THE APO
The Official Research Journal of Gordon College

Volume 5, Issue 1
January to December 2022
ISSN: 2546-1745

IMPACT OF COMPUTER-ASSISTED INSTRUCTION (CAI) TO THE BSED-SCIENCE STUDENTS' ENGAGEMENT AND LEARNING EXPERIENCES AMIDST COVID-19 PANDEMIC

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ABSTRACT

This study determined the impact of Computer-Assisted Instruction (CAI) on students' learning experiences and engagement amidst COVID-19. A descriptive research method was utilized. It was revealed that CAI tools improve teacher-student communication and the students' learning outcomes. There was a significant difference in students' learning experiences in terms of Faculty-Student interaction, student content, and Student Character when grouped according to Year Level and Age. In Faculty-Student Interaction, the learning experiences of 3rd-year students from age bracket of 18-20 significantly differ from 1st and 2nd year and from 21 and above age group, respectively. In terms of student content, students from the age group of 18-20 significantly differ from students under 21 and above. In Student Character, the learning experiences of 1st and 2nd year and from 18-20 age group are better than those of the 3rd year students and from the age group of 21 and above, respectively. Additionally, there were significant differences in the students' engagement when grouped according to year level and age. The study recommends conducting CAI Training Programs further to capacitate the instructors, as well as students, to improve the teaching-learning process despite the implementation of Distance Learning due to COVID-19.

Keywords: Computer-Assisted Instruction, Learning Experiences, Students' Engagement, COVID-19, Behavioral Engagement, Cognitive Engagement, Affective Engagement

How to cite: Obispo, K.P.C., Yap, J.M., Caliboso, F., Niduaza, M.D., Udan, R.J. (2022). Impact of computer-assisted instruction (CAI) to the BSEd-Science students' engagement and learning experiences amidst COVID-19 pandemic. *The APO, 5*(1), 77-97. https://zenodo.org/doi/10.5281/zenodo.10799079

INTRODUCTION

The COVID-19 pandemic has altered the course of history. Due to the nature of the virus, residents were instructed to stay at home and non-essential establishments, public transportation, malls, and even schools and universities were closed. This greatly affected

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the delivery of quality education to the students as face-to-face interaction and traditional classroom settings were prohibited. Higher education institutions (HEIs), both public and private, have also had to adjust to the new situation by finding innovative ways to pursue education, research, and service (Simbulan, 2020). To address the situation, the Commission on Higher Education (CHEd) implemented Flexible Learning to ensure the continuity of inclusive and accessible education. Flexible learning is a pedagogical strategy that allows for time, place, and audience flexibility, including, but not limited to, the use of technology.

Though CHEd and the Department of Education (DepEd) have already pursued the integration of Information and Communications Technology (ICT) in the school curriculum (Dap-og, Orongan, 2021) before the pandemic, the course syllabus and requirements were transitioned to flexible teaching and learning modalities which made the students and teachers heavily relied more on the use of ICT. This ICT has been integrated into a variety of ways in the teaching-learning process, such as Computer Assisted Instruction (CAI), to facilitate students' learning (Dap-og, Orongan, 2021).

Among other disciplines, science requires a lot of visualizations and experiments. Due to the situation, teaching science to students has become a challenge. Virtual laboratory simulation websites, software and other computer applications have been used as CAI tools in providing activities to represent abstract ideas. Physics Education Technology (PhET), Amrita Virtual Laboratories, interactive PowerPoint presentations, and video lectures are just some of these CAI tools. Several studies have provided evidence of CAI's effectiveness in instruction in promoting students' interest and academic achievement (Chinwendu & Patience, 2017).

There are four interactions necessary for effective online education which was adopted from Moore's Transactional Distance Theory, which explains that "distance education is not just a geographic separation of students and professors; it is, more crucially, a pedagogical concept (Culatta, 2018). These interactions include Faculty-student, Student-content, Student-student, and Student Character, which were used in this study to describe the learning experiences of the students. Students' engagement, on the other hand, was also categorized into three dimensions: Behavioral, Affective, and Cognitive.

Interaction between instructors and learners is a critical element in the learning process during an online course. In the context of online education, effective teacher-student interaction is a prerequisite for deep learning, according to other researchers as well (Mu & Wang, 2019); it is the most important aspect of the online learning environment (Jiang, et al., 2019). Moore (1989) defined student-content interaction as "the process of intellectually interacting with content that results in changes in the learner's understanding, the learner's perspective or the cognitive structures of the learner's mind" and characterized it as "the defining characteristic of education." In a traditional classroom set-up, student-student interaction occurs face-to-face. However, in online distance learning, this type of interaction occurs digitally or virtually through email, instant messaging applications, and various social media platforms and even in virtual simulations. According to the study conducted by Nwanko (2015), one variable of transactional distance that influences students' learning experiences is the personalities

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of students themselves and an important component of personality for distance learners is autonomy or the ability to work independently.

The concept of engagement is frequently used in education to explain a range of actions that students take in the classroom. According to researchers, the notion of student engagement is still vague and there isn't a clear consensus on how to assess it. (Boekaerts, 2016). Fredricks et al. (2004) typology of student engagement suggests that there are three types of engagement: Behavioral, Cognitive, and Affective or Emotional.

According to the National Association of Social Workers Press and Oxford University Press, behavioral theory seeks to explain human behavior by analyzing the antecedents and consequences present in the individual's environment and the learned associations he or she has acquired through previous experience (Angell, 2013). According to Fredricks et al. (2004), behavioral engagement refers to a student's actions while completing a learning assignment, including their effort, persistence, and contribution to their own learning. Recent research has characterized behavioral engagement as student involvement, effort, attention, persistence, and positive behavior toward the learning activity (Fredricks et al., 2016). Second, the affective theory of mind has three subcomponents of executive functions (inhibition, updating, and shifting). Affective theory of mind was positively related to age, and all three executive functions (Vetter, 2013). Student involvement is influenced by a number of affective factors, such as attitude, personality, motivation, effort, and self-confidence (Mandernach et al., 2011).

