Filipino Science Teachers' Evaluation on Webinars' Alignments to Universal Design for Learning and Their Relation to Self-Efficacy amidst the Challenges of the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic has led teachers in the Philippines to rely on technology to provide and support continued education for K-12 students. However, it is not only technology, but also the interactive online learning environments crafted by teachers that impact student science learning. To support teachers to cope with pandemic teaching, the government provided professional development in the form of teacher-training webinars. This study evaluated the webinars using Universal Design for Learning (UDL) principles to understand the impact these professional development sessions had on science teachers' self-efficacy for delivering science instruction during the pandemic. The study found that webinars including UDL design elements improved science teachers' self-efficacy for teaching science and there were no significant differences in teacher perceptions relative to gender or teaching experience. Implications for the use of UDL to design long-term professional development offerings beyond the pandemic are discussed.

Keywords

Universal Design for Learning – self-efficacy – science education – webinar – COVID-19 pandemic

1 Introduction

The closure of educational institutions worldwide in response to the COVID-19 pandemic has affected more than 1.5 billion learners worldwide, including more than 28 million learners in the Philippines (UNESCO, 2020). Before COVID-19, many schools in the Philippines were barely coping due to scarce funding, inadequate facilities, and rising enrollments. It was feared that the pandemic would worsen these problems, which critics blame on years of under-investment in public education. COVID-19 did not create the school woes that are present today; rather, it exposed the long-standing situation of the Philippine education system. In response to the pandemic, the Department of Education (DepEd) and President Duterte announced the postponement of the new school year, which starts annually in June (pre-pandemic in the Philippines) to give time to revive many sectors of the falling economy (Palatino, 2020).

The challenges faced by the DepEd were significant as they attempted to roll out a plan for distance learning to be implemented by August 2020. The DepEd was tasked to map a system that would determine which learning modality would be appropriate for different areas in the country, for example, print production of self-learning modules or having students access content via the internet, television, and radio. In July 2020, several senators questioned the agency's ability to train all its teachers for distance-learning education in time for the opening of classes, as only 40% of the more than 800,000 public school teachers had been trained for the “new normal” (Abelita, 2020). However, even before the pandemic, the country faced serious challenges to providing quality science education and to using technology to facilitate teaching and learning. Studies have shown that Filipino students' achievement lags behind other countries in the Trends in International Mathematics and Science Study (TIMSS; Foy & Arora, 2009), and results from the 2018 Programme for International Student Assessment (PISA) in science (the first year that the Philippines participated) also found Filipino students were underachieving in science compared to other countries (Schleicher, 2019). A report from the World Economic Forum ranked the Philippines 67th among 140 countries in 2016 and 79th among 138 countries in 2017 in terms of global competitiveness in quality science education (Fuente, 2019).

Teachers and students also face many challenges regarding accessing and using technology for teaching and learning. The 2020 Global Connectivity Index (GCI) information and communications technology (ICT) report benchmarks countries using 40 indicators to track the impact of ICT on a nation's economy, digital competitiveness, and future growth. The report considers the current level of ICT products and services, the demand for and use of connectivity by the government and individuals, and the potential for future development. The Philippines ranked 59th out of 79 countries and was categorized as a "starter" when it comes to digital transformation (Balinbin, 2021). While this report reflects the ICT challenges existing in the country today, the findings are not considerably different from a profile of Philippine elementary and secondary schools published two decades ago (Southeast Asian Ministers of Education Organization Regional Center for Educational Innovation and Technology [SEAMEO INNOTECH], 2003). Both studies acknowledge high barriers for accessing ICT resources, limited knowledge about how to use ICT resources, and limited experience of teachers and students in using ICT in schools.

When the government announced the plan to prepare and implement a series of online teacher professional development activities aimed at improving science teachers' self-efficacy for teaching science in the "new normal," we were concerned about the effectiveness of this approach. Because a teacher's self-efficacy affects their instructional activities and their orientation towards the educational process (Woolfolk, et al., 1990), we wanted to assess science teachers' self-efficacy after participating in the new professional development webinars designed to support teachers to teach in a new way. We selected principles from Universal Design for Learning (UDL) as a tool for having teacher participants examine the webinar content they experienced. We reasoned the UDL principle could provide teachers a useful frame for evaluating the quality of the professional development content and for reflecting on how the content informed teachers' sense of self-efficacy for teaching science online during the pandemic. While the webinars were not originally designed based on UDL principles, we recognized that the UDL principles specifically address concerns related to access and application of digital forms of education, learner variability and the unsuitability of a one-size-fits-all curriculum for all students. By having science teachers evaluate the webinar professional development content using the UDL principles, we would be able to provide some insights about the ability of the government and education sector to adequately prepare teachers to be responsive to learner needs in this time of crisis. In addition, we chose to focus our attention on teachers in the Bulacan school division in the Central Luzon Region of the Philippines as it is representative of regions with low

academic student performance and limited infrastructure to support online education. We were interested to know the correlation of UDL-aligned webinars to science teachers' positive self-efficacy for teaching science in an online environment during the COVID-19 pandemic, even in a region that has more barriers for teachers and learners.

In the sections that follow, we introduce some background information about science education and ICT access and use in the Philippines before introducing research on self-efficacy and UDL as the main lens for examining the webinar content and teachers' experiences as learners in these professional development courses. Following this section, we introduce the research questions framing our study and the research context and methods in more detail. After sharing the findings of our research, we discuss the implications for UDL as a tool for developing effective professional development for teachers and raise some questions about the need for continued development and research in science and technology education in the Philippines.

