



# Challenges Faced by the Implementation of E-learning Educational Approach during the Covid-19 Pandemic Disease

Gratien Habarurema<sup>1</sup>, Theonille Mukabagorora<sup>2</sup>, Janvier Mukiza<sup>3</sup> 

<sup>1</sup>School of Education, University of Rwanda-College of Education

<sup>2</sup>Department of Chemistry, University of Rwanda-College of Science and Technology

<sup>3</sup>Department of Medical Imaging, University of Rwanda-College of Medicine and Health Science

## ARTICLE INFO

### Article history:

Received February 06, 2022

Revised February 09, 2022

Accepted May 12, 2022

Available online May 25, 2022

### Kata Kunci:

Covid-19, Tantangan, Pendidikan, E-learning, Teknologi

### Keywords:

Covid-19, Challenge, Education, E-learning, Technology

### DOI:

<https://dx.doi.org/10.23887/jet.v6i2.45534>

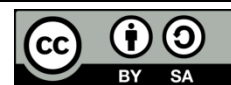
## ABSTRAK

Pertumbuhan pesat pendidikan jarak jauh dalam pendidikan tinggi telah didorong terutama selama penutupan sekolah. Studi ini dilakukan dalam konsorsium universitas negeri yang bertujuan untuk menyelidiki tantangan yang dihadapi pada masuknya pendekatan e-learning selama Covid-19. Penelitian ini menggunakan pendekatan deskriptif kuantitatif. Seratus lima (105) mahasiswa yang terdaftar di program sarjana dan tiga puluh tujuh (37) staf pengajar dari perguruan tinggi pengajaran umum berpartisipasi dalam laporan ini, dan jumlah peserta terakhir adalah 142. Data dikumpulkan secara acak dan hasil dianalisis menggunakan SPSS. Meskipun upaya ini dilakukan, sejumlah keterbatasan dialami, dan ditunjukkan oleh 62 (59%) siswa yang melaporkan krisis keuangan, 26,7% siswa dan 8,1% fasilitator dengan keterbatasan konektivitas, 37,1% siswa tidak dapat memanfaatkan e- praktik tutorial dimana 13 (35,1%) moderator tidak dapat memfasilitasi siswa dari jarak jauh, peserta yang tidak dapat mengakses platform e-learning yang direkomendasikan secara efektif, 35 (33,3%) siswa dan 6 (16,2%) fasilitator. Pengamatan secara keseluruhan menunjukkan bahwa strategi e-learning-teaching mendorong sekolah berkelanjutan dari rumah, tetapi siswa dari keluarga kurang mampu dan/atau daerah pedesaan pada khususnya mengalami berbagai keterbatasan.

## ABSTRACT

The rapid growth of distance education within higher education has been encouraged particularly during school closure. This study was conducted within a consortium public university aiming to investigate the challenges faced upon the inclusion of e-learning approach during the Covid-19. This study is using a quantitative descriptive approach. One hundred and five (105) students registered in the undergraduate programs and thirty-seven (37) teaching staff of the public teaching colleges participated in this report, and the final number of participants was 142. Data were collected on a random basis and the results were analyzed using SPSS. Although this effort was made, a number of limitations was experienced, and showed by 62 (59%) of students that reported a financial crisis, 26.7% students and 8.1% facilitators with a limitation to connectivity, 37.1% students could not benefit e-tutorial practice whereas 13 (35.1 %) moderators could not be able to facilitate students remotely, the participants that could not effectively access the recommended e-learning platforms, 35 (33.3 %) students and 6 (16.2 %) facilitators. The overall observation showed that the e-learning-teaching strategy promoted the continuous schooling from home, but students from disadvantaged families and/or rural areas in particular experienced various limitations.

This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.  
Copyright © 2022 by Author. Published by Universitas Pendidikan Ganesha.



