



## Self-efficacy and Academic Performance of Mathematics Students in a South African University during the COVID-19 Pandemic

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### ABSTRACT

Students' learning contexts are capable of having a significant impact on their learning beliefs and academic performance. As a result, students studying during the COVID-19 pandemic outbreak may be at risk of lower academic self-efficacy and subject grades. These students may also hold specific ideas regarding the impact of COVID-19-related changes on their ability to succeed, which could have a direct impact on their self-efficacy and academic performance. Thus, this study seeks to examine how the COVID-19 pandemic has affected the self-efficacy and academic performance of mathematics students in a South African university. The paper also sought to examine how teaching and learning in a mathematics education classroom can be sustained post-COVID-19 pandemic. As such, the study was underpinned by an interpretivist paradigm. The study employed a qualitative research approach and a case study design in which the participants of the study were mathematics education lecturers, heads of departments, and pre-service mathematics student-teachers registered for the 2019/20 academic session at the faculty of education in the selected university. Data for the study was collected through the use of a semi-structured interview. The findings of the study revealed that although students' self-efficacy is adversely impacted by negative emotions like tension, the psychological strain of confinement, academic workload demands, online assessment, and the loss of relatives brought on by the COVID-19 pandemic, these factors have no impact on students' academic performance. Furthermore, findings revealed that for the teaching and learning of mathematics education to be sustained post-COVID-19 pandemic, there is a dire need for a change in curriculum as well as the pedagogical approaches. Based on the findings of the study, it was concluded that even though the original goal of the sudden transition in the education system was to salvage the academic year, it is now evident that maintaining teaching and learning in higher education institutions will require more than just changing instructional delivery but mathematics education lecturers should adopt the lessons learned from online instruction and develop opportunities for a hybrid approach to teaching-learning.

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## INTRODUCTION

The COVID-19 pandemic has transformed educational institutions, particularly higher education. With the abrupt switch to deal with the pandemic's outbreak, teaching and learning moved from face-to-face to an online platform, requiring students to carry out activities online from their own homes rather than on campus. This situation necessitated innovative ways of teaching and learning in all sectors of education, one of which is online learning.<sup>1</sup> While the transition to a virtual platform needs the remote availability of technology to assist lesson delivery and continued contact among students, parents, and other stakeholders, ensuring that this technological gadget is accessible to all poses a significant problem.<sup>2</sup> This sudden transition also posed a problem for several fields of science, particularly mathematics, which requires intensive face-to-face processes for students to develop an understanding of their concepts.<sup>3</sup> Similarly, “the challenge for mathematics teacher educators whose pre-pandemic on-campus classes were characterized by interactive activities was to devise alternative ways to provide appropriate mathematical experiences to their learners,”<sup>4</sup> such as scaffolding of complex learning content, and making use of concrete representations of concepts that are abstract.<sup>5</sup>

While it has been argued that one of the important factors in learning mathematics besides the cognitive factor is the affective factor,<sup>6</sup> self-efficacy is believed to be one of the affective factors that might influence student learning.<sup>7</sup> This is because, when students conduct an investigation, their actions, efforts, persistence, flexibility in differences, and goal realisation are influenced by their self-efficacy.<sup>8</sup> Thus, self-efficacy is described by Bandura as a student's evaluation of his or her capacity to achieve the desired or established level of performance, which affects subsequent actions.<sup>9</sup>

<sup>1</sup> Babawande Emmanuel Olawale and Bonginkosi Mutongoza, “Digital Transformation in Higher Education Institutions: Issues of Functionality amid the COVID-19 Pandemic,” in *10th International Conference of Global Education Network (GEN), East London, 2021*, 265–75.

<sup>2</sup> Vusi Mncube and Emmanuel Olawale, “Empowering Teachers for ELearning in South African Schools: Readiness for the Fourth Industrial Revolution?,” in *ICERI Conference* (Seville, Spain, 2019), 36–44, <https://doi.org/10.21125/iceri.2019.0021>; Anjali Khirwadkar et al., “Reimagining Mathematics Education During the COVID-19 Pandemic,” *Brock Education Journal* 29, no. 2 (September 5, 2020): 42, <https://doi.org/10.26522/brocked.v29i2.839>; Vusi Mncube and Emmanuel Olawale, “Managing Higher Education Institutions in the Context of Covid-19 Stringency: Experiences of Stakeholders at a Rural South African University,” *Perspectives in Education* 39, no. 1 (2021), <https://doi.org/10.18820/2519593X/pie.v39.i1.24>.

<sup>3</sup> Endah Wulantina et al., “Self-Efficacy of Mathematics Students” on e-Learning during Covid 19 Pandemic,” *PROCEEDING UMSURABAYA* 0, no. 0 (September 8, 2020): 109–15, <http://journal.um-surabaya.ac.id/index.php/Pro/article/view/5965>; Emmanuel Olawale, Winston Hendricks, and Vusi Mncube, “Rethinking Assessment in Mathematics Teacher Education Programme during COVID-19 Pandemic,” 2021, 10056–62, <https://doi.org/10.21125/iceri.2021.1899>.