2 Literature Review

2.1 *Science Education in the Philippines*

Science in the Philippines has been described by tight funding, deficient scientific accommodation (Gibson et al., 2018), and mediocre research capability (Lacanilao, 2008). In a country where survival is a daily struggle (Schelzig, 2005), promoting science as relevant has been a challenge. In 2020, 26.5% of the total population lived below the poverty line, including 10 million women (UNDP, 2020). It has therefore been difficult to make science meaningful to poverty-stricken people when it arguably has no importance in day-to-day living (Joubert, 2007). Science as a career has been seen as expensive and not leading to employment (Sjøberg & Schreiner, 2005; Navarro & McKinnon, 2020). Studies have revealed that the sources of the problem in Philippine science education are related to a defective science curriculum, poor capacity for preparation of science teachers in areas of content and pedagogy, faulty implementation of delivery of science education, and the dearth of a science culture in the country (Bernardo et al., 2008).

Filipino students' perceptions have also been indicative of existing problems in science education. Students have viewed science teaching as lacking suitability between materials used in actual classes and tests and assignments (Bernardo et al., 2008). Further, there has been a discrepancy in the way

science has been taught in the classroom and the way it has been communicated outside the classroom (Navarro & McKinnon, 2020). Particularly, science education stresses memorization of facts instead of conceptual understanding. Moreover, the assessment or grading procedures have not matched or been reflective of the students' actual learning (Bernardo et al., 2008). In fact, in 2003, the DepEd revised the grading procedures used by teachers (Bernardo et al., 2008), allowing students to pass science subjects without thoroughly gaining their curricular goals. In other words, students have been given credit for success they did not work for. Correspondingly, this has been reflected in Filipino students' low performance in international assessments such as TIMSS and PISA. Thus, the problematic situation of science in the Philippines before this global catastrophe has made it hard for students to demonstrate positive outcomes in science learning.

2.2 *Information and Communication Technologies in the Philippines*

Both public and private institutions in the Philippines have been using ICT as a tool to improve teaching and learning since 2001, when a legislation formally incorporated ICT into the curriculum at all levels of education (Rodrigo, 2001). However, the actualization of these goals has been uneven and current information on how extensively the Philippines use computers and for what purposes have not been well documented. More recently, a 2007 study reported that of 26 million students, nearly 12 million in public schools did not have any access to ICT resources and only 1 million students from private schools could access ICT resources (Kubota et al., 2007). An earlier study found large disparities and gaps between urban and rural schools regarding access to ICT (Kubota et al., 2007). While this study is already more than a decade old, the access and infrastructure have not changed significantly. Even now, it seems that computer and internet access is only enjoyed by a small percentage of students, and should schools shift from their traditional and conventional "chalk and talk" style of teaching to the more ICT- and multimedia-based teaching, then only a handful of students would benefit. In addition to students' and schools' lack of access to internet connectivity, poor network infrastructures and underinvestment in faculty training in online and blended learning remain as significant barriers to teachers' successful science instruction in online environments (Bozkurt et al., 2020). Exploring teachers' self-efficacy for using technology to teach science in online and blended classrooms is important now that the pandemic is pushing the government to try to support these options as a means to reduce transmission of COVID-19. In the section that follows, we describe research on self-efficacy.

2.3 *Science Teachers' Self-Efficacy*

According to Bandura (1977), "most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions, this coded information serves as a guide for action" (p. 22). In other words, teachers tend to teach the way they were taught. This is an important aspect to examine during the pandemic, as most Filipino teachers have been products of face-to-face instruction, and their teaching practice has been focused on the traditional four-wall physical classroom. Therefore, their technical skills in tailoring pedagogy and familiarity with the use of different assessment approaches in the emergency remote environment has not yet been well understood (Bozkurt et al., 2020). While one may argue that there are similarities among the dispositions, knowledge, and skills required for teachers to teach in both face-to-face and online settings, there are unique knowledge and skills teachers need to learn to successfully manage an online learning environment and deliver the instructional content in an engaging and meaningful manner.

The beliefs that individuals hold about themselves can have a strong impact on their behaviors. That is, individuals tend to evaluate the outcomes of their own actions, and the meanings and interpretations they associate with those outcomes will in turn create their efficacy beliefs. Bandura (1977) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Self-efficacy beliefs influence one's motivation and self-management processes in different ways. First, they set the directions of the courses of action people choose and execute. Second, beliefs of personal competence can determine how much effort, perseverance, and resilience people will expend on an activity when confronted with adverse situations and difficulties (Daniilidou et al., 2020).

That is, the greater one's self-efficacy is, the greater the exerted effort, persistence, and resilience. Successful outcomes raise self-efficacy while failed outcomes lower it. However, this does not mean that people can perform and achieve more than their abilities for the reason that skills and will go hand in hand. This only signifies the role of self-efficacy in individuals controlling their own environments to execute actions required to govern tasks and situations. Researchers have long regarded teachers' beliefs of personal efficacy to be a contributing factor in their actions towards instructional activities and adaptation to educational processes. In this study, we seek to examine teachers' self-efficacy for instructing science in new ways after participating in online professional development sessions offered via DepEd webinars. Specifically, we use the lens of UDL to evaluate the impact of these professional development sessions on teachers' self-efficacy.

2.4 *Role of Universal Design for Learning during COVID-19 Pandemic*

During the height of pandemic, questions emerged such as how the current and future education workforce will be prepared and whether equity-driven education systems will be required to ensure that students have the technologies and skills needed to work in both traditional and online settings. Changes in ways of thinking are needed to maximize technology-enriched education opportunities. While there is no current or future “silver bullet” that will “fix” long-standing problems, UDL is a flexible design framework that encourages proactive anticipation of learner variability. In the most ideal situation, global education leaders will envision a future education system that is equitable, beneficial, and meaningful for all learners.