By evaluating the level of student engagement and considering these affective aspects, instructors can more effectively plan lessons and activities that will encourage students to be more active participants in their learning and coursework (Jennings & Angelo, 2006; Mandernach et al., 2011). Then, Cognitive theories of multimedia learning tend to focus on instructional methods aimed at reducing extraneous processing. While motivational theories frequently concentrate on instructional strategies designed to promote generative processing, they tend to place less emphasis on managing necessary processing (such as splitting a lesson into sections) or managing essential content. (such as adding appealing graphics or challenging scenarios) (Mayer, 2014). Cognitive engagement is defined as the students' level of investment in learning; it includes being thoughtful and purposeful in the approach to school tasks and being willing to exert the effort necessary to comprehend complex ideas or master difficult skills (Fredricks, 2004). Cognitive engagement includes thinking deeply and broadly about concepts while using strategies such as organization, rehearsal, and elaboration as well as regulating and managing the learning process (Hidayah et al., 2021)

Hence, this study was conducted to describe the impact of Computer Assisted Instruction to the learning experiences and engagement of 1st, 2nd and 3rd year students from the Bachelor of Secondary Education- Major in Science amidst the pandemic.

RESEARCH METHODOLOGY

Research Design

This study used the descriptive method of research. A descriptive study systematically describes the facts and characteristics of a given population or those that are of interest,

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factually and accurately (Bueno, 2006). It is concerned with the conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing (Best & Kahn, 2009). The purpose of this study is to collect information that describes existing phenomena; identify problems or justify current conditions and practices, and make comparisons and evaluations (Bueno, 2006). The methodology used in this study is the survey research. Survey research obtains data to determine and summarize the specific characteristics of individuals or groups or physical environments (Fraenkel & Wallen, 2012). Here, the researchers used a survey questionnaire to collect data and to assess the impact of Computer-Assisted Instruction on the BSEd-Science Students' Learning Experiences and Engagement. This involves asking the same set of questions to the chosen respondents via Google Forms. Thus, the main purpose and reason of the study is to determine the impact of Computer-Assisted Instruction on the BSEd-Science students' learning experiences and engagement.

Respondents

The respondents of this study were the BSEd-Science 1st, 2nd, and 3rd-year students, who are currently enrolled at Gordon College, Olongapo City for the Academic Year 2021-2022. The researchers used non-probability sampling. Non-probability sampling is a sampling procedure that will not bid a basis for any opinion of probability that elements in the universe will have a chance to be included in the study sample (Etikan & Bala, 2017). In particular, the non-probability sampling used in the study was purposive sampling. Purposive sampling is when a researcher chooses respondents based on their personal viewpoint of who will be the most representative or useful (Polit and Beck, 2006). The researchers may choose individuals who are thought to be representative of the general population or who are particularly knowledgeable about the issues under research. In this study, the researchers believe that the students of Bachelor of Secondary Education-Major in Science were suitable respondents for the research as they were exposed to Computer-Assisted Instruction which includes the utilization of virtual laboratory simulations and video lectures during the implementation of Flexible Learning. The researchers ensure that the participants possess the desired information and that they are all willing to answer the questions.

Validation of the Instrument

To ensure the reliability of the instrument, the questionnaire was validated by the experts, specifically the teachers engaged in teaching Science and Research courses, and piloted to 30 students from the College of Education, Arts and Sciences in Gordon College. Pilot testing was done to test the research approach with a small number of participants before conducting the main study (Wright & So, 2022). This aims to improve some of the items in the instrument. It will be judged if the questionnaire is fully understood and accepted based on the results of the dry run.

The data gathered from the pilot testing was statistically treated to generate Cronbach alpha values to measure the internal consistency and reliability of the Likert Scale questions. Results of the reliability test indicated "Acceptable" (0.772) Cronbach's alpha values for: Faculty-Student (0.700, Acceptable), Student-Content (0.701, Acceptable),

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Student-Content (0.904, Excellent), Student Character (0.762, Acceptable), Behavioral Engagement (0.772, Acceptable), Cognitive Engagement (0.831, Good), and Affective Engagement (0.734, Acceptable).
The experts' comments were also taken into account. Before administering the final draft of questionnaires, the revised instrument was sent to the adviser for feedback and suggestions.

Statistical Analysis

The study underwent statistical analysis with the aid of SPSS 20. The statistical tools used in the computation were frequency, percentage, and mean for the descriptive part. For the inferential statistics, the study used t-test and Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

This part of the study presents the data in tabular form, the analysis and corresponding interpretation to answer specific problems posited. It includes the profile of the respondents, most used CAI Tools and differences of the variables and the implications of the learning experiences and students' engagement on Computer-Assisted Instruction (CAI).
The profile of the respondents was described in terms of Sex, Year Level, Age, and Internet Connectivity, and Computer Ownership.

Table 1. Profile of the Respondents

Profile	Frequency	Percentage
Sex		
Female	25	50
Male	25	50
Year Level		
1st	18	36
2nd	14	28
3rd	18	36
Age		
18-20	31	62
21 and above	19	38
Internet Connectivity		
Mobile Data	27	54
Broadband	23	46
Others	13	26
Computer Ownership		
Yes	32	64
No	18	36
Total	50	100

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Table 1 shows the profile of the respondents. It can be seen in the table that there are 25 (50%) female students and 25 (50%) male students in the BSEd-Science. For year level, majority are from 1st year and 3rd year both with 18 respondents and 14 respondents for 2nd year. Majority of the respondents are 18-20 years old with 31 (62%) respondents. About 54% of the students used mobile data and 64 % or 32 respondents owned a computer.

Table 2. Most Commonly Used CAI Tools

CAI Tools	Frequency	Percentage
Gordon College Learners Academic Management Portal	48	96
Google Classroom	49	98
Zoom	9	18
Google Meet	50	100
Powerpoint Presentations	48	96
Video Lectures	34	68
Schoology	18	36
Quizizz	19	38
PhET virtual simulations	19	38
Amrita virtual simulations	36	72
Physicsclassroom simulations	17	34
Labster virtual simulations	4	8
Praxilabs	1	2

The most used CAI tools of the respondents are presented in the table above. As reflected, all, or 100.0% of the respondents chose “Google Meet” as the CAI tool they commonly use during their Science classes. The said CAI tool is where real-time meetings occur, where students and teachers can share videos, desktops, and presentations during discussions. This implies that Google Meet is the most used application/website by BSEd-Science students in conducting online classes or discussions during the pandemic.