<sup>4</sup> Sharyn Livy et al., “Creative Approaches to Teaching Mathematics Education with Online Tools during COVID-19,” *International Journal of Mathematical Education in Science and Technology* 53, no. 3 (March 16, 2022): 573–81, <https://doi.org/10.1080/0020739X.2021.1988742>.

<sup>5</sup> Barbara Means, Marianne Bakia, and Robert Murphy, *Learning Online* (Routledge, 2014), <https://doi.org/10.4324/9780203095959>; Livy et al., “Creative Approaches to Teaching Mathematics Education with Online Tools during COVID-19.”

<sup>6</sup> H.R.P Negara et al., “Mathematics Self Efficacy and Mathematics Performance in Online Learning,” *Journal of Physics: Conference Series* 1882, no. 1 (May 1, 2021): 012050, <https://doi.org/10.1088/1742-6596/1882/1/012050>.

<sup>7</sup> Moon-Heum Cho and Demei Shen, “Self-Regulation in Online Learning,” *Distance Education* 34, no. 3 (November 2013): 290–301, <https://doi.org/10.1080/01587919.2013.835770>; Einar M. Skaalvik, Roger A. Federici, and Robert M. Klassen, “Mathematics Achievement and Self-Efficacy: Relations with Motivation for Mathematics,” *International Journal of Educational Research* 72 (2015): 129–36, <https://doi.org/10.1016/j.ijer.2015.06.008>; Ya-Ling Wang et al., “Identifying Taiwanese Junior-High School Students’ Mathematics Learning Profiles and Their Roles in Mathematics Learning Self-Efficacy and Academic Performance,” *Learning and Individual Differences* 54 (February 2017): 92–101, <https://doi.org/10.1016/j.lindif.2017.01.008>.

<sup>8</sup> Negara et al., “Mathematics Self Efficacy and Mathematics Performance in Online Learning.”

<sup>9</sup> Albert Bandura, *Self-Efficacy: The Exercise of Control.*, *Self-Efficacy: The Exercise of Control.* (New York, NY, US: W H Freeman/Times Books/ Henry Holt & Co, 1997).

According to Ma et al., self-efficacy is the belief that one can carry out foreseeable daily tasks, which affects one's ability to make decisions.<sup>10</sup> As a result, highly efficacious people tend to set more challenging goals, are more resilient, and feel fewer negative emotions as they work toward their objectives.<sup>11</sup> Therefore, student self-efficacy appears to be crucial in tough learning situations, such as online learning, where students do not have the opportunity to engage with others and may feel socially isolated. Several studies indicate that self-efficacy beliefs may weaken with increased anxiety, depression, dissatisfaction, and weariness during the COVID-19 outbreak.<sup>12</sup> While some studies imply that self-efficacy beliefs are resistant to outside effects, there is also evidence that they can alter in response to interventions and over time. Therefore, understanding self-efficacy in online learning during the COVID-19 pandemic is critical to improving online education, which can be an important component of academic achievement in remote education.<sup>13</sup>

Although some levels of arousal are beneficial for learning, studies have shown that stress, anxiety, and depression negatively affect memory and academic performance.<sup>14</sup> Furthermore, it is suggested that the psychosocial and psychological effects of the COVID-19 pandemic outbreak may negatively affect students' academic performance in addition to the practical effects of the COVID-19 pandemic outbreak on learning experiences. In academic settings, self-efficacy is usually regarded as one of the most important non-intellectual determinants of performance. According to studies such as Multon et al., a meta-analysis of the relationship between self-efficacy and academic achievement typically has a favourable connection.<sup>15</sup> This is because self-efficacy plays an important role and is the main influencer of one's performance in a particular task.<sup>16</sup> It is also argued that self-efficacy affects the prediction of motivation and performance.<sup>17</sup> As such, the authors suggested that a low level of self-efficacy can contribute to avoidance behavior and low academic performance.<sup>18</sup>

While reviews of studies revealed that self-efficacy was the most potent student-related predictor of success in higher education, other studies revealed that, when prior academic achievement is considered, self-efficacy remains a positive, if moderate, predictor of academic performance.<sup>19</sup> As such, academic self-efficacy is a crucial factor to consider in the university setting because it reveals

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<sup>10</sup> Kang Ma et al., "Online Teaching Self-Efficacy during COVID-19: Changes, Its Associated Factors and Moderators," *Education and Information Technologies* 26, no. 6 (November 10, 2021): 6675–97, <https://doi.org/10.1007/s10639-021-10486-3>.

<sup>11</sup> Moon-Heum Cho and David Jonassen, "Development of the Human Interaction Dimension of the Self-Regulated Learning Questionnaire in Asynchronous Online Learning Environments," *Educational Psychology* 29, no. 1 (January 9, 2009): 117–38, <https://doi.org/10.1080/01443410802516934>. Moon-Heum Cho, Shen Demei, and James Laffey, "Relationships between Self-Regulation and Social Experiences in Asynchronous Online Learning Environments.," *Journal of Interactive Learning Research* 21, no. 3 (July 2010): 297–316; Negara et al., "Mathematics Self Efficacy and Mathematics Performance in Online Learning."

