Student Perception of Learning, Engagement, and Confidence in Research Skills Using Mobile Devices as an Active Learning Strategy in a Science Course

Reina R. Irinco[1] and Reiza R. Irinco-Salinas[2]

[1]College Librarian, University of the Philippines Diliman, Philippines, rririnco@up.edu.ph
[2]Faculty, San Beda University, Philippines, rsalinas@sanbeda.edu.ph

Abstract

This study aimed to determine how tertiary students use their mobile devices for academic in-class activities and learning tasks. Specifically, it examined the students' perceptions of their learning, engagement, and confidence in research skills in relation to their use of mobile devices. This study used an online survey which consisted of a four-point Likert scale and verbal interpretation. Data analysis was performed using frequency distribution, mean, and standard deviation to assess respondents' views on the influence of mobile devices in their learning and confidence in conducting research. The findings showed that students agreed with the positive impact of mobile devices in their education. In addition, students reported greater confidence in their research skills when using mobile devices. Overall, the students felt that mobile technology improved their knowledge and engagement. Moreover, the study showed that gadgets and applications should only be used as learning tools because the outcomes should still depend on the pedagogical strategy and learning objectives. As the research used convenience sampling, the results may only partially represent undergraduate students' perceptions of engagement, learning, and confidence in their research skills using their mobile devices. However, the research's findings still provide insights on the potential benefits of integrating mobile devices in the classroom. These results can guide the development and formulation of more effective instructional methods and materials to enhance the students' learning experience.

***Keywords**: mobile devices, tertiary students, pedagogy, research skills, learning engagement*

Introduction

Technology is quickly evolving in every aspect of our society, including education. Consequently, information technology is increasingly utilized as a tool for

learning. Like other learning organizations, higher education institutions closely monitor these advanced technologies to enhance their educational processes. Furthermore, mobile learning has appeared as a significant advancement, offering educators and learners numerous opportunities (Mohammadi et al., 2020).

The potential of gadgets has significantly increased due to rapid advancements in computation power, internal storage, and screen size with its resolution. Mobile application developers can leverage these improvements to create more sophisticated and valuable applications, enhancing mobile device users' personal and professional lives (Krawczyk & Nykiel, 2017). Mobile devices are particularly effective for teaching and learning, especially given their popularity among adolescents and undergraduates. Data indicates that many students own them and consider them a necessity rather than a luxury. Essential uses of smartphones or gadgets, such as for communication, instant messaging, social media, gaming, and texting, underscore their importance in personal and professional contexts (Wang et al., 2015).

Although numerous studies have examined smartphones, few have delved into the current use of mobile devices as an active learning strategy in science courses, specifically biology. This research aimed to ascertain undergraduate students' perceptions of using smartphones for educational purposes, including in-class engagement, learning activities, and their confidence in research skills. The findings may help develop instructional strategies that integrate smartphones or similar technologies to increase student knowledge, especially laboratory settings and provide insights on the benefits of incorporating mobile devices into classroom instruction.

Objectives

This study aimed to determine how tertiary students use their mobile devices for academic reasons, including in-class activities and learning tasks. Specifically, it examined the students' perceptions of their engagement, learning, and confidence in research skills regarding their mobile devices.

Review of Related Literature

Despite the educational benefits that mobile devices offer, many instructors need to prepare effectively for their integration into courses. Bose and Lowenthal (2016) developed a program to aid college professors in creatively using mobile devices in the lecture room. This research reports college professors' experiences and perceptions regarding incorporating mobile devices into their teaching practices. The findings indicate that college professors utilized mobile devices for digital creation, communication, information storage, and sharing. Deb and Fuad (2014) examined the mobile devices used in the classroom, focusing on their role in interactive problem-solving to increase the engagement of college students and promote active learning.

In the same way, Power (2013) established learning theories and analytical frameworks frequently cited in written works on mobile learning. One such

framework, Collaborative Situated Active mLearning (CSAM), provides a new perspective on instructional systems design, contemplative practices, and self-assessment of mobile learning practices. In addition, Mayberry et al. (2012) investigated the use of instructional technology among faculty, highlighting several creative, active learning strategies for integrating the iTouch device inside and outside the lecture room.

Science during Pandemic

Middle and senior high school students inevitably study science. They engage in science learning by being allowed to test their hypotheses and muster understanding. Therefore, a teacher needs to be able to provide authentic experiential activities, educate and assist students' learning, and support students in engaging in hands-on and mind-on learning to aid in their comprehension. Practical experience, or job experience, is but one of the situations they must face (Ambawati et al., 2021).