Followed by “Google Classroom” where learners can access the materials given by their instructor, which is equivalent to 98.0 percent. Then 48 or 96 percent of the respondents selected “Gordon College Learners' Academic Management Portal (GCLAMP)” and “Powerpoint Presentations.” Followed by those who use ”Amrita virtual simulations” which is equivalent to 72.0 percent. Followed by respondents who use “Video lectures” which is equivalent to 68.0 percent. There were 19 or 38.0 of the respondents who selected “PhET virtual simulations” and “Quizizz.” Followed by “Schoology” which was chosen by 18 or 36.0% of the respondents. There were 17 or 34.0% of the respondent who selected “Physicsclassroom simulations.” Followed by “Zoom” which was chosen by 9 or 18.0% of the respondents. “Labster virtual simulations” and “Praxilabs” are the two least chosen CAI tool which were selected by 4 or 8% and 1 or 2% of the respondents, respectively.

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Table 3. Learning Experience through Different Interactions

Interaction	Mean	Descriptive Interpretation
Faculty- Student	3.05	Respondents have good learning experience.
Student- Content	3.16	Respondents have good learning experience.
Student- Student	3.00	Respondents have good learning experience.
Student- Character	3.12	Respondents have good learning experience.
Average	**3.08**	**Respondents have good learning experience.**

Table 3 presents that respondents have good learning experiences from CAI in terms of Faculty-Student, Student-Content, Student-Student, and Student-Character with weighted means of 3.05, 3.16, 3.00, and 3.12, respectively. In a face-to-face classroom setting, instructors are the one who lectures, questions, guides and responds to students' needs. However, distance learning limits the interaction between the students and the instructors. However, instructors can design online courses that enable them to interact with and teach students in meaningful ways to move them toward learning goals and begin thinking in new and more profound ways (York & Richardson, 2012).

Table 4. Level of Student Engagement

Student Engagement	Mean	Descriptive Interpretation
Behavioral	2.96	Respondents agreed that CAI improved their engagement.
Cognitive	3.02	Respondents agreed that CAI improved their engagement.
Affective	3.06	Respondents agreed that CAI improved their engagement.
Average	**3.01**	**Respondents agreed that CAI improved their engagement.**

Among the three levels of engagement, Affective Engagement had the highest average mean of 3.06, followed by Cognitive Engagement with an average mean of 3.02, and Behavioral Engagement with an average mean of 2.96. This implies that majority of the respondents are affectively or emotionally engaged towards CAI.

Dap-og and Orongan also found the same findings (2021). Bennett and Thompson's (2011) findings support that students' engagement is at higher levels in which interaction, hands-on activities, and science applications occur in the teaching-learning process. This study's results are in line with Cupida (2014) and Vegafria (2016) that the integration of multimedia learning as an instructional approach is effective in enhancing student engagement and developing a positive attitude toward learning. Cupida (2014) supports that computer-assisted instruction has improved student engagement, which has been affected by their exploration of technology applications (Mahmood, 2006).

According to a literature review conducted by Schindler et. al. (2017), most of the technologies they had reviewed (Web-conferencing, Blogs, Wikis, Facebook, Twitter, and Digital Games) had a positive influence on multiple indicators of student engagement. For instance, digital games influence all three types of student engagement. First, digital games were designed to provide authentic learning contexts in which students could

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practice skills and apply learning (Cognitive), which is consistent with experiential learning and adult learning theories. Second, students reported that digital games (and gamified elements) are fun, enjoyable, and interesting (Affective). Third, digital games were closely integrated into the curriculum as required activities (Behavioral). This is in line with the study of Dap-og and Orongan (2021) where the results showed that the students' engagement with computer-assisted instruction favored the three domains where they also suggested that the integration of CAI as a promising approach in science teaching would promote positive cognitive, affective, and behavioral learning outcomes; students may be exposed to well-planned CAI to develop active learning experiences further.

Table 5. Differences in the Learning Experiences when grouped According to Sex

Learning Experiences	Sex	M	SD	*t*-value	*p*-value
Faculty-Student	Male	3.0320	.70162	-.238	.813
	Female	3.0720	.46504		
Student-Content	Male	3.1200	.53229	-.522	.604
	Female	3.1920	.43772		
Student-Student	Male	3.0160	.55952	.253	.801
	Female	2.9760	.55773		
Student-Character	Male	3.0480	.57816	-.877	.385
	Female	3.1840	.51614		

Note: df=49

Table 5 implies that sex had no effect on the learning experiences of BSEd-Science from Computer-Assisted Instruction. This can be supported by Margolis and Fisher (2002) who suggested that online learning environments are gender-neutral and provide a democratic and equal environment. The study by Korlat et al. (2021) showed that there were no differences between boys and girls in competence beliefs in digital learning, indicating that they had equal levels of perceived abilities in digital learning. Their study further revealed the equality between boys and girls with respect to managing digital learning using technologies and technical equipment to complete their school tasks and comprehension of tasks performed in a digital learning format. There were also studies suggesting that there were no differences between boys and girls in attitudes toward digital learning (Cuadrado-García et al., 2010; Hung et al., 2010) or in average ICT participation and motivation (Cuadrado-García et al.,2010). In contrast, some studies had revealed that one sex have an advantage from the other. Ashong and Commander (2012) suggested that boys may have an advantage over girls in the online classroom solely based on their higher perceived ability, comfort, and engagement with computers. Perkowski (2013) revealed in a meta-analysis of university students that there was a higher competence belief regarding learning in digital settings in young women compared to young men. Furthermore, it has been found that individuals high on both masculinity and femininity—androgynous individuals—are more flexible and adaptable to different situations, as they possess a broader repertoire of traits and behaviors (Pauletti et al., 2017).

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Table 6 shows that in Faculty-Student Interaction, *F*=5.130, *p*= .10. As the *p*-value is less than .05, it is safe to assume that there is a significant difference between the learning experiences of 1st, 2nd and 3rd-year students in terms of Faculty-Student interaction.