## 1. INTRODUCTION

Education is a very important component of human life and is both a fundamental human right (Alcaide et al., 2020; Chen & Yang, 2019), and a central factor in this era of sustainable development (Gregoriadis & Grammatikopoulos, 2014; Yen et al., 2018). In the conventional educational setting where their interactions take place face-to-face in classrooms, the relationship between students and facilitators has been thoroughly explored (Martínez-Argüelles & Batalla-Busquets, 2016). However, this approach has faced numerous challenges, and the implementation of advanced information and communication technology (ICT) has been promoted in almost all systems, including education, economic and industrial systems, as well as in various sectors such as agriculture, health and transport (Moubayed et al., 2020; Pham et al., 2019). The use of ICT has brought a major shift in many beneficial activities (Duță & Martínez-Rivera, 2015), and universities have begun to incorporate different ICT resources and platforms in their teaching activities (Harrison et al., 2018; Wang & Zhao, 2020). The use of such technology tools allows university personnel to use innovative pedagogical strategies when attempting to meet the needs of the community (Mirata et al., 2020). This practice of involving the use of learning technology in different universities around the world helps to achieve the teaching and learning objectives. Educational

technology also greatly contributes to distance learning, hereby influencing the nature and quality of learning outcomes, and is seen as a key to responding to unexpected disasters, including pandemic diseases (Moubayed et al., 2020; Pham et al., 2019). To achieve this the internet is considered as a major necessity and a pillar to be involved in order to conduct e-service-learning in higher education institutions and other sectors in order to remotely enhance the standard of practice. Few years ago, the world has started to use digital media and technical education in teaching involving different technological devices and ICT in many areas since the arrival of the era of technology (Seale et al., 2021; Vanslambrouck et al., 2018). As far as education is concerned, technology has significantly assisted both teachers and students across different channels during teaching-learning activities (Dziuban et al., 2016; J. S. Krajcik & Mun, 2014). More importantly, e-learning approach helps learners to acquire new skills without demanding physical interaction with the teacher, and students have access to online instructional materials (Nguyen, 2015; Vaughan et al., 2017). Therefore, many universities, colleges, schools and even primary schools have shown interest in raising the level of e-learning platforms, thus encouraging both teachers and students to include promote the use of e-learning platforms in their everyday initiatives (Aldhafeeri & Khan, 2016; White, 2005). During the current situation of Covid-19 that the world is going through, many more teaching institutions are installing learning technology facilities in their classrooms, conference halls, and sometimes provide different technological devices such as tablets and computers, to improve internet connectivity, and deliver trainings for both teachers and students to improve computer literacy (Mirata et al., 2020; Vanslambrouck et al., 2018). Multimedia, web-based learning, computer-assisted learning, e-books, e-service-learning courses, e-library, e-business, and other emerging technologies that facilitate student learning may be part of learning technologies. Recent studies revealed that these learning technologies require internet and software applications designed to perform the desired tasks (Shorey et al., 2018; Vanslambrouck et al., 2018) and are effective cognitive tools that assist in multiple science practices (Herrington & Oliver, 2000). Learning technologies also allow learners to grow information actively (Novak & Krajcik, 2019).

As the current pandemic disease; Covid-19 has forced many governments around the world to close schools, teaching institutions are encouraged to help students from their families, as other studies have reported in similar cases (Ahmed et al., 2018; Mirata et al., 2020). In addition to other preventive measures, the Government of Rwanda also has recently introduced a lockdown across the country and announced school closures in addition to other various non-pharmaceutical initiatives to prevent further transmission of the latter disease as it changes unto severe forms. All teaching institutions, education sectors and partners need to support distance-learning to help students continue their studies remotely from their home. In addition to potential e-learning channels, both TV and radio are also contributing to this distance learning for primary schools and high schools, and the contribution of parents or guardians is required. However, a number of obstacles impede the effective achievement of the desired objectives and learning performance. Financial and communication difficulties, lack of access to infrastructure and energy, restricted access to the internet or networking, lack of well-trained teachers/facilitators or with less digital literacy and other technical skills can indeed be among the factors that the online education system faces. In some cases, inadequate assistance to facilitators as well as to some unprepared parents and workers can also be seen as difficulties (J. S. Krajcik & Mun, 2014; Lazarevic & Bentz, 2021). Higher education teachers often feel less confident in distance learning, highlighting a lack of pedagogical support and contributing to poor student-facilitator experiences (Bangert, 2006; Jaggars & Xu, 2016). In addition, educators with less experience in educational technology may also have insufficient technology-based pedagogical strategies to deliver the designed curricula (Jaggars & Xu, 2016). Many more factors, such as being new to e-learning platforms, would cause users to struggle to produce quality student performance, which may prevent them from gaining sufficient skills to meet the criteria for opportunities. Another challenge for teachers is to track students as they have to work independently and a student may give up in the case of a challenging subject, whereas the teacher seeks an effective pedagogical technique during a face-to-face to inspire poor learners (Dzemidzic Kristiansen et al., 2019; Dziuban et al., 2016). In this study, a tremendous effort was made to examine the impact of Covid-19 and its related challenges on the suggested alternative; distance learning system in Rwanda. The main objectives of this research study were to explore the influence of the selected factors that influenced the relationships between teaching and learning during Covid-19. Financial and communication issues, restricted access to technology and the internet or connectivity were the selected challenges that hindered the maintenance of a teacher-learner-centered approach during distance education/e-learning. Herein, we report the first data from the conducted survey that allowed to investigate the challenges that distance education faced during school closure in Rwanda due to Covid-19. The literature was used to review our results with other studies examining the contribution of learning technology to the promotion of student-centered learning methods or problem-based learning methods (J. Krajcik & Shin, 2014; Ronteltap & Eurlings, 2002; Stewart, 2015).