Universal Design for Learning (UDL) was originated and coined by Rose, Meyer, and Gordon (2010) at the Center for Applied Special Technology (CAST; Edyburn, 2005). Ronald Mace's universal designs in architecture (Meyer, Rose, & Gordon, 2014) was the inspiration of the application of this framework to teaching and learning. The UDL framework was primarily proposed to address students in an average classroom who have backgrounds that differ in some way from the dominant language, culture, and history of the majority of students and who therefore deal with the hurdles in accessing information presented in a one-size-fits-all manner among diverse students (Rose & Meyer, 2002). Although the UDL framework was initially conceptualized with students with disabilities in mind, it quickly shifted its focus from the student's disability to the “disabled curriculum” (Rappolt-Schlichtmann et al., 2012), emphasizing that the “problem” is the instruction rather than the students, who were just recipients of constricted goals, methods, materials, and teaching strategies in a school system (Rappolt-Schlichtmann et al., 2012).

The framework is based on the premise that learning barriers occur as an interaction between learners' strengths, challenges, and preferences. Thus, UDL overcomes the deficit-driven approach to education, where students who struggle are viewed as the problem. The UDL guidelines are (1) *providing multiple means of representation* in terms of perception, language, expressions, symbols, and comprehension to support learning through recognition networks; (2) *providing multiple means of action and expression* including physical action, expression and communication, and executive function to support learning through strategic networks; and (3) *providing multiple means of engagement* including recruiting interest, sustaining effort and persistence, and self-regulation to support learning through affective networks (CAST, 2010).

The science teachers of the Philippines, despite the sudden transition to remote education, nevertheless have to deal with the impacts of pandemic. With a lack of experience and exposure to this mode of instruction, using UDL

principles during the webinar training would be helpful to support teachers to think about how to create accessible and flexible learning content (Al-Azawei et al., 2016). Therefore, this study introduced teacher participants to UDL principles so they could evaluate their webinar learning experiences. We then evaluated teachers' self-efficacy for transitioning to emergency remote teaching based on the training they received. We were especially interested to determine if webinars evaluated as being better aligned to UDL principles had more positive impacts on teachers' sense of self-efficacy for teaching science in new ways. This study asked the following questions:

1. How do science teachers evaluate the webinars they participated in based on the UDL rubric?
2. What was the impact of these webinars, considering science teachers' gender, teaching experience, and the challenges they encountered, on their self-efficacy in online learning and teaching?
3. What is the correlation of webinars aligned to UDL principles to science teachers' self-efficacy to teach online?

3 Methodology

3.1 *Research Context*

In the 2020–21 school year, in response to the COVID-19 public health emergency, and in accordance with the DepEd Order No. 012 (DepEd, 2020), a series of capacity-building workshops were implemented by district ICT advisers, ICT councils, ICT coordinators, and school ICT coordinators to train teachers and school leaders to become familiar with tools necessary for supporting online education. Online distance learning was relatively new to the DepEd, and the mechanisms needed for its full implementation during the outbreak of the COVID-19 pandemic were still in their initial stages (DepEd, 2020). Despite the limited experience and resources, however, DepEd Secretary Leonor Briones stood firm that education must continue even in times of crisis. Therefore, teacher training through webinars was implemented.

Webinars were executed using Zoom links on the DepEd Execom and DepEd Announcements Facebook pages. Therefore, all webinars were accessible to everyone for free. Invited speakers led the webinars using PowerPoint presentations and demonstrations, and question and answer sessions, evaluations, and feedback were also included. These webinars introduced how to use various multimedia learning resources, e-book development, Google Suite, Autodesk 3D model development using Tinker CAD and Fusion360, Photoshop, Canva and Graphic Design, Microsoft Office 365, teaching and parenting under the new normal, and the introduction of open educational resources (OERs).

Coordinators guided teachers on the administration of Microsoft Office 365, Google Suite for Education, and Facebook Workplace and to create an online learning environment where teachers and other stakeholders could pilot test these programs. Other webinars were offered through the DepEd Digital Rise Program, providing free webinar sessions via Facebook Live and YouTube Live Stream covering topics about emerging technologies, open educational resources, ICT skills development programs, and distance-learning modalities (DepEd, 2020).

All webinars were accessed for free and were available to teachers in both public and private schools nationwide. Teachers were able to access the webinars by logging in to the DepEd website and the schedule of webinars was announced on the DepEd's official Facebook account, YouTube channel, and website. Teachers who participated in the webinars and completed the required assessments within a given time period were awarded Certificates of Recognition as Educational Technology Specialists. Certificates of Attendance were also given to all participants in the live webinar sessions. As of May 2020, 17,890 Certificates had been given for Basic OER, 8,908 for Advanced OER, and 16,701 for Google Suite (DepEd, 2020).

3.2 *Research Participants*

Teachers in Bulacan, which is one of the 10 school divisions in the Central Luzon Region of the Philippines, were targeted for this research. The DepEd Schools Division of Bulacan serves 21 municipalities in a province that provides education to children in 568 barangays (villages) with a total area of 262,500 square kilometers. While the DepEd has been providing teacher training courses to high school teachers and school heads several times a year to promote ICT literacy to cope with the teachers' lack of computer knowledge and skills, these online training courses were only available in big cities such as Manila, Cebu, or Central Visayas (Tomaro, 2018).

A total of 318 junior high school science teachers (Grades 7–10) from public high schools in the Bulacan school division participated in the research. Questionnaires were distributed to school principals and then disseminated to their respective science teachers through their schools' head teachers. The questionnaire items were answered via Google survey and all participation was voluntary. The only requirements for participation were that the teachers had to have attended government sponsored webinars and they had to teach science. Participants included 273 females (86%) and 45 males (14%). In terms of age, the majority of teachers (152; 48%) were ages 30–39, and 144 teachers (45%) had been teaching more than 10 years (Table 1).

