concentrating. The impaired attention and study skills

(DuPaul et al., 2017) may provide some explanation for the decrease of self-efficacy to cognitive operations that specifically require these skills.

We also examined the students' belief in their self-efficacy in RL. Students with LD only were more likely to express beliefs in their RL self-efficacy than were those in the other groups. These results suggest that RL, in contrast to face-to-face learning, provides an environment of independent and self-controlled learning and an opportunity for students with LD to learn more effectively at their own pace, with more control of their learning. This way they can take advantage of the flexibility that RL provides. They may benefit from the direct communication with instructors via e-mail, recorded lectures, and synchronous class recordings that facilitate the learning in a virtual environment (Lee et al., 2021). This point needs further investigation.

The lower ASE and belief in their self-efficacy to RL of students with ADHD and LD + ADHD may be related to their lower self-regulation skills, including time management, concentration, and test strategies (Reaser et al., 2007). In order to succeed in a remote learning environment, the student is required to learn independently and also to avoid distractors in the learning environment (Lee et al., 2021). The emergent shift to RL during COVID-19 without prior preparation posed challenges such as distractors and a need for time management that interfered with the students' learning (Lipka et al, 2020). These challenges may interfere with learning for students with ADHD and therefore are reflected in their beliefs to RL.

Examination of the students' engagements in RL classes during COVID-19 revealed that students with ADHD in each of the groups (LD + ADHD and ADHD) engaged less in a RL class than did students without LD/ADHD. Some of the findings in the study by DuPaul et al. (2017) provide support for our findings. The authors examined students' expectations of engagement and their self-ratings of disengagement and showed that students with ADHD in both groups anticipated less engagement in academic activities than did students without ADHD, and expected more challenges than did students without disabilities. Two groups of ADHD students (ADHD + LD and ADHD) in the study by DuPaul et al. (2017) also reported more school disengagement during their last year of high school than did their peers without ADHD, and less time spent on studying and doing homework. They also anticipated more college-related challenges than did students with LD only or students without disabilities. Our findings examined students' reported engagement during learning and suggested that the attention difficulties of students with ADHD affect engagement in RL classes. Perhaps because students with ADHD may anticipate difficulties in RL, this may affect their confidence and their efficacy in the ability to engage in class.

It was hypothesized that the ASE during RL will predict the engagement of students in RL.

Hypothesis 4

Examining the contribution of background characteristics and ASE to engagement in class revealed a direct connection between ASE in social interaction, belief in self-efficacy in RL, and ADHD (ADHD only or LD + ADHD), and engagement in RL classes in the group of students with LD, ADHD, or both. Online RL provided less formal student-instructor interaction than did regular classes, which may require more attention and greater effort from the learner. It may be that because students with ADHD faced challenges in focusing attention in RL, social interaction during learning fostered their self-efficacy and resulted in higher engagement in RL. These findings are consistent with the results of a recent study

conducted among US students (Son et al., 2020), demonstrating that many students complained about having difficulties concentrating, citing such reasons as a distractive home environment, lack of social interaction, and prolonged screen time. It may be that the intensity required for studying for an entire day in front of the computer, which few undergraduates had encountered before, caused extreme fatigue and resulted in less engagement during RL classes. The fatigue may be more critical for students characterized by attention difficulties.

We found that university students reported less engagement in RL classes than did college students. We did not expect universities and colleges to differ, as both types of institutions in Israel provide a bachelor's degree, and we had no basis for assuming that a difference existed. The difference between colleges and universities in Israel is usually class size. In colleges, classes are smaller than at the university, students are less anonymous, and the learning is more intimate than at the university. It may be that this environment affects the interaction between students and instructors, causing the students to feel more comfortable and possibly more committed to learning, and therefore more engaged in RL. This finding requires further investigation to examine the characteristics of colleges that may contribute to engagement during RL.