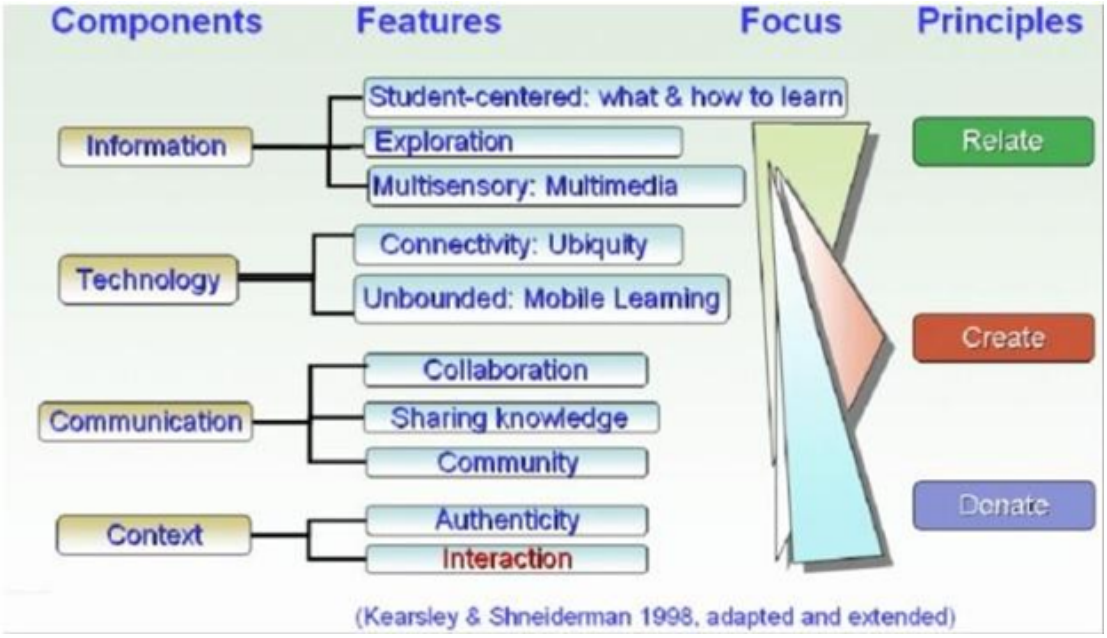
According to recent data exhibited at the American Educational Research Association conference, students hardly struggle to learn science during the pandemic. However, they find it more challenging, intriguing, and applicable to daily activities. (Sparks, 2021).

Using Mobile Apps in Online Science Courses

Sprong et al. (2022) elaborated that pedagogy encompasses teaching methods and practices, particularly in educational topics or academic concepts. During the COVID-19 pandemic, online science teaching faced numerous obstacles and challenges, including integrating technology in the classroom. When used mindfully, along with careful pedagogical consideration, technology can serve as a valuable tool to provide students with learning content, minimize interruptions, and enhance shared experiences accompanied by peers and professors. However, students should remain cautious, as devices and apps are tools; their effectiveness depends on the pedagogical approach and the established learning goals. Relevant studies conducted by Mohammadi et al. (2020) indicate that mobile phones offer several benefits as teaching tools, such as increasing individual contribution to educational activity, serving as helpful supplemental resources, aiding in management and planning, and shaping students' perceptions of mobile apps as essential learning tools. While Gallegos et al. (2019) emphasized that science educators should prioritize pedagogy in their teaching practices. Countless academic work has focused on the part of mobile devices in advancing active learning (Bose & Lowenthal, 2016; Deb & Fuad, 2014; Mayberry et al., 2012; Power, 2013).

Theoretical Framework

Figure 1
Kearsley and Schneiderman's Framework for Technology-Based Teaching and Learning



Kearsley and Schneiderman's Framework for Technology-Based Teaching and Learning emphasizes active learning with technology and applying concepts in real-world settings. The key principles of this framework suggest that students should be relevantly engaged in pedagogical scenarios through interaction with others and work on meaningful tasks. In addition, technology can enhance this participation in ways that are often difficult to reach through traditional methods.

Kearsley and Schneiderman's theory promotes interaction through collaborative activities as technology is used more as a communication tool than a media delivery service and project-oriented learning because technology is a tremendous resource for quickly uncovering an abundance of information about any topic and provides an easily accessible source to share with others (Gallegos et al, 2019).