TABLE 1 Research participants' profile

Category	Subcategory	n	Percentage (%)
Gender	Male	45	14.2
	Female	273	85.8
	Total	318	100.0
Age	less than 30	49	15.4
	30–39	152	47.8
	40–49	83	26.1
	50–59	32	10.1
	more than 60	2	0.6
	Total	318	100.0
Teaching Experience	less than 2 years	4	1.3
	2–5 years	65	20.4
	6–10 years	105	33.0
	more than 10 years	144	45.3
	Total	318	100.0
Rank	Teacher I	140	44.0
	Teacher II	55	17.3
	Teacher III	99	31.1
	Master Teacher I	17	5.4
	Master Teacher II	6	1.9
	Master Teacher III	1	0.3
	Total	318	100.0

3.3 *Instrument Development and Implementation Overview*

The questionnaire used in this study was written in English and combined different aspects of previously developed tools for use in this research. A single instrument was developed to serve the purpose of this study. The instrument we developed was divided into four parts: (1) data collection of research participants' demographic profiles, (2) science teachers' evaluations of online trainings/webinars through the lens of UDL adapted from He's (2014) online course design based on a UDL rubric, (3) science teachers' responses of perceived confidence and self-efficacy adapted from the online learning readiness scale

of Hung, Chou, Chen, and Own (2010), and (4) science teachers' responses about perceived challenges during the COVID-19 pandemic in the Philippines adapted from Alea, Fabrea, Roldan, and Farooqi (2020).

The instrument was used to collect data about the demographic profiles of the research participants, including age, gender, teacher ranking, and teaching experience. These items were included and seen as factors that could influence teacher participants' self-efficacy. Second, the instrument included a UDL rubric to assess the online course design for science teachers to assess the webinar content. Third, items examining science teachers' perceived confidence and self-efficacy were included to measure the self-efficacy of science teachers after their participation in webinars. Finally, items that measured teachers' perceptions about the challenges of science teaching in online environments during the COVID-19 pandemic were adapted to examine science teachers' self-efficacy beliefs during the pandemic. Below we describe each section of the instrument in more detail.

3.3.1 Demographic Profiles Survey

The age of teacher participants was assessed to determine whether age was an impediment to acquiring 21st century skills (Sang et al., 2018). In addition, past studies have revealed that males tend to have more confidence and positive attitudes in using technology than their female counterparts (Yau & Cheng, 2012). Examining age and gender differences relative to perceptions about confidence in using technology, a necessary skill in the implementation of science distance education, was important for the study. Next, because teacher rank was based on teacher qualifications and performance and teaching experience reflected the length of time or period the teacher participant had been in the teaching profession, we included both to see if these factors had any impact on science teaching self-efficacy during the COVID-19 pandemic.

3.3.2 Online Course Design Based on a UDL Rubric

We adapted an online training evaluation instrument using UDL as a rubric to assess six dimensions of universal design (He, 2014). We adapted this tool to reflect the role of UDL in online webinars. A new conceptual framework was created (see Figure 1) that categorized principles of UDL among six dimensions: learner support resources (Dimension 1) and online organization and design (Dimension 2) under the UDL principle of providing multiple means of representation; instructional design and delivery (Dimension 3) and assessment and evaluation of student learning (Dimension 4) under the UDL principle of providing multiple means of engagement; and innovative teaching with technology (Dimension 5) and faculty use of student feedback (Dimension 6)

FIGURE 1 Conceptual framework: UDL rubric for webinar evaluation

under the UDL principle of providing multiple means of action and expression. Teachers used this rubric to identify design elements of the webinars that were well aligned to UDL.

3.3.3 Science Teachers’ Perceived Confidence and Self-Efficacy Scale
The science teachers’ perceived confidence and self-efficacy scale consisted of five subscales: computer/internet self-efficacy, self-directed learning, learner control (in an online context), motivation for learning (in an online context), and online communication self-efficacy. The items “I feel confident in performing basic functions of Microsoft Office programs” (computer/internet self-efficacy), “I set up my learning goals” (self-directed learning), “I can direct my own learning progress” (learner control in an online context), “I like to share my ideas with others” (motivation for learning in an online context), and “I feel confident in using online tools to effectively communicate with others” (online communication self-efficacy) all reflected the content and goals of webinars implemented by DepEd and echoed UDL principles.

3.3.4 Perceived Challenges during the COVID-19 Pandemic Scale
The perceived challenges during the COVID-19 pandemic in the Philippines scale was adapted from Alea et al. (2020). Originally, it was composed of 15 items measured using a 4-point Likert scale (*strongly disagree* to *strongly*

agree). However, five open-ended questions were added to elicit specific responses from the science teachers about difficulties they encountered during the implementation of distance education. This instrument was included to serve as supporting data on science teachers' self-efficacy beliefs – with the hypothesis that self-efficacy will remain high despite the high challenges present during the pandemic.

3.4 Instrument Validity and Reliability

Since the adapted instruments in this study were validated instruments, validities of the instruments were assumed (Corcocan & Fischer, 2013, p. 15). In addition, their reliability was examined using SPSS and obtained an acceptable reliability based on the standard 0.7 Cronbach's alpha, as seen in Table 2. Further, the instruments were not translated into any native Philippine languages and were used in their original English form.

TABLE 2 Test of reliability

Instrument	Category	Subcategory	Reliability
Webinar evaluation through UDL rubric	Representation	Learner support and resources	0.92
		Online organization and design	0.96
	Engagement	Instructional design and delivery	0.97
		Assessment and evaluation of student learning	0.94
	Action and expression	Innovative teaching with technology	0.95
		Faculty use of student feedback	0.95
Perceived confidence and self-efficacy	Computer/internet self-efficacy		0.95
	Self-directed learning		0.96
	Learner control (in an online context)		0.90
	Motivation for learning (in an online context)		0.98
	Online communication self-efficacy		0.95
Challenges encountered	Challenges in emergency remote learning		0.97

Note: N = 318 participants.

3.5 Data Analysis

All data were gathered and tabulated from a Google Form that had been administered to 92 public high schools in Bulacan. Descriptive statistics were mainly used to interpret the participants' demographic profiles, webinar evaluations, science teachers' perceived confidence and self-efficacy, and challenges encountered. Six categories of webinar evaluation were also analyzed in terms of the three UDL principles. An independent-samples *t*-test was also used to compare the means of participants' gender (male and female) and teaching experience (non-veteran and veteran) to online training evaluation, science teachers' perceived confidence and self-efficacy, and challenges encountered. Pearson correlation was then calculated to analyze the relationship between the webinars evaluated through the UDL rubric and the participants' perceived self-efficacy in online learning and teaching while challenges were encountered due to the COVID-19 pandemic in the Philippines.