A post hoc test revealed that 1st and 2nd-year BSEd- Science students' learning experiences in terms of Faculty-Student Interaction are significantly higher or better than those of the 3rd-year students. These findings imply that instructors should make use of the wide variety of strategies to promote positive emotions in students to facilitate the learning process and make sure that there is a responsive, friendly, gender-sensitive, safe, and motivating learning environment despite of distance learning modalities (Dap-og & Orongan, 2021).

Table 6. Differences in the Learning Experiences when grouped According to Year Level

Learning Experiences	Sex	M	SD	*F*-value	*p*-value
Faculty-Student	1st Year	3.30	.430	5.130*	.010
	2nd Year	3.14	.447		
	3rd Year	2.73	.696		
Student-Content	1st Year	3.23	.419	1.503	.233
	2nd Year	3.26	.426		
	3rd Year	3.00	.566		
Student-Student	1st Year	3.04	.478	1.360	.267
	2nd Year	3.14	.535		
	3rd Year	2.83	.622		
Student-Character	1st Year	3.21	.457	6.927*	.002
	2nd Year	3.41	.461		
	3rd Year	2.79	.542		

*Note: *p < .05*

In terms of Student-Content interaction, *F*=1.503, *p*= .233. The *p*-value is greater than 0.05, hence, there is no significant difference between the learning experiences of 1st, 2nd, and 3rd-year students in terms of Student-Content Interaction.

In terms of Student-student interaction, *F*=1.360, *p*= .267. As the p-value is greater than 0.05, there is no significant difference between the learning experiences of students from different year level in terms of Student-student interaction.

In terms of Student character, *F*=6.927, *p*= .002. The obtained *p*-value is less than .05, thus, there is a significant difference between the learning experiences of students from different year level in terms of Student Character.

A post hoc test revealed that 1st and 2nd-year BSEd- Science students' learning experiences in terms of Student Character are significantly higher or better than those of the 3rd-year students. These findings may be attributed to the longer period spent by 3rd-year students in online distance learning compared to the 1st and 2nd-year students. The result further implies that 3rd-year students may have felt discouraged and inefficient.

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According to Avila et al. (2021), freshmen student respondents revealed that distance learning is excellent and essential. Similarly, they were inspired to use educational technologies and often used various learning techniques during the COVID-19 pandemic. This is in contrast with Harefa et al. (2021) where it was revealed that students' perception in online learning is less effective, and less comfortable and they were not motivated and enthusiastic about online learning.

Table 7: Difference between Respondents' Learning Experiences in terms of Age

Learning Experiences	Age	M	SD	*t*-value	*p*-value
Faculty-Student	18-20 years old	3.23	.506	2.975*	.005
	> 21 years old	2.76	.609		
Student-Content	18-20 years old	3.26	.454	2.095*	.041
	> 21 years old	2.98	.489		
Student-Student	18-20 years old	3.07	.494	1.230	.225
	> 21 years old	2.87	.633		
Student Character	18-20 years old	3.26	.480	2.593*	.013
	> 21 years old	2.87	.574		

*Note: *p < .05; df=49*

Table 7 shows that there is a significant difference in the learning experiences between age groups in terms of Faculty-Student interaction. The *t*-value of 2.975 with the corresponding probability value of .005 is significant at alpha .05. The mean difference of 0.47436 is in favor of the students from the age group of 18-20 years old. This means that there is a sufficient sample evidence to prove that the students from the younger age group have better learning experiences from Computer-Assisted Instruction than students from the older group in terms of Faculty-Student interaction.

There is a significant difference in the learning experiences between age groups in terms of Student-content interaction. The *t*-value of 2.095 with the corresponding probability value of .041 is significant at alpha .05. The mean difference of 0.28557 is in favor of the students from the age group of 18-20 years old. This means that there is a sufficient sample evidence to prove that the students from the younger age group have better learning experiences from Computer-Assisted Instruction than students from the older group in terms of Student-content interaction.

There is no significant difference in the learning experiences between age groups in terms of Student-student Interaction. The *t*-value of 1.230 with the corresponding probability value of .225 is insignificant at alpha .05. The mean difference of 0.19728 is in favor of the students from the age group of 18-20. This means that there is no sufficient sample evidence to prove that the students from the age range of 18-20 have better learning experiences from Computer-Assisted Instruction than the students from 21 and above age group in terms of Student-student interaction.

There is a significant difference in the learning experiences between age groups in terms of student character. The *t*-value of 2.593 with the corresponding probability value of .013 is significant at alpha .05. The mean difference of 0.39083 is in favor of the students from

the age group of 18-20 years old. This means that there is a sufficient sample evidence to prove that the students from the younger age group have better learning experiences from Computer-Assisted Instruction than students from the older group in terms of Student character.

A study conducted by Simonds and Brock (2014) showed that different age groups respond differently to online learning methods, which can also be supported by Morin et al. (2019), where older students found asynchronous forms of learning such as pre-recorded video lectures to be useful learning activities and younger students preferred interactive learning, such as; live chats and group projects. Koh and Lim (2012) reported a similar finding for younger students in their study. Also, offering older students a blend of synchronous and asynchronous activities in a course will appeal to their comfort level while also exposing them to new ways of learning. Younger students will also benefit from this blended approach as they learn how to use digital tools for the purpose of academic learning (Simonds & Brock, 2014).

Age is certainly an important factor to consider when designing online courses. Morin et al. (2019) revealed that students in the older category are more enthusiastic about participating in online learning as they feel that they have stronger self-efficacy and better mental readiness. In this regard, course designers and instructors are suggested to design effective online teaching strategies that can be used with any age group and execute the course considering the ease of use and guided pedagogy implemented in the online learning website with dynamic and interactive activities that connect students to students to teachers to content (Morin et al., 2019).

Table 8. Difference between Respondents' Learning Experiences in terms of Internet Connectivity

Learning Experiences	Internet Connectivity	M	SD	*F*-value	*p*-value
Faculty-Student	Mobile Data	3.10	.533	0.012	.988
	Broadband	3.08	.732		
	Others	3.08	.412		
Student-Content	Mobile Data	3.10	.469	0.689	.506
	Broadband	3.23	.539		
	Others	3.28	.428		
Student-Student	Mobile Data	3.08	.465	1.171	.317
	Broadband	2.89	.670		
	Others	3.17	.565		
Student Character	Mobile Data	3.10	.558	0.708	.497
	Broadband	3.11	.544		
	Others	3.31	.507		

Presented in Table 8 that in Faculty-Student Interaction, F= 0.012, p= .988. The generated probability value is greater than .05. There was no significant difference between the learning experiences of students in terms of internet connectivity from faculty-student interaction.