Methodology

The authors sent a permission letter to the Chairman of the Biology Department, University of the East Manila (UEM) for this research. The online survey was conducted from January 20 to 27, 2023, during the start of the academic semester when student enrollment was still ongoing. It was the resumption of face-to-face classes which had been suspended since March 10, 2020, due to the Covid-19 pandemic. Consequently, only eighteen (18) undergraduate students responded to the online survey.

The survey questionnaire was based on Gallegos et al. (2019), with some items modified to fit the study objectives within the Philippine context. Data were

analyzed using the Jamovi output format and statistical measures such as the mean and standard deviation were computed to assess student-respondents' engagement, learning, and confidence in research skills. The survey data analysis applied a four-point Likert scale and verbal interpretation for the first and second categories, i.e., perceptions of engagement and learning: 4 (4.00-3.00) = strongly agree, 3 (2.99-2.0) = agree, 2 (1.99-1.0)- disagree and 1 (1.0-0.99) strongly disagree. For the third category, confidence in research skills, the ratings were 4 = very confident, 3 = fairly confident, 2 = slightly confident, and 1 = not confident.

Due to the limited time, the research survey used convenience sampling of the UEM biology students. Therefore, the result may only be conclusive in UEM and other similarly situated institutions.

Results and Discussion

The sample consisted of eighteen (18) respondents with 10 (55.6%) males and 8 (44.4%) females. Twelve respondents were between the age of 18 to 19 years old (66.7%), five from 20 and 21 years old (27.8%), and one from 22 and 23 years old (5.6%). Out of the 18 respondents, 6 (33.3%) were in their first year college, 10 (55.6%) in the second year, and 1 (5.6%) each in the third and fourth year.

Table 1 shows survey results of the Student Perceptions of Engagement as described in three descriptive variables.

Table 1
Student Perceptions of Engagement (N=18)

Categories	Descriptive Variables	Mean	SD	Verbal Interpretation
Student Perceptions of Engagement	Using a mobile device increased the student's overall engagement in lecture discussions.	2.67	0.907	Agree
	Using a mobile device helped the students pay more attention to the instructors during lectures.	2.33	0.970	Agree
	Using a mobile device motivated the students to learn the course material.	2.61	0.979	Agree
	Overall weighted mean	2.54	0.952	Agree

On the first descriptive variable, "using a mobile device increased the student's overall engagement in lecture discussions," the survey response of the student respondents indicates a statistical mean of 2.67. Based on the Likert scale, the mean value falls under a verbal interpretation where the students agree. Edmodo (2017) discusses how technology can significantly enhance students' ability to seek help. Texting, for example, facilitates class participation by allowing students to ask questions discreetly, empowering shy individuals to engage more confidently. Not all students can articulate their ideas and questions effectively in a traditional classroom setting, but mobile devices can support those who struggle with verbal communication. Teachers can leverage SMS in their classrooms to gauge student comprehension and identify those who require additional assistance. The data also indicates that “students believe using mobile devices helps them pay more attention to instructors during lectures,” as evidenced by a computed mean of 2.33.

Bose and Lowenthal (2016) highlight how instructors have utilized smartphones or gadgets to produce content, communicate, store, and partake in information. Exercises were adapted to incorporate handheld or portable technology, enhancing technological competency and modifying appraisal strategies. Professors give an account of improvements in students' technological competency, conveying skills, and active learning due to merging smartphones or similar technologies into the learning process.

The last variable, "using a mobile device motivated the students to learn the course material," has a computed mean of 2.61, indicating that the students agree. Mayberry et al. (2012) explored the incorporation of mobile devices in the lecture room. Their study highlights a creative, active learning approach for using the iTouch inside and outside the lecture room and the gadget's strengths, weaknesses, and prospective applications for future courses. Consequently, incorporating the iTouch in the classroom enhances student motivation to engage with the course material.

Table 2 shows the survey results of Student Perceptions of Learning as described in five descriptive variables.