<sup>12</sup> Kate Talsma et al., "COVID-19 Beliefs, Self-Efficacy and Academic Performance in First-Year University Students: Cohort Comparison and Mediation Analysis," *Frontiers in Psychology* 12 (June 22, 2021), <https://doi.org/10.3389/fpsyg.2021.643408>.

<sup>13</sup> Negara et al., "Mathematics Self Efficacy and Mathematics Performance in Online Learning."

<sup>14</sup> Talsma et al., "COVID-19 Beliefs, Self-Efficacy and Academic Performance in First-Year University Students: Cohort Comparison and Mediation Analysis."

<sup>15</sup> Karen D. Multon, Steven D. Brown, and Robert W. Lent, "Relation of Self-Efficacy Beliefs to Academic Outcomes: A Meta-Analytic Investigation.," *Journal of Counseling Psychology* 38, no. 1 (January 1991): 30–38, <https://doi.org/10.1037/0022-0167.38.1.30>.

<sup>16</sup> Sebastián Bruque, José Moyano, and Ronald Piccolo, "OCB and External–Internal Social Networks: Effects on Individual Performance and Adaptation to Change," *The International Journal of Human Resource Management* 27, no. 1 (January 2, 2016): 1–22, <https://doi.org/10.1080/09585192.2015.1020441>.

<sup>17</sup> Bruque, Moyano, and Piccolo, "OCB and External–Internal Social Networks: Effects on Individual Performance and Adaptation to Change," 1-22.

<sup>18</sup> Talsma et al., "COVID-19 Beliefs, Self-Efficacy and Academic Performance in First-Year University Students: Cohort Comparison and Mediation Analysis."

<sup>19</sup> Jeffrey C. Valentine, David L. DuBois, and Harris Cooper, "The Relation Between Self-Beliefs and Academic Achievement: A Meta-Analytic Review," *Educational Psychologist* 39, no. 2 (June 2004): 111–33, [https://doi.org/10.1207/s15326985ep3902\\_3](https://doi.org/10.1207/s15326985ep3902_3).

students' aspirations for the future based on their aptitudes, such as motivation for achievement, access to scholarships, academic success, or persistence in higher education.<sup>20</sup> However, given that we quickly switched from in-person instruction to remote emergency instruction during this period of confinement, it is crucial to investigate whether this improvised change brought on by the pandemic has an impact on the perceived self-efficacy of mathematics education students to succeed academically in a South African university given that they were unprepared. Hence, the study sought to answer two questions: How has the COVID-19 pandemic affected the self-efficacy and academic performance of mathematics students? And how can teaching and learning in a mathematics education classroom be sustained post-COVID-19 pandemic?

## RESEARCH METHOD

Under an interpretivist paradigm, the present study employed a qualitative research approach and a case study design. A qualitative approach was found suitable for the study because it allows the researchers to critically examine how the pandemic affects mathematics education students' perceived self-efficacy to achieve academic success and how teaching and learning mathematics can be sustained post-COVID-19 pandemic. Similarly, the researchers wanted to examine the above phenomenon in its actual, and natural environment, so a case study design was appropriate.<sup>21</sup> For this study, the population comprises two mathematics education lecturers, one head of school and twenty pre-service mathematics student teachers registered for the 2019/20 academic session at the faculty of education in a selected higher education institution in the Eastern Cape Province, South Africa. As such, the purposive sampling technique was employed to select twenty pre-service mathematics student teachers, two mathematics education lecturers, and a science education head of school, making a sample total of twenty-three participants. The purposive sampling technique was deemed suitable because it enables the researchers to select by hand the cases required for the sample by inferring their applicability to the investigation. In this manner, the researchers gathered and used samples relevant to the research topic.<sup>22</sup>

For the present study, the researchers used a semi-structured interview to investigate how the COVID-19 pandemic affects mathematics education students' perceived self-efficacy to achieve academic success and how teaching and learning mathematics can be sustained post-COVID-19 pandemic. Because semi-structured interviews enable the researchers to ask more questions when subjects provide ambiguous or incomplete answers, it was therefore deemed appropriate. This in-depth interview was audiotaped and framed by both formal and informal conversations that lasted for approximately 10-15 minutes. The thematic analysis proposed by Marshall and Rossman, which comprises six steps, was employed to analyse the data gathered for this present study.<sup>23</sup> Triangulation was employed to ensure data validity. According to Cohen et al., to increase the validity of research findings, researchers may consider triangulating multiple sites, sources, and data collection techniques.<sup>24</sup> The main ethical issues for this study were the topic of confidentiality, anonymity, and privacy. Before the start of data collection, this requirement was discussed and accepted. Additionally, participants were given a choice to leave the study at anytime, in which case their responses would not be used in the analysis.

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<sup>20</sup> María Andrea Borzone Valdebenito, "Autoeficacia y Vivencias Académicas En Estudiantes Universitarios," *Acta Colombiana de Psicología* 20, no. 1 (2017): 266–83, <https://doi.org/10.14718/ACP.2017.20.1.13>.