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In terms of Student-Content interaction, *F*= 0.689, *p*= .506. As the probability value was greater than .05, no significant difference was seen between the learning experiences of students in terms of internet connectivity from student-content interaction.

In terms of student-student interaction, *F*= 1.171, *p*= .317, wherein the probability value was greater than .05, there is no significant difference between the learning experiences of students in terms of internet connectivity from Student-Student Interaction.

In terms of student character, the study got *F*= 0.708, *p*= .497 with the p value greater than .05. It is safe to conclude that there was no significant difference between the learning experiences of students in terms of internet connectivity from Student Character. Internet connectivity has improved and is available everywhere such as homes, offices, and schools. The availability of the internet is almost everywhere and most students have had access to internet on their cellphones (Ellore, 2014).

In a study conducted by Asio et. al. (2021), it was revealed that 98% of the 2,894 student-respondents, of the same institution, have internet access, where 70% of them have internet access in their homes. This further supports that most of the students are capable to open and engage in the CAI tools being used as they have internet access, whether it is through mobile data, broadband, or other types of connection. These findings, however, may argue the results of a study conducted by Belgica et. al. (2020) where students cited internet connectivity as one of the major challenges in their online distance learning.

Table 9. Difference Between Respondents' Learning Experiences in terms of Computer Ownership

Learning Experiences	Computer Ownership	M	SD	*t*-value	*p*-value
Faculty-Student	Yes	3.03	.654	-0.428	.670
	No	3.10	.467		
Student-Content	Yes	3.16	.527	0.125	.901
	No	3.14	.410		
Student-Student	Yes	2.96	.581	-0.674	.504
	No	3.07	.509		
Student Character	Yes	3.08	.598	-0.703	.488
	No	3.19	.447		

Note: df= 49

In Table 9, the result shows that there is no significant difference in the learning experiences between Computer and non-computer owners in terms of Faculty-Student interaction. The *t*-value of -0.428 with the corresponding probability value of .670 is insignificant at alpha .05. The mean difference of -0.075 is in favor of the non-computer owners. This means that there is no sufficient sample evidence to prove that non-computer owners have better learning experiences from Computer-Assisted Instruction than Computer owners in terms of Faculty-Student interaction.

There is no significant difference in the learning experiences between Computer and non-computer owners in terms of Student-Content Interaction. The *t*-value of 0.125 with the corresponding probability value of .901 is insignificant at alpha .05. The mean difference

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of 0.018 is in favor of the computer owners. This means that there is no sufficient sample evidence to prove that computer owners have better learning experiences from Computer-Assisted Instruction than non-computer owners in terms of student-content interaction.

There is no significant difference in the learning experiences between Computer and non-computer owners in terms of Student-Student Interaction. The *t*-value of -0.674 with the corresponding probability value of .504 is insignificant at alpha .05. The mean difference of -0.11 is in favor of the non-computer owners. This means that there is no sufficient sample evidence to prove that non-computer owners have better learning experiences from Computer-Assisted Instruction than Computer owners in terms of student-student interaction.

There is no significant difference in the learning experiences between Computer and non-computer owners in terms of Student Character. The *t*-value of -0.703 with the corresponding probability value of .488 is insignificant at alpha .05. The mean difference of -0.114 is in favor of the non-computer owners. This means that there is no sufficient sample evidence to prove that non-Computer owners have better learning experiences from Computer-Assisted Instruction than Computer owners in terms of student character. These findings imply that Computer ownership had no effect to the learning experiences of BSEd-Science students. This might be attributed to the availability of other devices that they can use to attend online classes. The studies conducted by Asio, et. al. (2021) and Belgica et. al. (2020) showed that the majority of their student-respondents were using smartphones, and some use tablets, aside from laptops and personal computers. Today's mobile devices, such as tablets and smartphones, are designed to be portable and can function to do many of the same things people would normally do on a desktop or laptop computer (GCFglobal.org).

Table 10. Difference in the Level of Engagement in terms of Sex

Level of Engagement	Sex	M	SD	*t*-value	*p*-value
Behavioral	Male	2.94	.460	-0.259	.797
	Female	2.98	.414		
Cognitive	Male	3.05	.636	0.389	.699
	Female	2.98	.523		
Affective	Male	3.02	.603	-0.463	.646
	Female	3.10	.619		

Note: df=49

The level of engagement when grouped according to sex is shown in Table 10. It is divided into three categories such as Behavioral, Cognitive, and Affective which appears to be insignificant when according to Sex through a *t*-test.

There is a probability value of .797 for Behavioral; .699 in Cognitive; and .646 for Affective which are all insignificant at alpha .05 which means that there is no significant difference between male and female in terms of their level of engagement. The data reveals that

there is not enough evidence to prove that Sex affects the level of engagement of the learners.

This is in contrast with the study of Amir et al. (2014) where there was a significant difference between males and females in relation to affective and behavioral engagement, while there was no significant difference between males and females in terms of cognitive engagement level. Their findings showed that female students are more emotionally engaged on learning tasks than male students. Their study also presented additional support for the teacher's role in relation to students' emotional development. Supportive, caring, and emotionally available teachers can have students feel a sense of belonging and consequently get engaged in the process of learning (Reyes et al., 2012). It was suggested that teachers should look for ways to make the class atmosphere attractive for students of both genders.

Hollister et al. (2022) gathered that instructors could be using engagement strategies more often to match students' enthusiasm for those strategies, such as chat features and polls. Their research also presented evidence that online learning can be engaging for students with the right tools.