Table 2
Student Perceptions of Learning (N=18)

Categories	Descriptive Variables	Mean	SD	Verbal Interpretation
Student Perceptions of Learning	The mobile device helped the students participate in activities that enhanced their learning.	3.06	0.639	Strongly agree
	Using the mobile device develops skills that apply to the student's academic career and professional life.	2.61	0.979	Agree
	Using the mobile device helped the students apply course content, solve problems, and connect ideas in a new way.	2.72	0.958	Agree
	Using the mobile device helped the students develop confidence in a subject area.	2.44	1.042	Agree
	Using a mobile device helped connect ideas in a new way.	2.94	0.802	Agree
	Overall weighted mean	2.54	0.884	Agree

The first descriptive variable, "using the mobile device helped the students participate in activities and enhanced their learning," yielded a statistical mean of 3.06 from the student respondents. Based on the Likert scale, the mean falls under a verbal interpretation where students strongly agree. This is consistent with Mayberry (2012) who stated that mobile technology tools attract students and assist in learning. Darko-Adjei (2019) discussed how smartphones or similar technologies are slowly becoming compelling learning tools used to enhance teaching in distance learning. Its usage ensures that training sessions are administered and allows learners to access the e-learning environment and instructional materials and interact automatically. Therefore, mobile devices help students participate in activities that enhance learning. The second variable, "using the mobile device develops skills that apply to the student's academic career and professional life," has a computed mean of 2.61, indicating that the students agree. Kim et al. (2020) discussed the

scholarly use of handheld and portable devices that engage students beyond face-to-face education conditions. Over the past few years, higher education institutions have encouraged students' learning and growth by aiding their use of handheld or portable technology. Mobile technology offers intellectual prospects to increase students' growth in university education. Therefore, mobile devices help strengthen skills that apply to the students' scholarly life and later in professional careers. The third variable, "using the mobile device, helped the students apply course content to solve problems and connect ideas in a new way" has a computed mean of 2.72, indicating that students also agree. Deb and Fuad (2014) discussed that authorizing the students to answer problems on their preferred handheld or portable devices will create an amiable educational setting where they want to retain knowledge and be agile and skilled. Therefore, mobile devices allow students to put in an application course content to answer problems. The fourth variable, "using the mobile device helped the students develop confidence in a subject area," has a computed mean of 2.44, indicating that the students agree.

Lexia (2024) stated that today's students have various apps and platforms on their smartphones and gadgets. In many cases, this flexibility enables students to produce results that professors may not have initially envisioned when designing the project. The last variable, "using a mobile device helped connect ideas in a new way," has resulted in a computed mean of 2.94, indicating that students also agree. Lexia (2024) discussed that students will go above and beyond expectations if they can choose the subject matter. Given various circumstances, suppose they are allowed to incorporate any relevant material, the students can make research outlines with just five minutes of research time at the beginning of class. This approach allows them to share or work in teams to account for students without phones.

Table 3 shows the survey results of Student Confidence in Research Skills as described in five descriptive variables.

For the online component of blended learning implementation, pairwise comparisons revealed that STEM students had significantly more positive evaluations than HUMSS students ($W = 5.757$, $p < .001$). ABM students reported significantly lower evaluations compared to both GAS ($W = -4.373$, $p = .011$) and HUMSS ($W = -6.515$, $p < .001$) strands. These findings suggest that STEM students may be more adept at or satisfied with the online learning components of the blended model, while ABM students may face more challenges or have less positive experiences.

Table 3
Student Confidence in Research Skills (N=18)

Categories	Descriptive Variables	Mean	SD	Verbal Interpretation
Confidence in research skills	The mobile device helped the students become confident using references at the end of research articles to find more resources to review.	3.22	0.808	Very Confident
	The mobile device helped the students use an electronic bibliographic database.	3.17	0.924	Very Confident
	Using a mobile device helped the students access the research literature through internet search engines such as Google.	3.33	0.840	Very Confident
	Using mobile devices helped the students understand and apply the theory.	3.11	0.900	Very Confident
	Using mobile devices helped the students use research results from conference posters or podium presentations.	3.11	0.963	Very Confident
	Using mobile devices helped the students follow how a theory leads to specific research questions.	3.22	0.878	Very Confident
	Overall weighted mean	3.19	1.17	Very Confident