<sup>21</sup> Robert Yin, "The Case Study Crisis: Some Answers," in *Case Studies* (1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom : SAGE Publications Ltd, 2014), <https://doi.org/10.4135/9781473915480.n38>.

<sup>22</sup> Louis Cohen, Lawrence Manion, and Keith Morrison, *Research Methods in Education* (Eighth edition. | New York: Routledge, 2018.: Routledge, 2017), <https://doi.org/10.4324/9781315456539>.

<sup>23</sup> C. Marshall, and G. Rossman, *Designing Qualitative Research* (5th ed.). (Thousand Oaks: Sage Publications 2011).

<sup>24</sup> Cohen, Manion, and Morrison, *Research Methods in Education*.

## RESULTS AND DISCUSSION

The present study investigates how the COVID-19 pandemic has affected the self-efficacy and academic performance of mathematics students in a South African University. As such, results and discussions were presented under the following themes:

- Impact of COVID-19 pandemic on mathematics students' self-efficacy and academic performance
- Sustaining teaching and learning in a mathematics education classroom post-COVID-19 pandemic

### **Impact of COVID-19 pandemic on mathematics students' self-efficacy and performance**

To elicit information regarding the impact of the pandemic on mathematics students' self-efficacy and academic performance, participants were asked: "how has the COVID-19 pandemic affected mathematics education students' confidence in their ability to perform well?" Research findings revealed that negative emotions such as tension, the psychological pressure of confinement, academic workload demands, online assessment, and the death of relatives and close friends caused by the COVID-19 pandemic negatively affect the perception of students' self-efficacy but did not affect students' academic performance. For instance, a participant stated,

*...the sudden outbreak of the COVID-19 pandemic forced us [students] back home. Having to attend classes online caused a lot of concern and anxiety for me and most of my colleagues. We [students] were not prepared at all for such transitioning. Also, the loss of one of my family members during the pandemic period makes me feel very sad, stressed and helpless to the point that I feel like taking the whole academic year off. This lowered my belief in myself for the successful completion of the academic year. However, in terms of academic performance, I was able to pass all the registered modules. (Pre-service mathematics student-teacher 9)*

Similarly, another participant added that,

*...the fear of the COVID-19 pandemic affected my confidence because we [students] were made to believe that we could not get the required support from important people such as our families, friends, and even our lecturers, given that everyone was forced to stay home. This makes me feel stressed, isolated, and vulnerable to mental health issues – despite these challenges, which lower my self-confidence in my abilities, my grades were not much affected because the online platforms give me access to several information needed to complete the given tasks by several lecturers. (Pre-service mathematics student-teacher 11)*

The head of the department, who was of the view that COVID-19 pandemic-related beliefs (with regards to health importance, information seeking, and perceived immunity) contributed to students' stress which affected their self-efficacy, but not academic performance, stated,

*During the first few months of the emergence of COVID-19, little was known about the health implication of this virus. As different information continued to circulate, the majority of the information gathered on social media was conflicting and misleading, which created a lot of fear and anxiety in the university community. This increased controversial information gave most of the staff and students a feeling that we were less efficient in dealing with pandemic-related issues. Although this upheaval significantly dropped our spirit in several ways, however, the overall performance both at the department was encouraging, including that of the majority of our students. (Head of Department)*

While it was expected that the psychological and psychosocial disturbances associated with the COVID-19 pandemic would be linked with poor academic performance, this was not the case. As such, a participant explained,

*Due to the nature of the virus and the fact that it is very contagious, most of my students experienced this situation with an increase in anxiety, depression, and other stress reactions. While the situation of uncertainty and ignorance about the disease was very high, this generated a lot of concerns given the challenges they faced with the closure of the university. As such, the common problems with online learning such as the availability of the internet to students who live in provincial and rural areas, the ability to teach, learn and assess the mathematical concepts on an online platform, shortness of the available time to solve the online tests, and spending a long time on online learning led to the loss of motivation, interest and increased level of anxiety which lowers student self-confidence. However, given the nature in which students' tasks were assessed and the special arrangements made by the faculty to carry all students along, academic performance was not negatively affected. (Mathematics education lecturer 2)*

In line with the above, another participant reiterates that,

*...the stress generated by the academic context, such as the overload of tasks in various modules, pressure due to work and assignment submission, shortness of time for online assessment, and less interaction due to no contact between students and lecturers, makes it very boring. It makes one [students] to easily lose concentration. This has lowered the expectation of my confidence and ability [self-efficacy], but surprisingly, my academic performance was not negatively affected. (Pre-service mathematics student-teacher 2).*