4 Results and Discussion

In this section, we discuss the findings of the survey analysis, including teachers' perceptions about the alignment of the webinar content to UDL, teachers' self-efficacy for having the knowledge and skills to teach science online, and teachers' perceptions of the challenges they will face in implementing science classes in online environments. Following our description of teachers' overall responses, we focus attention on age, gender, and teaching experience as potential factors that may influence teachers' perceptions of the webinar content, their self-efficacy for teaching, and their perceptions about challenges. We include both results and discussion in this section.

4.1 Science Teachers' Perception of Webinars through the Lens of UDL

With the values interpreted as 0.0–1.0 = *poor*, 1.1–2.0 = *fair*, 2.1–3.0 = *good*, 3.1–4.0 = *very good*, and 4.1–5.0 = *excellent*, the science teachers graded the online trainings/webinars they participated in as *very good*, (as shown in Table 3) with the highest rating ($M = 3.68$, $SD = 0.81$) given to innovative teaching with technology under the UDL principle “provide multiple means of action and expression.”

TABLE 3 Webinar evaluation based on a UDL rubric

UDL principle	Online training element	M	SD
Provide multiple means of representation	Learner support and resources	3.59	0.79
	Online organization and design	3.54	0.78
Provide multiple means of engagement	Instructional design and delivery	3.65	0.81
	Assessment and evaluation of student learning	3.59	0.79
Provide multiple means of action and expression	Innovative teaching with technology	3.68	0.81
	Faculty use of student feedback	3.55	0.83

Note: *N* = 318 participants.

This was followed by instructional design and delivery (*M* = 3.65, *SD* = 0.81), under the principle “provide multiple means of engagement.” The third highest rating was given to both assessment and evaluation of student learning (*M* = 3.59, *SD* = 0.79) under the UDL principle “provide multiple means of engagement” and learner support and resources (*M* = 3.59, *SD* = 0.79) under the principle “provide multiple means of representation.”

This result, specifically the highest rating (*M* = 3.68, *SD* = 0.81) given to innovative teaching with technology, reflects the focus and goal of DepEd in executing webinar workshops to utilize Microsoft Office 365, Google Suite for Education, and Facebook Workplace to support online remote learning during the COVID-19 pandemic outbreak, which was emphasized in Division Memorandum No. 159 s. 2020, implemented before the start of school year 2020–2021. Therefore, this is echoed in the reason the science teachers in Bulacan mostly associated their perceptions of the webinars they attended with innovative teaching with technology.

Although the webinars were not originally designed and constructed using UDL principles, the findings revealed (according to science teachers’ evaluations) that the webinars were aligned to UDL principles. This result could signify that applying UDL principles in the digital online platform is achievable because, despite the limited experience and resources and short preparation caused by the COVID-19 pandemic, webinars included components in alignment with UDL. Online courses and webinars that are intentionally designed

and constructed using UDL principles may further maximize educational advantages, including improving teachers’ positive outlook about the use of digital forms of education and the need to expand accessibility and learner variability.

4.2 Science Teachers Perceived Self-Efficacy

Based on the values 0.0–1.0 = *strongly disagree*, 1.1–2.0 = *disagree*, 2.1–3.0 = *neutral*, 3.1–4.0 = *agree*, and 4.1–5.0 = *strongly agree*, science teachers strongly agreed (as shown in Table 4) that they gained motivation for learning (in an online context); specifically, they acquired self-efficacy on being open to new ideas ($M = 4.10$, $SD = 1.03$). Moreover, they agreed that they gained motivation to learn ($M = 4.04$, $SD = 1.02$). Also, science teachers felt most confident in performing the basic functions of Microsoft Office programs (MS Word, MS Excel, and MS PowerPoint) under the computer/internet self-efficacy scale ($M = 4.02$, $SD = 0.98$). On the whole, science teachers agreed that they gained confidence and self-efficacy in online learning and teaching after participating in online training/webinars.

Therefore, based on these results, it can be assumed that DepEd was able to provide training and implement webinars that can have a positive impact on science teachers’ confidence and self-efficacy in time of crisis. Moreover, DepEd was able to select necessary webinar content that was a necessary response to the COVID-19 pandemic.

TABLE 4 Science teachers’ perceived self-efficacy

Science teachers’ perceived self-efficacy		M	SD
Computer/ Internet self-efficacy	I feel confident in performing the basic functions of Microsoft Office programs (MS Word, MS Excel, and MS PowerPoint).	4.02	0.98
	I feel confident in my knowledge and skills of how to manage software for online learning.	3.81	0.88
	I feel confident in using the Internet (Google, Yahoo) to find or gather information for online learning.	3.96	0.97

TABLE 4 Science teachers' perceived self-efficacy (cont.)

Science teachers' perceived self-efficacy		M	SD
Self-directed learning	I carry out my own study plan.	3.78	0.85
	I seek assistance when facing learning problems.	3.84	0.88
	I manage time well.	3.77	0.89
	I set up my learning goals.	3.85	0.90
	I have higher expectations for my learning performance.	3.74	0.83
Learner control (in an online context)	I can direct my own learning progress.	3.79	0.85
	I am not distracted by other online activities when learning online (instant messages, Internet surfing).	3.59	0.89
	I repeated the online instructional materials based on my needs.	3.75	0.87
Motivation for learning (in an online context)	I am open to new ideas.	4.10	1.03
	I have motivation to learn.	4.04	1.02
	I improve from my mistakes.	4.01	1.00
	I like to share my ideas with others.	3.98	0.99
Online communication self-efficacy	I feel confident in using online tools (email, discussion) to effectively communicate with others.	3.83	0.92
	I feel confident in expressing myself (emotions and humor) through text.	3.75	0.90
	I feel confident in posting questions in online discussions.	3.74	0.89

Note: N = 318 participants.