## 2. METHOD

The College of Science and Technology and College of Education at the University of Rwanda are responsible to prepare qualified facilitators to assist in the implementation of e-learning. One hundred and five (105) students registered in the undergraduate programs and thirty-seven (37) teaching staff of the public teaching colleges participated in this report, and the final number of participants was 142. One of the key requirements for inclusion was that the participants come from universities that use technological education to achieve social or academic benefits. Students from the fields of science and technology emphasized the last inclusion criteria. The selection criteria do not include either the specific number of males and females or the age. The participants' residence was considered to examine if it had any impact on the education system through the e-learning platforms provided. In order to achieve the purpose of this study, the data were randomly selected by means of the administration of an online anonymous questionnaire and the perceptual data were obtained from all 142 participants between the end of April and the end of October 2020. Each participant was first contacted and informed of the purpose of the study, and they all agreed to contribute. In order to contact participating teachers and students during the data collection, the survey items were composed of 5 close-ended questions. Two major questions that prompted us to conduct this study are: (1) What is the attitude of students and teachers to distance learning? (2). What is the effectiveness of the e-learning approach on the teaching-learning goals achievement? The questions proposed were comprehensive and divided into three categories; those addressed only to facilitators, those addressed only to students, and the last collection of questions consisted of questions addressed to both groups. The obtained data were carefully summarized and analyzed using Statistical Package for Social Sciences (SPSS) version 21, and the description statistics were used.

## 3. RESULT AND DISCUSSION

### Result

Similarly, to other pandemic diseases, Covid-19 and its related threats are a subject that has been discussed by numerous politicians, health professionals, academics, and the media, as was done during other recent pandemics, such as the 2009 H1N1 influenza (Cauchemez et al., 2014). During such circumstances, distance learning has been encouraged to facilitate teacher-student interactions. Our study highlights the severity and impact on the use of e-learning platforms of financial challenges, the communication aspect, limited access to technology facilities and the internet and time management. Our goal was not only to carry out this research on those challenges, but also to provide the recommendations of the participating groups. In this time or in other unique circumstances, this may also allow discussions on certain challenges and trigger policy makers and stakeholders to propose new strategies. According to standardized questions, all participants submitted data and information on their personal experiences during the school closure, and the answers and expectations differed between all the contacts. Some of the related works in the field of student-teacher engagement using e-learning platforms were used to be able to discuss our findings. The data summarizing the studies and the main findings evaluated (Table 1 and Figure 1) are reported here based on the selected scale items.

**Table 1.** Descriptive Statistical Data From Students and Facilitators

Variable		105 students		37 Facilitators	
		Frequen cy	Percentage (%)	Frequen cy	Percentage (%)
Residence location	Town	46	43.8	33	89.2
	Rural	59	56.2	4	10.8
E-learning as a std strategy	Yes	105	100	100	100
	No	0	0	0	0
Financial crisis	Yes	62	59	0	0
	No	43	41	100	100
Access to electricity	Yes	95	90.5	36	97.3
	No	10	9.5	1	2.7
Access to Connectivity	Yes	77	73.3	34	91.9
	No	28	26.7	3	8.1
Causes of poor connectivity	Location	3	2.9	0	0
	Finance	15	14.3	0	0
	Poor signal strength	3	2.9	3	8.1
	Lack of ICT	3	2.9	0	0