Table 11. Difference in the Level of Engagement in terms of Year Level

Learning Experiences	Sex	M	SD	*F*-value	*p*-value
Behavioral	1st Year	3.02	0.328	3.833*	.029
	2nd Year	3.14	0.388		
	3rd Year	2.76	0.493		
Cognitive	1st Year	3.17	0.641	3.115	.054
	2nd Year	3.16	0.438		
	3rd Year	2.76	0.538		
Affective	1st Year	3.24	0.507	4.952*	.011
	2nd Year	3.24	0.438		
	3rd Year	2.72	0.686		

*Note: *p < .05*

Table 11, the level of engagement of the students are examined to determine the significant difference in terms of year level through the Analysis of Variance (ANOVA) test. The data shows that there is a significant difference when it comes to behavioral and affective, with probability values of .029 and .011, respectively.

In behavioral engagement, $F = 3.833$, $p = .029$. As the p-value is less than .05, there is a significant difference between the engagement of 1st, 2nd, and 3rd year students in terms of the behavioral domain. A post hoc test revealed that 1st and 2nd-year BSEd-Science students' engagement in terms of the Behavioral domain is significantly higher than those of the 3rd-year students.

However, the cognitive level of engagement remains insignificant with a probability value of .054 which indicates the year level does not affect the cognitive level of engagement of the learners.

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In affective engagement, *F*= 4.952, *p*= .011. As the probability value was less than .05, there is a significant difference between the engagement of 1st, 2nd, and 3rd year students in terms of the affective domain. A post hoc test revealed that 1st and 2nd year BSEd-Science students' engagement in terms of the Affective domain is significantly higher than that of the 3rd year students.

These findings might be associated with the postponement of science courses which were supposedly done on a face-to-face set-up such as practical laboratory works and experiments. As the execution of laboratory works and practical was postponed due to COVID-19, this resulted in the lack of motor skills experiences, less chance of direct consultation with the instructors, and less practical assignments (Amir et al., 2020) that can lead to students being less engaged.

The study of Avila et al. (2021), conducted at the time of the COVID-19 Pandemic, showed that freshmen students perceived that distance learning is good and is necessary for their degrees and despite the sudden shift in the teaching modalities from the traditional classroom setup, the students often utilize educational technologies as they are often motivated to join their online classes.

In a study by Amir et al. (2020), among dental students who preferred distance learning, the percentage of freshman students was significantly higher than the of seniors. According to Amir et al. (2020), one factor that contributes to this finding might be related to the curriculum implemented at the time of the study. Senior students learned more courses that involve both theory and procedural knowledge and skills which essentially required laboratory skill sessions to enhance the understanding of the learned subjects. The curriculum of first-year students studied more basic science courses which are mostly conceptual theories so that the content knowledge acquisition could still be reinforced by laboratory activities based on online tutorials and exercises in the form of videos or photographs. However, it was also revealed that more students felt lower learning satisfaction and more difficulty communicating either with instructors or with peer students during distance learning due to COVID-19.

Table 12. Difference in the Level of Engagement in terms of Age

Level of Engagement	Age	M	SD	*t*-value	*p*-value
Behavioral	18-20 years old	3.04	.370	1.670	.101
	> 21 years old	2.83	.504		
Cognitive	18-20 years old	3.16	.557	2.381*	.021
	> 21 years old	2.78	.541		
Affective	18-20 years old	3.26	.512	3.301*	.002
	> 21 years old	2.73	.615		

*Note: *p < .05*

Table 12 shows the data on the learners' level of engagement in terms of Age. In the Behavioral domain, there is no significant difference in engagement between age groups. It has a probability value of .101 which is insignificant at alpha .05 which indicates that age does not affect the behavioral level of engagement of the respondents. This means

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there is no sufficient sample evidence to prove that the students from the younger age group are more engaged than students from the older group in terms of affective domain. There is a significant difference in the engagement between age groups in terms of cognitive level of engagement. The *t*-value of 2.381 with the corresponding probability value of .021 is significant at alpha .05 significance level. This is in favor of the students from the age group of 18-20 years old. This means that there is sufficient sample evidence to prove that the students from the younger age group are more engaged than students from the older group in terms of the cognitive domain.

There is a significant difference in the engagement between age groups in terms of Affective level of engagement. The *t*-value of 3.301 with the corresponding probability value of .002 is significant at alpha .05. This is in favor of the students from the age group of 18-20 years old. This means that there is sufficient sample evidence to prove that the students from the younger age group are more engaged than students from the older group in the Affective domain.

Age is often associated with a decline in cognitive abilities (Clark et al., 2015). The study of Amir et al. (2014) found a significant difference in the three levels of engagement between students of different age groups. Their study revealed that students' engagement decreases as they grow older. Particularly, their data showed that as students grow older, their cognitive participation in class activity declines, which is in line with the results of the current study. The study suggested that teachers are supposed to be trained to learn how to give attention to all students regardless of their genders or ages.

CONCLUSION

Based on the findings, the following conclusions were drawn:

- The majority of BSEd-Science students are aged 18-20, use mobile data, and own a PC/laptop.
- The most frequently used CAI (Computer-Assisted Instruction) tools among these students are Google Meet, Google Classroom, GCLAMP, and PowerPoint Presentations. For virtual laboratory simulations, Amrita and PhET simulations are the top choices.
- Students' experiences with CAI indicate a preference for instructors using CAI over traditional methods, attributing to better teacher-student communication. CAI tools enhance memory recall, understanding, creativity, and competitiveness, promoting group activities. They also encourage self-driven learning, punctuality, flexibility, and efficiency.
- With respect to engagement, students are more attentive, undistracted, and proactive during CAI-based classes. They can relate content to real-life scenarios and are comfortable using various CAI tools. Most respondents are emotionally engaged during these sessions.
- Students' CAI learning experiences vary based on year level and age, especially in terms of faculty-student and student-content interactions. However, factors like

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Sex, Internet Connectivity, and Computer Ownership don't significantly affect their experiences.

- Engagement levels among students, categorized by Sex, Year Level, and Age, showed mixed results. Year Level affected behavioral engagement, Age influenced cognitive engagement, while both Year Level and Age impacted affective engagement. Sex had minimal influence on engagement metrics.