4.3 *Perceived Challenges during COVID-19 Pandemic in the Philippines*
Table 5 shows, in reference to values 0.0–1.0 = *strongly disagree*, 1.1–2.0 = *disagree*, 2.1–3.0 = *agree*, and 3.1–4.0 = *strongly agree*, that science teachers agreed that they encounter challenges in knowledge and skills required in delivering distance-learning education classes (M = 2.94, SD = 0.69); use of phones, laptops, and tablets or any devices for distance-learning education

($M = 2.97, SD = 0.78$); use of any learning management system ($M = 2.95, SD = 0.71$); use of social media, e-mails, and other platforms of distance-learning education ($M = 2.90, SD = 0.77$); and giving instruction and responding to queries through e-mail and messages ($M = 2.94, SD = 0.74$).

TABLE 5 Perceived challenges during COVID-19 pandemic in the Philippines

Items	M	SD
Challenges in knowledge and skills required in delivering distance-learning education classes	2.94	0.69
Challenges in establishing communication with my students	3.11	0.71
Challenges in having stable internet access intended for distance learning education	3.34	0.74
Challenges in the use of phones, laptops, and tablets or any devices for distance-learning education	2.97	0.78
Challenges in the use of any learning management system (LMS)	2.95	0.71
Challenges in use of social media, e-mails, and other platforms of distance-learning education	2.90	0.77
Challenges in giving instruction and responding to queries through e-mail and messages	2.94	0.74
Challenges in encouraging participation and utilization of features in online classes	3.06	0.70
Challenges in time management in the conduct of classes, monitoring of responses, availability of students, and other online classes issues	3.03	0.69
Challenges in the sudden shift from face-to-face to online classes	3.06	0.72
Challenges in managing the stress caused by the community quarantine at home and in between online classes' demands	3.16	0.70
Challenges in meeting the deadlines and requirements set by the school administrators	3.12	0.73
Challenges in establishing a network of communication among stakeholders such as parents for support at home	3.09	0.71
Challenges in checking and evaluating students' output from the e-mail of an online learning management system (LMS)	3.11	0.70
Challenges in building a positive environment in online classes through emotional support among my students aside from content-based teaching and learning	3.03	0.71

Note: $N = 318$ participants.

In addition, they strongly agreed that they confronted problems with establishing communication with their students ($M = 3.11$, $SD = 0.71$); having stable internet access ($M = 3.34$, $SD = 0.74$); encouraging participation and utilization of features in online classes ($M = 3.06$, $SD = 0.70$); time management in the conduct of classes, monitoring of responses, availability of students, and other online class issues ($M = 3.03$, $SD = 0.69$); sudden shift from face-to-face to online classes ($M = 3.06$, $SD = 0.72$); managing the stress caused by the community quarantine at home and in between online classes' demands ($M = 3.16$, $SD = 0.70$); meeting the deadlines and requirements set by the school administrators ($M = 3.12$, $SD = 0.73$); establishing a network of communication among stakeholders such as parents for support at home ($M = 3.09$, $SD = 0.71$); checking and evaluating students' output from the e-mail of an online learning management system ($M = 3.11$, $SD = 0.70$); and building a positive environment in online classes through emotional support among their students apart from content-based teaching and learning ($M = 3.03$, $SD = 0.71$).

Filipino science teachers' *agree* to *strongly agree* responses to all perceived challenges during the COVID-19 pandemic in the Philippines subscales indicate their high perceived confidence and self-efficacy. This may be because genuine self-efficacy produces greater exerted effort, persistence, resilience, and secured perception of personal competence despite the challenges brought by the pandemic. Furthermore, being open to new ideas ($M = 4.10$, $SD = 1.03$) and having the motivation to learn ($M = 4.04$, $SD = 1.02$) set direction to how science teachers choose and execute courses of action when it comes to science education. In addition, high self-efficacy perceived by science teachers can help them keep composure and positive attitudes when dealing with adverse situations and difficulties and, consequently, find solutions to problems brought by the pandemic.

4.4 *Gender Differences in Webinar Evaluation, Perceived Self-Efficacy, and Challenges Encountered*

An independent-samples *t*-test was conducted to test gender differences in webinar evaluation through the UDL rubric, science teachers' perceived self-efficacy, and perceived challenges constructs (Tables 6 and 7). The test revealed that there were no significant differences between males ($p > .05$) and females ($p > .05$) except for perceived challenges during the COVID-19 pandemic in the Philippines, where there was a significant difference in the scores of females ($M = 3.09$, $SD = 0.56$) and males ($M = 2.87$, $SD = 0.72$; $t(316) = 2.29$, $p = .02$).

TABLE 6 Gender differences in webinar evaluation

	Gender						<i>t</i>	<i>p</i>
	Female			Male				
	n	M	SD	n	M	SD		
Learner support and resources	273	3.60	0.79	45	3.53	0.82	.53	.99
Online organization and design	273	3.54	0.78	45	3.52	0.80	.14	.95
Instructional design and delivery	273	3.64	0.81	45	3.68	0.83	-.35	.75
Assessment and evaluation of student learning	273	3.58	0.80	45	3.65	0.78	-.55	.90
Innovative teaching with technology	273	3.68	0.80	45	3.71	0.84	-.25	.64
Faculty use of student feedback	273	3.55	0.83	45	3.60	0.82	-.41	.76

Note: *N* = 318 participants (female *n* = 273 and male *n* = 45).