Research findings revealed that while the COVID-19-pandemic-related changes lowered mathematics student self-efficacy, it was not sufficiently impactful to influence performance outcomes. As such, the stress generated by the academic context such as tasks overload, academic pressure, constant and voluminous assessment, and common online problems such as the availability of learning devices and the internet, shortness of time for assessment, inability to effectively make use of mathematical concepts and notation in an online platform amongst many lowered mathematics students' self-efficacy. These findings support Xiao's contention that the psychological pressure of restraint, combined with academic pressures, workloads, and online assessments, negatively affects the perception of academic self-efficacy, resulting in higher levels of anxiety among university students.<sup>25</sup> In addition, Alemany-Arrebola et al. add that stressful conditions such as the pandemic and students' confinement, combined with catastrophic events such as illness and loss of relatives during the COVID-19 pandemic, increased anxiety, which influences academic self-efficacy.<sup>26</sup> It also became evident in the study's findings that fear experienced during the COVID-19 pandemic outbreak affected the self-efficacy perception of students as they were unable to seek support from their family, friends, and lecturers. This finding also corroborates that of Yenen and Çarkit, who found that the fear of the COVID-19 pandemic had a negative impact on general efficacy and perceived social support.<sup>27</sup>

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<sup>25</sup> Chunfeng Xiao, "A Novel Approach of Consultation on 2019 Novel Coronavirus (COVID-19)-Related Psychological and Mental Problems: Structured Letter Therapy," *Psychiatry Investigation* 17, no. 2 (February 25, 2020): 175–76, <https://doi.org/10.30773/pi.2020.0047>.

<sup>26</sup> Inmaculada Alemany-Arrebola et al., "Influence of COVID-19 on the Perception of Academic Self-Efficacy, State Anxiety, and Trait Anxiety in College Students," *Frontiers in Psychology* 11 (October 9, 2020), <https://doi.org/10.3389/fpsyg.2020.570017>.

<sup>27</sup> Emin Tamer Yenen and Ersoy Çarkit, "Fear of COVID-19 and General Self-Efficacy among Turkish Teachers: Mediating Role of Perceived Social Support," *Current Psychology*, October 20, 2021, <https://doi.org/10.1007/s12144-021-02306-1>.

Therefore, given the negative impact of the COVID-19 pandemic, the above findings revealed that anxiety in the university community, as well as the general environment, affects individuals' self-efficacy but not academic performance. These findings are consistent with several other studies which suggest that although students may experience the negative impact of the COVID-19 pandemic, these experiences do not necessarily mean that academic performance will be affected.<sup>28</sup> Hence, a growing body of evidence suggests that academic performance is always stable over time and the only constant factors that can be used to predict academic performance in any circumstance are genes, demographics, socioeconomic status, parental educational background, intelligence, and prior achievements.<sup>29</sup> Therefore, based on the research findings, it might then be that the COVID-19 pandemic-related challenges that mathematics students experienced do not have a significant enough impact capable of affecting academic performance in the context of the stable factors that were strongly predictive of academic outcomes as described above.

### **Sustaining teaching and learning in mathematics education post-COVID-19 pandemic**

While it is evident that we cannot return to the world as before, it becomes paramount to examine how teaching and learning can be sustained after the pandemic. Therefore, research participants were asked: "how do you think the teaching and learning of mathematics should be sustained post-COVID-19 pandemic?" Research findings revealed that teaching and learning post-COVID-19 pandemic should be viewed as a means of achieving lifelong learning, fulfillment, betterment, happiness, opportunity, and contribution to humanity. As such, participants highlighted the need for a change in pedagogy in mathematics education, as well as the need for a new curriculum that will allow student personalisation and the development of new competencies for the new age. For instance, a participant stated,

*...although the changes that occurred in the education system were not the type of changes we require for sustenance in the post-COVID-19 pandemic world. The changes that we need that will keep the teaching and learning of mathematics going after the pandemic must start from the curriculum. We need a change in the mathematics education curriculum – we need a curriculum that will be able to respond to a number of needs, develop new competencies amongst students for the computer age, as well as a curriculum that will be co-developed by students so that they will be able for follow their passions and strengths. (Mathematics education lecturer 1)*

A participant added,

*Teaching and learning of mathematics post-pandemic should focus on more effective models which should be a combination of asynchronous and synchronous learning. So, instead of going back to the face-to-face method of teaching and learning, lecturers may consider a well-designed mixed-methods delivery of instruction – this will not allow us [students] to attend classes at the same time in the same place, which will allow us to have autonomy of our own learning. (Pre-service mathematics student- teacher 8)*

In addition to how teaching and learning of mathematics should be sustained after the COVID-19 pandemic, another participant explained,

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<sup>28</sup> Talsma et al., "COVID-19 Beliefs, Self-Efficacy and Academic Performance in First-Year University Students: Cohort Comparison and Mediation Analysis."

<sup>29</sup> Kaili Rimfeld et al., "The Stability of Educational Achievement across School Years Is Largely Explained by Genetic Factors," *Npj Science of Learning* 3, no. 1 (December 4, 2018): 16, <https://doi.org/10.1038/s41539-018-0030-0>; Sophie Stumm et al., "Predicting Educational Achievement from Genomic Measures and Socioeconomic Status," *Developmental Science* 23, no. 3 (May 2020), <https://doi.org/10.1111/desc.12925>.