RECOMMENDATION

Based on the findings and conclusions, the following are recommended:

1. The College Administration and instructors should utilize the result of this study by giving full identification and understanding of the student's engagement and learning experiences from CAI to help them design innovative classroom activities and strategies to improve the teaching-learning process further.
2. Gordon College Instructors, as well as students, should continue attending to available Computer-related Training Programs to keep abreast with the latest trends and innovations in teaching and learning.
3. The government should take advantage of the respondents' and instructors' enthusiasm to bring technology into the classroom by providing them with the necessary tools and greater access to CAI-infused training programs.
4. Assistance should be extended to students who wish to acquire a personal computer or laptop to help build basic computer competence and ICT pedagogical skills.
5. Related research should be conducted to build on this study and examine the students' perception of CAI in learning Science, as well as their preferences and responses to the utilization of various CAI tools in the classroom.
6. Do more exploration regarding the topic further to enhance the validity and reliability of the study.

References

Amir, L. R., Tanti, I., Maharani, D. A., Wimardhani, Y. S., Julia, V., Sulijaya, B., & Puspitawati, R. (2020). Student perspective of classroom and distance learning during COVID-19 pandemic in the undergraduate dental study program Universitas Indonesia. *BMC medical education, 20*(1), 1-8.

Amir, R., Saleha, A., Mohd Jelas, zalizan, Ahmad, A. R., & Hutkemri. (2014). Students' Engagement by Age and Gender: A Cross-Sectional Study in Malaysia. Middle-East *Journal of Scientific Research, 21*(10), 1886-1892. https://doi.org/10.5829/idosi.mejsr.2014.21.10.85168

Angell, B. (2013). Behavioral theory. Encyclopedia of Social Work. Retrieved From https://oxfordre.com/socialwork/view/10.1093/acrefore/9780199975839.001.0001/acrefore-9780199975839-e-30?q=Behavioral%2BTheory

Volume 5, Issue 1
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ISSN: 2546-1745

Ashong, C. Y., & Commander, N. E. (2012). Ethnicity, gender, and perceptions of online learning in higher education. *MERLOT Journal of Online Learning and Teaching, 8*(2).

Asio, J. M. R., Gadia, E., Abarintos, E., Paguio, D., & Balce, M. (2021). Internet Connection and Learning Device Availability of College Students: Basis for Institutionalizing Flexible Learning in the New Normal. *Studies in Humanities and Education, 2*(1), 56–69. https://doi.org/10.48185/she.v2i1.224

Avila, E., Abin, G., Bien, G., Acasamoso, D., Arenque, D. (2021). Students' Perception on Online and Distance Learning and their Motivation and Learning Strategies in using Educational Technologies during COVID-19 Pandemic. *Journal of Physics: Conference Series, 1933*, 012130. https://doi.org/10.1088/1742-6596/1933/1/012130.

Belgica, C. C., Calugan, J. A., Dumo, J. U., & Simber, L. A. (2020, December). Online distance learning: Thematic study on the challenges faced by Educare College Inc. primary pupils. In Proceedings of the 3rd International Conference on Advanced Research in Education, Teaching & Learning, Oxford, UK (pp. 18-20).

Bennett, J., & Thompson, G. (2011) Science teaching and learning activities and students' engagement in science. *International Journal of Science Education, 35*(8), 1325-1343. https://doi.org/10.1080?09500693.2011.608093

Best, J. W., & Kahn, J. V. (2009). Research in Education New Delhi, Printice Hall of India Pvt.

Boekaerts, M. (2016). Engagement as an inherent aspect of the learning process. *Learning and Instruction, 43*, 76-83. http://dx.doi.org/10.1016/j.learninstruc.2016.02.001

Bueno, D. (2006). Elements of Research and Thesis Writing. Columban College. Syneraide Research and Publications.

Chinwendu, N. S., & Patience, C. (2017). Computer-assisted instruction (CAI) on students' interest and achievement in physics in Imo state, Nigeria. IOSR Journal of Research & Method in Education, 7(3), 53-58. https://doi.org/10.9790/7388-0703045358

Clark, R., Freedberg, M., Hazeltine, E., & Voss, M. W. (2015). Are There Age-Related Differences in the Ability to Learn Configural Responses? *PloS one, 10*(8), e0137260. https://doi.org/10.1371/journal.pone.0137260

Cuadrado-García, M., Ruiz-Molina, M. E., and Montoro-Pons, J. D. (2010). Are there gender differences in e-learning use and assessment? Evidence from an interuniversity online project in Europe. Proc. Soc. Behav. Sci. 2, 367–371. https://doi.org/10.1016/j.sbspro.2010.03.027

Culatta, R. (2018). Transactional distance. InstructionalDesign.org. Retrieved April 15, 2022, from https://www.instructionaldesign.org/models/transactional_distance/

Volume 5, Issue 1
January to December 2022
ISSN: 2546-1745

Cupida, S. M. (2014). Effects of computer-based instruction on the academic achievement of students in physics through the guided-inquiry approach. Central Mindanao University.

Dap-og, E. R., & Orongan, M. J. Q. (2021). Computer-assisted instruction on students' academic achievement and engagement in Science. *International Journal of Teaching and learning, 1*(1), 46-57.

Dap-og, Evangeline & Orongan, Maris. (2022). COMPUTER-ASSISTED INSTRUCTION ON STUDENTS' ACADEMIC ACHIEVEMENT AND ENGAGEMENT IN SCIENCE. International Journal of Teaching and Learning. 46-57. https://doi.org/10.17501/26827034.2021.1104

Ellore, S. B. 2014. The influence of internet usage on academic performance and face - to-face communication. Journal of psychology and behavioural science. 2(2): 163-186.

Etikan I, Bala K. (2017) Sampling and sampling methods. Biometrics and Biostatistics International Journal. 2017;5(6):215–217. https://doi.org/10.15406/bbij.2017.05.00149

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). How to design and evaluate research in education (Vol. 7, p. 429). New York: McGraw-hill.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. Review of Educational Research, 74(1), 59-109. https://doi.org/10.3102/00346543074001059

Fredricks, J. A., Wang, M.-T., Schall Linn, J., Hofkens, T. L., Sung, H., Parr, A., & Allerton, J. (2016). Using qualitative methods to develop a survey measure of math and science engagement. Learning and Instruction, 43, 5-15. http://dx.doi.org/10.1016/j.learninstruc.2016.01.009

GCFGlobal.org. (n.d.). Computer Basics: Mobile devices. Retrieved June 21, 2022, from https://edu.gcfglobal.org/en/computerbasics/mobile-devices/1/

Harefa S. and Sihombing GLA. (2022). Students' perception of online learning amidst the Covid-19 pandemic: A study of junior, senior high school and college students in a remote area [version 2; peer review: 2 approved]. F1000Research, *10*, 867. https://doi.org/10.12688/f1000research.52152.2

Hidayah, I. N., Sa'Dijah, C., Subanji, S., & Sudirman, S. (2021, March). The students' cognitive engagement in online mathematics learning in the pandemic Covid-19 era. In AIP Conference Proceedings (Vol. 2330, No. 1). AIP Publishing.