TABLE 7 Gender differences in perceived self-efficacy

	Gender						<i>t</i>	<i>p</i>
	Female			Male				
	n	M	SD	n	M	SD		
Computer/internet self-efficacy	273	3.94	0.89	45	3.84	0.98	.68	.09
Self-directed learning	273	3.81	0.80	45	3.69	0.82	.96	.25
Learner control (in an online context)	273	3.73	0.78	45	3.59	0.86	.14	.19
Motivation for learning (in an online context)	273	4.05	0.98	45	3.91	1.02	.91	.19
Online communication self-efficacy	273	3.77	0.85	45	3.76	0.95	.13	.06

Note: *N* = 318 participants (female *n* = 273 and male *n* = 45).

These findings indicate that there were no differences between males and females when it came to their perceptions in the alignment of the webinars they attended to the UDL rubric and perceived self-efficacy in delivering science instruction online. This indicates that the perceptions of webinars of science teachers in this study and their self-efficacy were not influenced by gender. This may be attributable to the fact that pre-pandemic, online distance education was not widely implemented in the Philippines. Therefore, the same experiences and dilemmas were shared by both male and female science teachers nationwide, thus generating the same perception and response.

However, in terms of perceived challenges in distance-learning education, a significant difference in the scores of females ($M = 3.09$, $SD = 0.56$) and males ($M = 2.87$, $SD = 0.72$; $t(316) = 2.29$, $p = .02$) was recorded. This finding supports previous research (Yau & Cheng, 2012) claiming that there is a significant gender difference in attitude towards technology. That is, females were shown to be more anxious when dealing with online learning that has to utilize elements of technology. This may indicate that the greater the anxiety, the greater are the perceived challenges. The female science teachers in this study may have perceived more challenges in delivering science instruction online during the COVID-19 pandemic.

4.5 *Teaching Experience Differences in Webinar Evaluation, Perceived Self-Efficacy, and Challenges Encountered*

The length of time in service, or the teaching experience of participants, was assessed to determine whether a lack of experience may be an impediment to acquiring 21st century skills (Sang et al., 2018). In a country where online distance learning was relatively new and most of the teachers were products of face-to-face instruction, the teaching experience of participants that comes with their age and their ability to acquire self-efficacy during the COVID-19 pandemic are significant to examine.

This study also analyzed the relationship between science teachers' teaching experience, which were categorized as non-veteran (5 years or less) and veteran (6 years or more), as years of teaching experience can be divided into 5-year intervals (Noh et al., 2004). As presented in Tables 8 and 9, there were no significant differences between veteran ($p > .05$) and non-veteran teachers ($p > .05$) in their perceptions of webinars' alignment to UDL, perceived self-efficacy, and challenges encountered during the COVID-19 pandemic.

TABLE 8 Teaching experience differences in webinar evaluation

	Teaching experience						<i>t</i>	<i>p</i>
	Non-veteran			Veteran				
	n	M	SD	n	M	SD		
Learner support and resources	69	3.72	0.75	249	3.55	0.80	1.58	.40
Online organization and design	69	3.67	0.76	249	3.50	0.78	1.64	.56
Instructional design and delivery	69	3.75	0.82	249	3.62	0.80	1.19	.79
Assessment and evaluation of student learning	69	3.71	0.82	249	3.56	0.79	1.35	.49
Innovative teaching with technology	69	3.78	0.84	249	3.66	0.80	1.10	.38
Faculty use of student feedback	69	3.70	0.81	249	3.51	0.83	1.70	.88

Note: *N* = 318 participants (non-veteran *n* = 69 and veteran *n* = 249).

TABLE 9 Teaching experience differences in perceived self-efficacy

	Teaching experience						<i>t</i>	<i>p</i>
	Non-veteran			Veteran				
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>		
Computer/internet self-efficacy	69	4.02	0.79	249	3.90	0.93	1.00	.26
Self-directed learning	69	3.77	0.69	249	3.80	0.83	-.28	.39
Learner control (in an online context)	69	3.70	0.69	249	3.71	0.82	-.11	.31
Motivation for learning (in an online context)	69	4.04	0.82	249	4.03	1.02	.09	.13
Online communication self-efficacy	69	3.82	0.71	249	3.76	0.90	.55	.16

Note: *N* = 318 participants (non-veteran *n* = 69 and veteran *n* = 249).

These findings suggest that the length of teaching experience as a science teacher may not have been a necessary impediment to gaining high self-efficacy in delivering science instruction online during the COVID-19 pandemic. That is, being a veteran or non-veteran science teacher did not hinder the teachers’

beliefs in their own capabilities to teach science effectively in online distance education. However, it is important to note that almost half of the science teacher respondents in this study were in the 30–39 age bracket (48%), holding Teacher I positions (140, 44%), or had more than 10 years of teaching experience (144; 45%), for these can be contributing factors to such a result. Further, the results support the previous claim (Sang et al., 2018) that lack of teaching experience is not a barrier to 21st century teaching and learning.

4.6 Correlations among Constructs

Table 10 presents the positive correlation between webinar evaluation through a UDL rubric and science teachers' perceived self-efficacy during COVID-19 pandemic in the Philippines.

TABLE 10 Pearson correlation of UDL-aligned webinars to science teachers' self-efficacy

	REP	ENG	ACEX	CSE	SDL	LC	ML	OCSE
Representation (REP)	1							
Engagement (ENG)	.918**	1						
Action and expression (ACEX)	.902**	.949**	1					
Computer/internet self-efficacy (CSE)	.506**	.519**	.531**	1				
Self-directed learning (SDL)	.490**	.514**	.503**	.888**	1			
Learner control (LC)	.499**	.518**	.516**	.866**	.927**	1		
Motivation for learning (ML)	.489**	.513**	.508**	.870**	.899**	.851**	1	
Online communication self-efficacy (OCSE)	.528**	.530**	.539**	.871**	.897**	.894**	.859**	1

** Correlation is significant at the .01 level (2-tailed).
Note: N = 318 participants.

Pearson correlation of the UDL principle of providing multiple means of representation (learner support and resources and online organization and design) was found to be statistically significant and have moderately positive correlation with computer/internet self-efficacy ($r = .506, p < .001$) and online

communication self-efficacy ($r = .528, p < .001$). Also, it has low positive correlation with self-directed learning ($r = .490, p < .001$), learner control ($r = .499, p < .001$), and motivation for learning ($r = .489, p < .001$).