On the first descriptive variable, "using the mobile device helped the students become confident in using references at the end of research articles to find more resources to review," the survey response of the students has a computed statistical mean of 3.22. Based on the Likert scale, the mean falls under a verbal interpretation where students are very confident. Dias and Victor (2017) discussed that mobile devices have introduced a new generation of learning

strategies that afford innovative use and prompt access to rich resources. These handheld or portable devices hold onto outstanding learning perspectives. Therefore, using this wealth of resources helps the students become more confident using references at the end of their research articles. The second variable, "mobile device helped the students use an electronic bibliographic database," has a mean of 3.17, indicating that students are also very confident. Chakre and Ghante (2022) discussed that electronic resources play a significant role as information sources. The very benefit of electronic information is that it can be accessed by any tool available on the Internet. It could be smartphones, laptops, tablets, or other electronic gadgets. Therefore, mobile devices help students use electronic resources. The third variable, "using a mobile device helped the students access the research literature through internet search engines such as Google," has a mean of 3.33, indicating that students are also very confident. Apuke and Iyendo (2018) asserted that students turned on their smartphones or gadgets to access cyberspace through subscriptions from other Internet providers and have become overly dependent on Google, Yahoo, and open-access e-journals.

Nevertheless, tertiary students believed that the Internet enabled them to carry out research ahead of time, address numerous assignments, broaden the extent of reading and learning, encourage self-education, motivate and increase collaborative learning, and improve student examination preparation. The fourth variable, "using mobile devices helped the students understand and apply the theory," has a mean of 3.11, indicating that students are also very confident. Fitzula (2019) stated that digital literacy is a life skill (i.e., creating presentations, differentiating reliable vs. unreliable content, and online etiquette). Therefore, using mobile devices helped the students understand and apply the theory by being digitally literate. Fifth, “using mobile devices helped the students use research results from conference posters or podium presentations." It has a resulting mean of 3.11, with the verbal interpretation of very confident. Fitzula (2019) discussed the correlation between using mobile devices and increasing student motivation to learn both inside and outside the classroom. Therefore, mobile devices help students apply research results in conferences and presentations. The last variable, "using mobile devices helped the students follow how a theory leads to specific research questions," has a mean of 3.22, indicating that students are also very confident. Ahmad (2020) discussed that students were keen on mobile devices' usage as a social connectivity and collaborative tool, which they can use for flexible and personalized learning activities. Therefore, mobile devices help the students understand how a theory leads to specific research questions that can help them daily.

Findings

The findings derived from the first category, Student Perception of Engagement, show that students agree that using mobile devices increases their overall engagement in lecture discussions, helps them pay more attention during lectures, and motivates them to learn course materials. The second category, Student Perception of Learning, presents that students also agree that using mobile devices helped them participate in activities that enhanced their learning. The devices also supported the development of skills that can be

applied to their academic and professional lives, helped them to apply course lessons to answer problems, allowed creatively linking ideas, and boosted their confidence in a subject area. The last category, Confidence in Research Skills, reveals that students are very confident in using mobile devices, especially in using cited references at the end of research papers or articles to find additional resources. Mobile devices allow access to electronic bibliographic databases, enable students to look for research literature through internet search engines such as Google, help the students in understanding and applying theoretical concepts, aid the use of research results from conference posters or podium presentations and help the students follow how a theory leads to specific research questions.

Based on the results of this study, students' mobile devices help them in engaging, learning, and enhancing research skills, most notably in science courses like biology.

Conclusions and Recommendations

Mobile technology offers a positive impact on students' engagement and learning. However, educators must consider pedagogy when integrating technology in the classroom. Caution should still be exercised as the devices and apps are only tools, and the results should still depend on the pedagogical approach and learning goals. When used thoughtfully and with careful pedagogical considerations, technology can be a valuable tool to increase students' engagement with course content, limit off-task interruptions, and enhance collaborative learning experiences with peers and professors. It may be helpful for future studies to compare students' self-perceived skills and knowledge with their actual proficiency and application of such skills in real-life context. Additionally, studying the adverse effects of handheld or portable technology in the classroom will be a relevant research area especially in non-science courses. The study results can also serve as reference to develop and formulate adaptable and suitable instructional theories and materials to help and improve students' learning process.