*With the rate at which the pandemic has rapidly changed the way we do things, one can tell that lifelong careers and traditional employment pathways will not continue the way they have been over the years. You can tell from how technology took over every aspect of education during the outbreak. So, for higher education institutions to sustain teaching and learning after the pandemic, our lecturers must focus more on preparing students to be human educators who will serve as a consultant and resource curators rather than teaching machines. (Head of Department).*

Another participant added that

*...our lecturers must find ways of teaching online after the pandemic so that we [students] are encouraged to learn online. For instance, in a mathematics classroom, practical learning through interactive tools such as wolfram, EquatIO, Kahoot, and Smartboards which were used during the pandemic, should be revisited and provided together with the lecturer's notes and these tools should continue to be promoted for future instances of virtual learning or any unforeseen circumstances that might occur. (Pre-service mathematics student-teacher 16)*

A participant believed that pedagogy needed to change for mathematics education to help students thrive in the era of intelligent machines and the globalised world brought about by the COVID-19 pandemic ads.

*...while the pandemic has revealed that the digital divide is a significant issue around the world, mathematics education post-COVID-19 pandemic should be re-imagined so that technology can be incorporated into all aspects of its teaching and learning which will therefore make education more equitable for all. As such, all this transformation will require a new form of pedagogy that will assist students in developing their abilities. (Pre-service mathematics student-teacher 13)*

Research findings revealed that sustaining teaching and learning in mathematics education post-COVID-19 pandemic will require a combination of multiple factors, which include curriculum changes that respond to the needs of students and that of the immediate society, the development of new competencies amongst students for the computer age, and personalisation of students learning. These findings concur with that of Zhao and Watterston, who argued that it is obvious that lifelong careers and traditional employment pathways will not exist in the way they have for previous generations, given the rapidity of change we are already experiencing as a result of the pandemic.<sup>30</sup> As a result, there is a need for a new curriculum that aids students in developing new competencies for the new age, assists students in thriving in the era of smart machines and a globalised world and instructs students on how to be creative, entrepreneurial, and capable of working across borders.<sup>31</sup>

Research findings also revealed that to sustain the teaching and learning of mathematics post-COVID-19 pandemic, the higher institutions of learning should continue to explore different online learning resources/tools as well as innovative and effective models which enable a more desired way of learning. Findings also revealed that teaching and learning post-COVID-19 pandemic would require a change in pedagogy as well as a well-balanced mix of both synchronous and asynchronous sessions, which will help reduce stress, disengagement, and minimise personal interaction, as evident in the previous traditional approach to teaching and learning. These findings are similar to those of other

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<sup>30</sup> Yong Zhao and Jim Watterston, "The Changes We Need: Education Post COVID-19," *Journal of Educational Change* 22, no. 1 (February 18, 2021): 3–12, <https://doi.org/10.1007/s10833-021-09417-3>.

<sup>31</sup> Yong Zhao, "Personalizable Education for Greatness," *Kappa Delta Pi Record* 54, no. 3 (July 3, 2018): 109–15, <https://doi.org/10.1080/00228958.2018.1481645>; Zhao and Watterston, "The Changes We Need: Education Post COVID-19."

researchers, who stated that online learning is efficient, but a well-planned mixed-mode delivery of online and in-person instruction is more efficient, especially during this period, should there be future instances of virtual learning.<sup>32</sup> Ahmed et al., as well as Zhao and Watterston, add that these pedagogical changes are essential in the post-pandemic era because they allow students the flexibility of not having to show up for a class at set times or to receive instruction at the same place. As a result, students are free to work on their projects and contact their teachers or peers as needed.<sup>33</sup> According to Zhao and Watterston, instead of requiring students to memorise solutions to well-known problems, this new pedagogical approach to teaching must place a strong emphasis on student-initiated exploration of solutions to real-world problems with a real-world significance which will be required in the transformation process.<sup>34</sup>

## CONCLUSION

As higher education institutions enter the COVID-19 recovery phase, it is vital to examine whether improvised change caused by the pandemic affects mathematics education students' perceived self-efficacy to achieve academic success given that they were unprepared. Although students were overwhelmed by the negative impact of the COVID-19 pandemic, which led to increased anxiety and other stress reactions that affected their perceived self-efficacy, it has no significant impact on mathematics students' academic performance. This is because the sudden shift to online learning gave students an opportunity for self-study, which keeps students up and running. While this transition was to salvage the education system during the outbreak of the pandemic, it now becomes more evident that sustaining teaching and learning in higher education institutions will need to go beyond simply changing instructional delivery. As such, the lessons learned from online instruction must be embraced by mathematics education lecturers, who must also create opportunities for a hybrid approach to teaching, learning, and assessment.