Variable	105 students		37 Facilitators		
	Frequen cy	Percentage (%)	Frequen cy	Percentage (%)	
Communication	tools				
	> than one cause	4	3.8	0	0
	No	77	73.3	34	91.9
	connectivity problem				
	Yes	71	67.6	28	75.7
Access to e-learning platform	No	26	24.8	1	2.7
	Seldom	8	7.6	8	21.6
	More often	23	21.9	20	54.1
Interaction on e-learning	Less often	47	44.8	11	29.7
	No	35	33.3	6	16.2
	Yes	19	18.1	15	40.5
e-Tutorial	No	32	30.5	6	16.2
	Seldom	54	51.4	16	43.2
	Yes	66	62.9	24	64.9
	No	39	37.1	13	35.1

The results showed that more than half of the students contacted; 59 (56.2%) left in rural areas, while 33 (89.2%) remained in different towns in Rwanda for the majority of facilitators. The implementation policy of the use of e-learning platforms was endorsed by all participants and all agreed that it was a normal education approach during the school closure period despite some limitations (see Figure 1). Most participants, 95 (90.5%) students and 36 (97.3%) facilitators, have access to electricity and can be considered as one of the requirements for educational technology. The data collected, however, showed that the financial crisis was a problem for e-learning-based education, and 62 (59 percent) of students were financially affected. Out of 142 participants, 77 (73.3%) and 33 (91.9%) facilitators have access to connectivity, while the other participants have access to connectivity; 28 (26.7%) students and only 3 (8.1%) facilitators had connectivity limitations, and a similar case was previously reported (Stewart, 2014). Some of the students identified comparatively different causes of poor connectivity, such as location, financial crisis, poor signal strength, lack of ICT tools, and others had more than one limitation, with 15 (14.3%) dominating the financial issue, while 3 (8.1%) were threatened by only poor signal strength.

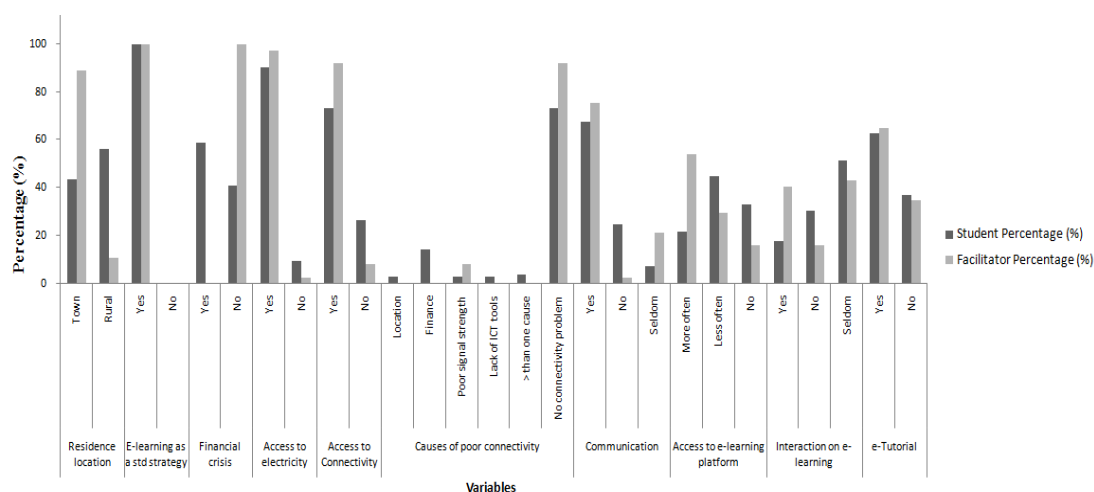


Figure 1. Distribution of Variables and Their Respective Percentage

Studies have shown that there is a great need for ongoing cooperation between all stakeholders, including students and university staff, to achieve educational objectives during online teaching pedagogy, as stated by other previous studies (Cavanaugh et al., 2009). During the current Covid-19 pandemic, however, a number of communication difficulties are commonly associated with e-learning or education systems. Due to the observed disconnection between some learners and their lecturers, the reported data from this study showed that

the recommended distance learning was negatively affected. 26 (24.8 %) students who could not participate in online contact with their teacher reported this difficulty, while only 1 (2.7 percent) facilitator was exposed to this effect. While some of the selected items were accessed by a number of students and facilitators, some of the participants were unable to access the suggested e-learning platforms effectively, impacting 35 (33.3 percent) students and 6 (16.2 %) facilitators. A large number of students also dominate this item; 47 (44.8 percent) and (29.7 percent) facilitators less frequently used the tool, which could be considered a serious challenge in distance learning strategy.