In conclusion, our findings show that students in general report a decrease in their ASE during RL, regardless of being LD/ADHD, probably due to sudden change in learning environment. In addition, the lower reported ASE by students with LD/ADHD is supported by previous research, showing that attention difficulties and study skills may play an important role in ASE to cognitive operations of students with ADHD only or LD + ADHD. More specifically, the findings that efficacy to cognitive operations is related with ADHD (only ADHD, or as comorbid) show that attention difficulties that these two groups share in common, combined with the need to concentrate for a long time in RL classes, affected their efficacy to learning activities such as learning in-depth academic subjects, listening to a learned subject, or concentrating in exams or in academic tasks that follow RL class. These results may suggest that support is needed in sudden changes in the learning methods. The support may be essential to students who are reported as ADHD or LD + ADHD.

The higher efficacy to RL of students with LD only could potentially indicate that students with LD differ in their study needs. The RL environment may provide flexible and self-paced learning for students with LD that fosters their efficacy to study.

Finally, higher ASE in social interactions was related to engagement in RL more than other subscales of ASE. It may be that social interaction during learning was a way of directing attention to engagement in learning, and therefore, students who perceived themselves to have higher ASE to social interactions were more engaged. Another explanation may be a possible shared common variability of efficacy to social interactions and engagement. This point should be further examined by an in-depth study.

There is limited experience with online RL and teaching that entirely replaces conventional face-to-face classes. Because RL is likely to stay with us and be integrated in many undergraduate studies, these results should be further examined to determine the best practices for online RL and for ADHD populations in particular.

Implications for practice

The results of the present study suggest that institutions of higher education should accommodate additional types of online teaching methods to support effective learning for their students in general, and for students with LD and ADHD in particular. Because

engagement may be important for learning outcomes (academic achievements) in RL, educators should apply a range of teaching methods to adapt learning to the challenges faced by students with attention difficulties, particularly to populations with disabilities. The results of the current study call for using different ways of fostering engagement in class. Increasing engagement may lead to better achievement and reduce dropout from higher education institutions.

Limitations

The study had several limitations. First, LD and ADHD were indicated by the self-report of students, based on them having been diagnosed by a professional such as psychologist or neurologist in the five years preceding the study. Because of confidentiality laws in Israel, we were not able to ask for confirmation of the specialist who diagnosed them.

Second, the comparison between ASE in face-to-face and RL learning was conducted on a different sample of students that was assembled before COVID-19 (pre-COVID). Ideally, this comparison would have been a longitudinal one, involving the same group of participants. But because students in Israel spend three years acquiring a BA degree in a college or university, most of the pre-COVID participants were probably no longer BA students at the time of COVID-19.

Third, the group that we examined before COVID-19 was a combined LD/ADHD group; therefore, it was possible to compare the unique change over time between specific groups of LD, ADHD, and comorbid LD + ADHD participants. It should be considered that the groups of LD, ADHD, and comorbid LD + ADHD may perform differently in face-to-face learning as well. We were not able to examine this difference because the specific diagnosis was not reported in pre-COVID sample. Future studies should classify participants into specific groups of disability.

We acknowledge the higher ratio of female students with LD/ADHD in both pre-COVID and COVID-19 groups, which probably represents the compliance ratio of women in surveys. This ratio does not reflect the higher ratio of male individuals generally found among the LD/ADHD population. However, it should be taken into consideration when interpreting the results for both gender groups.

One of the subscales of ASE measured in the study was technical ASE. Because of low reliability between its items, only one item could be included in the analyses. The examination of technical ASE may be an important component especially during a shift to emergency RL. Future studies should examine in depth the contribution of technological ASE to engagement in class of students with LD/ADHD.

Declarations

Conflict of interest The authors declare no competing interests.

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Miriam Sarid

Current themes of research and most relevant publications:

My current themes of research relate to students in higher education and students with learning disabilities in higher education.

Higher education is essential for young people who build their future, which enables better occupation and higher income. Barriers to higher education and variables that are related to achievements may influence students' achievements and dropout from college/university. I study the factors that may be related to dropout from college/university and/or achievements, in general population of students and in students with learning disabilities and/or ADHD. Among these are academic and cognitive factors such as achievements and literacy (Sarid et al., 2020; Sarid et al., 2021; Sarid et al., 2022), motivational factors and self-efficacy, emotional factors such as adjustment to higher education (Lipka et al., 2020; Lipka & Sarid, 2020), and background characteristics.

Taken it all together, this field of research indicates the contribution of cognitive, motivational, academic, emotional, and demographic factors to learning in higher education.

Publications

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Orly Lipka

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