## BIBLIOGRAPHY

- Ahmed, Samar A., Nagwa N. Hegazy, Hany W. Abdel Malak, W. Cliff Kayser, Noha M. Elrafie, Mohammed Hassanien, Abdulmonem A. Al-Hayani, Sherif A. El Saadany, Abdulrahman O. AI-Youbi, and Mohamed H. Shehata. "Model for Utilizing Distance Learning Post COVID-19 Using (PACT)<sup>TM</sup> a Cross Sectional Qualitative Study." *BMC Medical Education* 20, no. 1 (December 2, 2020): 400. <https://doi.org/10.1186/s12909-020-02311-1>.
- Aleman-Arrebola, Inmaculada, Gloria Rojas-Ruiz, Juan Granda-Vera, and Ángel Custodio Mingorance-Estrada. "Influence of COVID-19 on the Perception of Academic Self-Efficacy, State Anxiety, and Trait Anxiety in College Students." *Frontiers in Psychology* 11 (October 9, 2020). <https://doi.org/10.3389/fpsyg.2020.570017>.
- Bandura, Albert. *Self-Efficacy: The Exercise of Control*. *Self-Efficacy: The Exercise of Control*. New York, NY, US: W H Freeman/Times Books/ Henry Holt & Co, 1997.
- Borzzone Valdebenito, María Andrea. "Autoeficacia y Vivencias Académicas En Estudiantes Universitarios." *Acta Colombiana de Psicología* 20, no. 1 (2017): 266–83. <https://doi.org/10.14718/ACP.2017.20.1.13>.
- Bruque, Sebastián, José Moyano, and Ronald Piccolo. "OCB and External–Internal Social Networks: Effects on Individual Performance and Adaptation to Change." *The International Journal of*

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<sup>32</sup> Means et. al. *Learning online: What research tells us about whether, when and how*; K.E. Rudestam, & J. Schoenholz-Read, J. *Handbook of Online Learning (2nd edition ed.)*. (Calif: SAGE Publications, 2010); Zhao, "Personalisable education for greatness."

<sup>33</sup> Samar A. Ahmed et al., "Model for Utilizing Distance Learning Post COVID-19 Using (PACT)<sup>TM</sup> a Cross Sectional Qualitative Study," *BMC Medical Education* 20, no. 1 (December 2, 2020): 400, <https://doi.org/10.1186/s12909-020-02311-1>.

<sup>34</sup> Zhao and Watterston, "The Changes We Need: Education Post COVID-19."

- Human Resource Management* 27, no. 1 (January 2, 2016): 1–22.  
<https://doi.org/10.1080/09585192.2015.1020441>.
- Cho, Moon-Heum, Shen Demei, and James Laffey. “Relationships between Self-Regulation and Social Experiences in Asynchronous Online Learning Environments.” *Journal of Interactive Learning Research* 21, no. 3 (July 2010): 297–316.
- Cho, Moon-Heum, and Demei Shen. “Self-Regulation in Online Learning.” *Distance Education* 34, no. 3 (November 2013): 290–301. <https://doi.org/10.1080/01587919.2013.835770>.
- Cho, Moon-Heum, and David Jonassen. “Development of the Human Interaction Dimension of the Self-Regulated Learning Questionnaire in Asynchronous Online Learning Environments.” *Educational Psychology* 29, no. 1 (January 9, 2009): 117–38.  
<https://doi.org/10.1080/01443410802516934>.
- Cohen, Louis, Lawrence Manion, and Keith Morrison. *Research Methods in Education*. Eighth edition. | New York: Routledge, 2018.: Routledge, 2017.  
<https://doi.org/10.4324/9781315456539>.
- Khirwadkar, Anjali, Sheliza Ibrahim Khan, Joyce Mgombelo, Snezana Ratkovic, and Wendy Forbes. “Reimagining Mathematics Education During the COVID-19 Pandemic.” *Brock Education Journal* 29, no. 2 (September 5, 2020): 42. <https://doi.org/10.26522/brocked.v29i2.839>.
- Livy, Sharyn, Tracey Muir, Carol Murphy, and Allison Trimble. “Creative Approaches to Teaching Mathematics Education with Online Tools during COVID-19.” *International Journal of Mathematical Education in Science and Technology* 53, no. 3 (March 16, 2022): 573–81.  
<https://doi.org/10.1080/0020739X.2021.1988742>.
- Ma, Kang, Muhammad Chutiyami, Yijin Zhang, and Sandy Nicoll. “Online Teaching Self-Efficacy during COVID-19: Changes, Its Associated Factors and Moderators.” *Education and Information Technologies* 26, no. 6 (November 10, 2021): 6675–97.  
<https://doi.org/10.1007/s10639-021-10486-3>.
- Means, Barbara, Marianne Bakia, and Robert Murphy. *Learning Online*. Routledge, 2014.  
<https://doi.org/10.4324/9780203095959>.
- Mncube, Vusi, and Emmanuel Olawale. “Empowering Teachers for ELearning in South African Schools: Readiness for the Fourth Industrial Revolution?” In *ICERI Conference*, 36–44. Seville, Spain, 2019. <https://doi.org/10.21125/iceri.2019.0021>.
- . “Managing Higher Education Institutions in the Context of Covid-19 Stringency: Experiences of Stakeholders at a Rural South African University.” *Perspectives in Education* 39, no. 1 (2021). <https://doi.org/10.18820/2519593X/pie.v39.i1.24>.
- Multon, Karen D., Steven D. Brown, and Robert W. Lent. “Relation of Self-Efficacy Beliefs to Academic Outcomes: A Meta-Analytic Investigation.” *Journal of Counseling Psychology* 38, no. 1 (January 1991): 30–38. <https://doi.org/10.1037/0022-0167.38.1.30>.
- Negara, H R P, E Nurlaelah, Wahyudin, T Herman, and M Tamur. “Mathematics Self Efficacy and Mathematics Performance in Online Learning.” *Journal of Physics: Conference Series* 1882, no. 1 (May 1, 2021): 012050. <https://doi.org/10.1088/1742-6596/1882/1/012050>.
- Olawale, Babawande Emmanuel, and Bonginkosi Mutongoza. “Digital Transformation in Higher Education Institutions: Issues of Functionality amid the COVID-19 Pandemic.” In *10th International Conference of Global Education Network (GEN)*, East London, 265–75, 2021.
- Olawale, Emmanuel, Winston Hendricks, and Vusi Mncube. “Rethinking Assessment in Mathematics Teacher Education Programme during COVID-19 Pandemic,” 10056–62, 2021.  
<https://doi.org/10.21125/iceri.2021.1899>.
- Rimfeld, Kaili, Margherita Malanchini, Eva Krapohl, Laurie J. Hannigan, Philip S. Dale, and Robert Plomin. “The Stability of Educational Achievement across School Years Is Largely Explained by Genetic Factors.” *Npj Science of Learning* 3, no. 1 (December 4, 2018): 16.  
<https://doi.org/10.1038/s41539-018-0030-0>.