## Discussion

During the current situation of Covid-19 that the world is going through, many more teaching institutions are installing learning technology facilities in their classrooms, conference halls, and sometimes provide different technological devices such as tablets and computers, to improve internet connectivity, and deliver trainings for both teachers and students to improve computer literacy (Mirata et al., 2020; Vanslambrouck et al., 2018). Multimedia, web-based learning, computer-assisted learning, e-books, e-service-learning courses, e-library, e-business, and other emerging technologies that facilitate student learning may be part of learning technologies. Recent studies revealed that these learning technologies require internet and software applications designed to perform the desired tasks (Shorey et al., 2018; Vanslambrouck et al., 2018) and are effective cognitive tools that assist in multiple science practices (Herrington & Oliver, 2000). Learning technologies also allow learners to grow information actively (Novak & Krajcik, 2019). As the current pandemic disease; Covid-19 has forced many governments around the world to close schools, teaching institutions are encouraged to help students from their families, as other studies have reported in similar cases (Ahmed et al., 2018; Mirata et al., 2020). In addition to other preventive measures, the Government of Rwanda also has recently introduced a lockdown across the country and announced school closures in addition to other various non-pharmaceutical initiatives to prevent further transmission of the latter disease as it changes unto severe forms. All teaching institutions, education sectors and partners need to support distance-learning to help students continue their studies remotely from their home. In addition to potential e-learning channels, both TV and radio are also contributing to this distance learning for primary schools and high schools, and the contribution of parents or guardians is required. However, a number of obstacles impede the effective achievement of the desired objectives and learning performance. Financial and communication difficulties, lack of access to infrastructure and energy, restricted access to the internet or networking, lack of well-trained teachers/facilitators or with less digital literacy and other technical skills can indeed be among the factors that the online education system faces. In some cases, inadequate assistance to facilitators as well as to some unprepared parents and workers can also be seen as difficulties (J. S. Krajcik & Mun, 2014; Lazarevic & Bentz, 2021). Higher education teachers often feel less confident in distance learning, highlighting a lack of pedagogical support and contributing to poor student-facilitator experiences (Bangert, 2006; Jaggars & Xu, 2016). In addition, educators with less experience in educational technology may also have insufficient technology-based pedagogical strategies to deliver the designed curricula (Jaggars & Xu, 2016). Many more factors, such as being new to e-learning platforms, would cause users to struggle to produce quality student performance, which may prevent them from gaining sufficient skills to meet the criteria for opportunities. Another challenge for teachers is to track students as they have to work independently and a student may give up in the case of a challenging subject, whereas the teacher seeks an effective pedagogical technique during a face-to-face to inspire poor learners (Dzemidzic Kristiansen et al., 2019; Dziuban et al., 2016).

The findings found a significant association between e-learning platform access, e-learning engagement, and e-tutorials. Just 19 (18.1 %) students and 15 (40.5%) facilitators were able to engage with e-learning among the contacted participants. The e-tutorial activities were identified as useful tools, through tasks, exercises, and paper examples with answers, leading to the possible achievement of results. The practice was also investigated, and 39 (37.1%) students could not benefit this opportunity, whereas 13 (35.1 %) could not be able to facilitate students remotely. This limitation could also be one of the biggest barriers that impact education, which may hinder certain students and teachers to achieve the same academic outcomes. The general observation may predict that the e-learning teaching approach offered was impacted, and this may be due to the fact that this Covid-19 came when many individuals were not prepared for distance learning. This condition was a problem that was likely to impact students from disadvantaged families and rural areas, and this was highlighted as a barrier to continued e-learning.

## 4. CONCLUSION

The incorporation of distance-based learning methods in the education system is of great concern. This pedagogical approach needs several different stakeholders to participate. The present research highlights a study on various challenges that affected the implementation of e-learning during the Covid-19 study, and all



participants recognized that the above-mentioned learning strategies could help mitigate the pandemic during the dismissal of the class. However, some of the difficulties faced during the implementation of the suggested educational innovations have been demonstrated by all participating parties. The results showed that students were mainly impacted by the financial crisis, and this study showed a significant number of students and some lectures that faced connectivity limitations and could not access the recommended e-learning platforms effectively. The findings showed that students identified relatively different causes, such as the scarcity of ICT tools, and others had more than one constraint dominating the economic issue, while facilitators were challenged by weak signal strength. In general, e-learning was also related to a large gap in poor communication suggested by the disconnectedness between some students and their lecturers. The overall observation revealed that there was an effect on the usage of e-learning platforms in teaching, and the students were more influenced than their facilitators. This study predicted that learners from disadvantage families and rural areas have been strongly challenged.