References

Ahmad, T. (2020). Student perceptions on using cell phones as learning tools: Implications for mobile technology usage in Caribbean higher education institutions. *PSU Research Review,* 4(1), 25-43. https://doi.org/10.1108/PRR-03-2018-0007

Ambawati, W., Putri, E.K., Rahayu, D.A., & Khaleyla, F. (2021). Science online learning during the COVID-19 pandemic: difficulties and challenges. *Journal of Physics: Conference Series,* 147: 1-7. https://doi.org/10.1088/1742-6596/1747/1/012007

Apuke, O.D. & Iyendo, T.O. (2018). University students' usage of the internet resources for research and learning : forms of access and perceptions of utility. *Heliyon,* 4 (12). https://doi.org/10.1016/j.heliyon.2018.e01052

Bose D. & Lowenthal, P. (2016). Integrating mobile devices into classroom: A Qualitative Case Study of a Faculty Learning Community. *International Journal of Social Media and Interactive Learning Environments,* 4(4), 319-332. https://dx.doi.org/10.1504/IJSMILE.2016.081275

Chakre, M.R. & Ghante, P. B. (2022). Use of electronic resources with the help of mobile technology : a study of PG students. *International Journal of Research and Analytical Reviews*. 9 (3), 939-946. https://www.ijrar.org/papers/IJRAR22C2603.pdf

Darko-Adjei, N. 2019. The use and effect of smartphones in students' learning activities : evidence from the University of Ghana, Legon. Library Philosophy and Practice (e-journal). 2851. https://digitalcommons.unl.edu/libphilprac/2851

Deb D. & Fuad, M. M. (2014). *Use of mobile application to improve active learning and student participation in the computer science classroom.* SIGCSE '14: Proceedings of the 45th ACM technical symposium on computer science education. https://doi.org/10.1145/2538862.2544291

Dias, L. & Victor, A. (2017). Teaching and learning with mobile devices in the 21st century digital world : benefits and challenges. *European Journal of Multidisciplinary Studies,* 7(1), 26-34. https://doi.org/10.26417/ejms.v5i1.p339-344

Edmondo Guest Writer. (2017). How to increase student participation through mobile Devices. *Medium.* https://medium.com/@edmodo_staff/how-to-increase-student-participation-through-mobile-devices-97bed6ebb5

Fitzula, M. 2019. *Using mobile devices in the classroom.* Stockton University : Center for Learning Design. https://stockton.edu/ctld/documents/facres/mobile-devices-in-the-classroom.pdf

Gallegos, C., Gehrke, P., & Nakashima H. (2019). Can mobile devices be used as an active learning strategy? Student perceptions of mobile device use in a nursing course. *Nurse Educ* 44(5):270-274. https://doi.org/10.1097/NNE.0000000000000613

Kim. H. J., Yi, P. & Hong, J. I. 2020. Students' Academic Use of Mobile Technology and Higher-Order Thinking Skills: The Role of Active Engagement. *Educ. Sci.* 10 (3), 47. https://doi.org/10.3390/educsci10030047

Krawczyk, H. & Nykiel, M. (2017). Mobile devices and computing cloud resources allocation for interactive applications. *Archives of Control Sciences,* 27(2), 293-307. https://www.degruyter.com/downloadpdf/j/acsc.2017.27.issue-2/acsc2017-0019/acsc-2017-0019.pdf

Lexia. (2016). How Phones Can Increase Learning for All Types of Students. https://www.lexialearning.com/blog/how-phones-can-increase-learning-all-types-students

Mayberry J., Hargis, J., Boles, L., Dugas, A., O'Neill, D., Rivera, A., & Meler, M. (2012). Exploring Teaching and Learning using an iTouch mobile device. *Active Learning in Higher Education* 13(3). https://doi.org/10.1177/1469787412452984

Mohammadi, M., Sarvestani, M.S., & Nuoroozi, S. (2021). Mobile Phone Use in Education and Learning by Faculty Members of Technical-Engineering Groups: Concurrent Mixed Methods Design. *Front. Educ.* 5. https://doi.org/10.3389/feduc.2020.00016

Power R. 2013. Collaborative Situated Active Mobile Learning Strategies: A new perspective on effective mobile learning. Educational Technology for Learning. *Learning and Teaching in Higher Education: Gulf Perspectives,* 10(2). https:// doi.org/10.18538/lthe.v10.n2.137

Sparks, S. (2021). *Science Teaching and Learning Found to fall off in pandemic.* EducationWeek. https://www.edweek.org/teaching-learning/science

Sprong, M., Brinck, E., Jones, J., & Schultz, J. (2022). The Pedagogy of Rehabilitation Counseling: Perceptions of Rehabilitation Educators. *Journal of Applied Rehabilitation Counseling,* 53(1), 15. https://doi.org/10.1891/JARC-D-20-00003

Wang, J., Wang, H., Gaskin, J., & Wang, L. (2015). The role of stress and motivation in problematic smartphone use among college students. *Computers in Human Behavior,* 53. https://doi.org/10.1016/j.chb.2015.07.005