- Skaalvik, Einar M., Roger A. Federici, and Robert M. Klassen. "Mathematics Achievement and Self-Efficacy: Relations with Motivation for Mathematics." *International Journal of Educational Research* 72 (2015): 129–36. <https://doi.org/10.1016/j.ijer.2015.06.008>.
- Stumm, Sophie, Emily Smith-Woolley, Ziada Ayorech, Andrew McMillan, Kaili Rimfeld, Philip S. Dale, and Robert Plomin. "Predicting Educational Achievement from Genomic Measures and Socioeconomic Status." *Developmental Science* 23, no. 3 (May 2020). <https://doi.org/10.1111/desc.12925>.
- Talsma, Kate, Kayleigh Robertson, Cleo Thomas, and Kimberley Norris. "COVID-19 Beliefs, Self-Efficacy and Academic Performance in First-Year University Students: Cohort Comparison and Mediation Analysis." *Frontiers in Psychology* 12 (June 22, 2021). <https://doi.org/10.3389/fpsyg.2021.643408>.
- Valentine, Jeffrey C., David L. DuBois, and Harris Cooper. "The Relation Between Self-Beliefs and Academic Achievement: A Meta-Analytic Review." *Educational Psychologist* 39, no. 2 (June 2004): 111–33. [https://doi.org/10.1207/s15326985ep3902\\_3](https://doi.org/10.1207/s15326985ep3902_3).
- Wang, Ya-Ling, Jyh-Chong Liang, Chia-Yi Lin, and Chin-Chung Tsai. "Identifying Taiwanese Junior-High School Students' Mathematics Learning Profiles and Their Roles in Mathematics Learning Self-Efficacy and Academic Performance." *Learning and Individual Differences* 54 (February 2017): 92–101. <https://doi.org/10.1016/j.lindif.2017.01.008>.
- Wulantina, Endah, Fertilia Ikashaum, Juitaning Mustika, Pika Merliza, Selvi Loviana, Nur Indah Rahmawati, and Andianto Andianto. "Self-Efficacy of Mathematics Students" on e-Learning during Covid 19 Pandemic." *PROCEEDING UMSURABAYA* 0, no. 0 (September 8, 2020): 109–15. <http://journal.um-surabaya.ac.id/index.php/Pro/article/view/5965>.
- Xiao, Chunfeng. "A Novel Approach of Consultation on 2019 Novel Coronavirus (COVID-19)-Related Psychological and Mental Problems: Structured Letter Therapy." *Psychiatry Investigation* 17, no. 2 (February 25, 2020): 175–76. <https://doi.org/10.30773/pi.2020.0047>.
- Yenen, Emin Tamer, and Ersoy Çarkit. "Fear of COVID-19 and General Self-Efficacy among Turkish Teachers: Mediating Role of Perceived Social Support." *Current Psychology*, October 20, 2021. <https://doi.org/10.1007/s12144-021-02306-1>.
- Yin, Robert. "The Case Study Crisis: Some Answers." In *Case Studies*. 1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom : SAGE Publications Ltd, 2014. <https://doi.org/10.4135/9781473915480.n38>.
- Zhao, Yong. "Personalizable Education for Greatness." *Kappa Delta Pi Record* 54, no. 3 (July 3, 2018): 109–15. <https://doi.org/10.1080/00228958.2018.1481645>.
- Zhao, Yong, and Jim Watterston. "The Changes We Need: Education Post COVID-19." *Journal of Educational Change* 22, no. 1 (February 18, 2021): 3–12. <https://doi.org/10.1007/s10833-021-09417-3>.

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