## 5. REFERENCES

- Ahmed, F., Zviedrite, N., & Uzicanin, A. (2018). Effectiveness of workplace social distancing measures in reducing influenza transmission: a systematic review. *BMC Public Health*, 18(1), 1–13. <https://doi.org/10.1186/s12889-018-5446-1>.
- Alcaide, T. C. H., Solis, M. H., & Hontoria, J. F. (2020). Online learning tools in the era of m-learning: Utility and attitudes in accounting college students. *Sustainability (Switzerland)*, 12(12). <https://doi.org/10.3390/su12125171>.
- Aldhafeeri, F. M., & Khan, B. H. (2016). Teachers' and students' views on E-Learning readiness in Kuwait's secondary public schools. *Journal of Educational Technology Systems*, 45(2), 202–235. <https://doi.org/10.1177/0047239516646747>.
- Bangert, A. W. (2006). Identifying factors underlying the quality of online teaching effectiveness: An exploratory study. *Journal of Computing in Higher Education*, 17(2), 79–99. <https://doi.org/10.1007/BF03032699>.
- Cauchemez, S., Van Kerkhove, M. D., Archer, B. N., Cetron, M., Cowling, B. J., Grove, P., & Nicoll, A. (2014). School closures during the 2009 influenza pandemic: national and local experiences. *BMC Infectious Diseases*, 14(1), 1–11. <https://doi.org/10.1186/1471-2334-14-207>.
- Cavanaugh, C., Barbour, M., Brown, R., Diamond, D., Lowes, S., Powell, A., & Van der Molen, J. (2009). *Research Committee Issues Brief: Examining Communication and Interaction in Online Teaching*. International Association for K-12 Online Learning.
- Chen, C. H., & Yang, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review*, 26, 71–81. <https://doi.org/10.1016/j.edurev.2018.11.001>.
- Duță, N., & Martínez-Rivera, O. (2015). Between theory and practice: the importance of ICT in Higher Education as a tool for collaborative learning. *Procedia-Social and Behavioral Sciences*, 180, 1466–1473. <https://doi.org/10.1016/j.sbspro.2015.02.294>.
- Dzemidzic Kristiansen, S., Burner, T., & Johnsen, B. H. (2019). Face-to-face promotive interaction leading to successful cooperative learning: A review study. *Cogent Education*, 6(1). <https://doi.org/10.1080/2331186X.2019.1674067>.
- Dziuban, C. D., Moskal, P. D., Cassisi, J., & Fawcett, A. (2016). Adaptive Learning in Psychology: Wayfinding in the Digital Age. *Online Learning*, 20(3), 74–96. <https://eric.ed.gov/?id=EJ1113343>.
- Gregoriadis, A., & Grammatikopoulos, V. (2014). Teacher–child relationship quality in early childhood education: The importance of relationship patterns. *Early Child Development and Care*, 184(3), 386–402. <https://doi.org/10.1080/03004430.2013.790383>.
- Harrison, R. A., Harrison, A., Robinson, C., & Rawlings, B. (2018). The experience of international postgraduate students on a distance-learning programme. *Distance Education*, 39(4), 480–494. <https://doi.org/10.1080/01587919.2018.1520038>.
- Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development*, 48(3), 23–48. <https://doi.org/10.1007/BF02319856>.
- Jaggars, S. S., & Xu, D. (2016). How do online course design features influence student performance? *Computers & Education*, 95, 270–284. <https://doi.org/10.1016/j.compedu.2016.01.014>.
- Krajcik, J. S., & Mun, K. (2014). Promises and challenges of using learning technologies to promote student learning of science. In *Handbook of Research on Science Education* (pp. 351–374). Routledge.
- Krajcik, J., & Shin, N. (2014). Project-based learning. In *The cambridge handbook of the learning sciences* (pp. 275–297). Cambridge University Press.