Hollister, B., Nair, P., Hill-Lindsay, S., & Chukoskie, L. (2022, May). Engagement in online learning: student attitudes and behavior during COVID-19. In Frontiers in Education (Vol. 7, p. 851019). Frontiers Media SA.

Hung, M. L., Chou, C., Chen, C. H., and Own, Z. Y. (2010). Learner readiness for online learning: scale development and student perceptions. *Comput. Educ. 55,* 1080–1090. https://doi.org/10.1016/j.compedu.2010.05.004

Volume 5, Issue 1
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Jennings, J. M., & Angelo, T. (Eds.) (2006). Student engagement: Measuring and enhancing engagement with learning. Proceedings of the Universities Academic Audit Unit, New Zealand.

Jiang, Y. J., Bai, X. M., Wu, W. C., and Luo, X. J. (2019). Analysis of the structural relationship of influencing factors of the online learning experience. *Mod. Distance Educ. 1,*27–36. https://doi.org/10.13927/j.cnki.yuan.2019.0004

Koh, E. & Lim, J. (2012). Using online collaboration applications for group assignments: The interplay between design and human characteristics. Computers and Education, 59, 481-496.

Korlat S, Kollmayer M, Holzer J, Lüftenegger M, Pelikan ER, Schober B, and Spiel C (2021) Gender Differences in Digital Learning During COVID-19: Competence Beliefs, Intrinsic Value, Learning Engagement, and Perceived Teacher Support. Front. Psychol. 12:637776. https://doi.org/10.3389/fpsyg.2021.637776

Mahmood, S. J. (2006). Examining the mathematics performance of developmental mathematics students when computer-assisted instruction is combined with traditional strategies (pp. 1-90). Texas Southern University.

Mandernach, B. J., Donnelli-Sallee, E., & Dailey-Hebert, A. (2011). Assessing course student engagement. In R. Miller, E. Amsel, B. M. Kowalewski, B.B. Beins, K. D. Keith, & B. F. Peden (Eds.), Promoting Student Engagement: Techniques and Opportunities (pp. 277- 281). Society for the Teaching of Psychology, Division 2, American Psychological Association.

Margolis, J., & Fisher, A. (2002). Unlocking the clubhouse: Women in computing. MIT press.

Mayer, Richard. (2014). Incorporating motivation into multimedia learning. *Learning and Instruction, 29,* 171–173. https://doi.org/10.1016/j.learninstruc.2013.04.003

Moore, G. M. (1989). The three types of interaction. American Journal of Distance Education, 3(2), 1-6.

Morin, D., Safaee, H., & Saadé, R. (2019). Understanding online learning based on different age categories. Issues in Informing Science and Information Technology, 16, 307-317. https://doi.org/10.28945/4313

Mu, S., and Wang, X. J. (2019). Research on deep learning strategies in online learning. Distance Educ. China 10, 29–39+93.

Nwankwo, A. A. (2015). Students' learning experiences and perceptions of online course content and interactions (Doctoral dissertation, Walden University).

Pauletti, R. E., Menon, M., Cooper, P. J., Aults, C. D., and Perry, D. G. (2017). Psychological androgyny and children's mental health: a new look with new measures. Sex Roles 76, 705–718. https://doi.org/10.1007/s11199-016-0627-9

Perkowski, J. (2013). The role of gender in distance learning: a meta-analytic review of gender differences in academic performance and self-efficacy in distance learning. J. Educ. Technol. Syst. 41, 267–278. https://doi.org/10.2190/ET.41.3.e

Volume 5, Issue 1
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ISSN: 2546-1745

Polit, D. F., & Beck, C. T. (2006). Using research in evidence-based nursing practice. Essentials of nursing research. Methods, appraisal and utilization. Philadelphia (USA): Lippincott Williams & Wilkins, 12, 457-94.

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. Journal of educational psychology, 104(3), 700.

Schindler, L.A., Burkholder, G.J., Morad, O.A. et al. (2017) Computer-based technology and student engagement: a critical review of the literature. International Journal of Educational Technology in Higher Education 14, 25. https://doi.org/10.1186/s41239-017-0063-0

Simbulan, N. P. (2020, November 17). The Philippines – COVID-19 and its impact on higher education in the Philippines. The HEAD Foundation. Retrieved April 15, 2022, from https://headfoundation.org/2020/06/04/covid-19-and-its-impact-on-higher-education-in-the-philippines/

Simonds, T.A. & Brock, B.L.. (2014). Relationship Between Age, Experience, and Student Preference for Types of Learning Activities in Online Courses. Journal of Educators Online. 11. https://doi.org/10.9743/JEO.2014.1.3

Vegafria, L. A. (2016). Multimedia learning: An integrated teaching delivery model on students' achievements and attitudes in grade 10 science [Unpublished master's thesis]. Central Mindanao University.

Vetter, N. C., Altgassen, M., Phillips, L., Mahy, C., & Kliegel, M. (2013). Development of Affective Theory of mind across adolescence: Disentangling the role of executive functions. Developmental neuropsychology. Retrieved April 17, 2022, from https://pubmed.ncbi.nlm.nih.gov/23410214/

Wright, M., & So, N. (2022). How Pilot Testing Can Imrpove Your User Research. Widerfunnel. Retrieved May 10, 2022, from https://www.widerfunnel.com/blog/pilot-testing-user-research

York, C.S. & Richardson, J.C. (2012). Interpersonal interaction in online learning: Experienced online instructors' perceptions of influencing factors. Journal of Asynchronous Learning Networks, 16(4), 83-98.