- Lazarevic, B., & Bentz, D. (2021). Student perception of stress in online and face-to-face learning: the exploration of stress determinants. *American Journal of Distance Education*, 35(1), 2–15. <https://doi.org/10.1080/08923647.2020.1748491>.
- Martínez-Argüelles, M. J., & Batalla-Busquets, J. M. (2016). Perceived service quality and student loyalty in an online university. *International Review of Research in Open and Distributed Learning*, 17(4), 264–279. <https://doi.org/10.19173/irrodl.v17i4.2518>.
- Mirata, V., Hirt, F., Bergamin, P., & van der Westhuizen, C. (2020). Challenges and contexts in establishing adaptive learning in higher education: findings from a Delphi study. *International Journal of Educational Technology in Higher Education*, 17(1), 1–25. <https://doi.org/10.1186/s41239-020-00209-y>.
- Moubayed, A., Injadat, M., Shami, A., & Lutfiyya, H. (2020). Student engagement level in an e-learning environment: Clustering using k-means. *American Journal of Distance Education*, 34(2), 137–156. <https://doi.org/10.1080/08923647.2020.1696140>.
- Nguyen, T. (2015). The effectiveness of online learning: Beyond no significant difference and future horizons. *MERLOT Journal of Online Learning and Teaching*, 11(2), 309–319. [http://jolt.merlot.org/Vol11no2/Nguyen\\_0615.pdf](http://jolt.merlot.org/Vol11no2/Nguyen_0615.pdf).
- Novak, A. M., & Krajcik, J. S. (2019). A case study of project-based learning of middle school students exploring water quality. In *The Wiley Handbook of Problem-Based Learning* (pp. 551–572). Wiley Online Library. <https://doi.org/10.1002/9781119173243.ch24>.
- Pham, L., Limbu, Y. B., Bui, T. K., Nguyen, H. T., & Pham, H. T. (2019). Does e-learning service quality influence e-learning student satisfaction and loyalty? Evidence from Vietnam. *International Journal of Educational Technology in Higher Education*, 16(1), 1–26. <https://doi.org/10.1186/s41239-019-0136-3>.
- Ronteltap, F., & Eurelings, A. (2002). Activity and interaction of students in an electronic learning environment for problem-based learning. *Distance Education*, 23(1), 11–22. <https://doi.org/10.1080/01587910220123955>.
- Seale, J., Colwell, C., Coughlan, T., Heiman, T., Kaspi-Tsahor, D., & Olenik-Shemesh, D. (2021). ‘Dreaming in colour’: disabled higher education students’ perspectives on improving design practices that would enable them to benefit from their use of technologies. *Education and Information Technologies*, 26(2), 1687–1719. <https://doi.org/10.1007/s10639-020-10329-7>.
- Shorey, S., Siew, A. L., & Ang, E. (2018). Experiences of nursing undergraduates on a redesigned blended communication module: A descriptive qualitative study. *Nurse Education Today*, 61, 77–82. <https://doi.org/10.1016/j.nedt.2017.11.012>.
- Stewart, T. Y. (2015). *Effects of limited technology and internet access within a low income, rural community*. Nova Southeastern University.
- Vanslambrouck, S., Zhu, C., Lombaerts, K., Philipsen, B., & Tondeur, J. (2018). Students’ motivation and subjective task value of participating in online and blended learning environments. *The Internet and Higher Education*, 36, 33–40. <https://doi.org/10.1016/j.iheduc.2017.09.002>.
- Vaughan, N., Reali, A., Stenbom, S., Van Vuuren, M. J., & MacDonald, D. (2017). Blended learning from design to evaluation: International case studies of evidence-based practice. *Online Learning*, 21(3), 103–114. <https://eric.ed.gov/?id=EJ1154157>.
- Wang, C., & Zhao, H. (2020). The Impact of COVID-19 on Anxiety in Chinese University Students. *Frontiers in Psychology*, 11(May), 1–8. <https://doi.org/10.3389/fpsyg.2020.01168>.
- White, C. (2005). Contribution of distance education to the development of individual learners. *Distance Education*, 26(2), 165–181. <https://doi.org/10.1080/01587910500168835>.
- Yen, S. C., Lo, Y., Lee, A., & Enriquez, J. (2018). Learning online, offline, and in-between: comparing student academic outcomes and course satisfaction in face-to-face, online, and blended teaching modalities. *Education and Information Technologies*, 23(5), 2141–2153. <https://doi.org/10.1007/s10639-018-9707-5>.