The UDL principle of providing multiple means of engagement (instructional design and delivery and assessment and evaluation of student learning) was analyzed to be statistically significant and have moderately positive correlation to the five subscales of perceived self-efficacy: computer/internet self-efficacy ($r = .519, p < .001$), self-directed learning ($r = .514, p < .001$), learner control ($r = .518, p < .001$), motivation for learning ($r = .513, p < .001$), and online communication self-efficacy ($r = .528, p < .001$). Last, the UDL principle of providing multiple means of action and expression (innovative teaching with technology and faculty use of student feedback) was also evaluated to be statistically significant and have moderately positive correlation to five subscales of perceived self-efficacy: computer/internet self-efficacy ($r = .531, p < .001$), self-directed learning ($r = .503, p < .001$), learner control ($r = .516, p < .001$), motivation for learning ($r = .508, p < .001$), and online communication self-efficacy ($r = .539, p < .001$).

Overall, it can be assumed that the webinars attended by science teachers in this study were perceived by them as being aligned to UDL principles, which is positively correlated to their perceived high self-efficacy during the COVID-19 pandemic. This indicates that webinars, when aligned to UDL principles, can enhance self-efficacy of learners.

5 Conclusions and Recommendations

5.1 Conclusion

This study was conducted with the aim of finding solutions to failures and disabilities in the curriculum that the pandemic exposed. The study showed that science teachers surveyed graded the online trainings/webinars they attended and participated in as *very good*, with the highest rating ($M = 3.68, SD = 0.81$) given to innovative teaching with technology under the UDL principle of providing multiple means of action and expression. The findings suggest that UDL principles, when intentionally utilized to design an online course or webinar, could have a positive impact on science teachers' self-efficacy and can then lead to positive teaching practices. UDL, which was originally constructed for students with disabilities, likely also has the potential to mend a disabled curriculum, as this study was conducted during an uncertain time; with an unfavorable situation and limited preparation, experience, and resources, and with

the high challenges brought by the COVID-19 pandemic. Also, UDL likely has a positive impact on teachers' professional development. Hence, it is important for science teachers to learn how to use the principles of UDL to maximize technology in creating flexible materials and methods in their own online classes to make the learning content of science more accessible to Filipino diverse learners. To this end, it is of great significance in professional development and training to help science teachers understand how to incorporate the features of UDL principles into their instructional strategies.

It is also worth emphasizing that the *agree* to *strongly agree* responses of science teachers to all perceived challenges during the COVID-19 pandemic in the Philippines subscales best reflect their high perceived confidence and self-efficacy. This genuine self-efficacy produces greater exerted effort, persistence, resilience, and secured perception of personal competence despite the challenges brought by the pandemic. Furthermore, being open to new ideas ($M = 4.10$, $SD = 1.03$) and having the motivation to learn ($M = 4.04$, $SD = 1.02$) set the direction of how science teachers choose and execute courses of action when it comes to science education. In addition, high self-efficacy gained by science teachers can help them keep composure and positive attitudes during the pandemic and can help them in dealing with adverse situations and difficulties in the future.

Also, an inferential statistical test (independent *t*-test) showed that the means of male and female, veteran and non-veteran science teachers' populations were equal, as equal variances were assumed from the administered research instrument constructs. Most importantly, to address the general research question of this study, a Pearson correlation was executed that revealed a positive association and correlation of UDL-based webinars based on science teachers' evaluation and perceived high self-efficacy despite the perceived challenges inherent in emergency online learning. This indicates that the more aligned an online training/webinar was to UDL principles, the higher the confidence and self-efficacy were manifested in science teachers in this study. Also, perceived high confidence and self-efficacy remained stable despite the presence of high challenges during the COVID-19 pandemic.

5.2 Implications

Online education has come to the forefront during this pandemic. However, accessing this alternative platform and informal education settings requires a stable internet connection – a major problem in the Philippines. Among the 318 responses from science teachers, 228 (72%) asserted that the specific difficulty they have encountered in the execution of online education during the

pandemic has been securing a stable internet connection. They also reported concerns about the lack of equipment online education demands and the authenticity of assessment and evaluation in this mode of instruction. These responses were similar to the economic and ICT situation that had been reported in the country two decades previously. It is hard to make meaning of science when survival is still the priority, which has been a long-standing problem in the Philippine education system. Therefore, no matter how suitable UDL principles are in an online education course curriculum, if an institution is not prepared for it, they are a waste of time and resources.

On the other hand, self-efficacy beliefs measured at various levels of specific tasks, such as online learning activities, can prove useful as a diagnostic and assessment tool that can provide information about teachers' dispositions. This can help in understanding influences on performances. Moreover, teachers' beliefs about self-efficacy can affect their instructional activities and their orientation towards educational processes (Pajares, 1997). Thus, providing teacher training programs that can enhance science teachers' self-efficacy should be given importance, as this study revealed that 22% of the respondents relied on webinars to adapt to the sudden shift to classes online. Since this study has revealed the positive association of UDL principles with online curriculum design, it can also refute the notion that online learning education is just a mere transfer of face-to-face content and activities to an online format. This study also revealed the potential of the UDL rubric as guidelines for addressing the learning barriers that occur as a result of interaction between learners' strengths, challenges, and preferences and can be a tool to mend a disabled curriculum – a silver lining in education during the COVID-19 pandemic.

5.3 *Limitation and Recommendations*

This study revealed certain limitations that can be discussed in future research. Self-efficacy can be measured best by comparing pre- and post-activity outcomes. However, due to restrictions caused by the COVID-19 pandemic, this study was limited to the evaluation of the results of a task: attending several webinars. Also, online trainings were evaluated in general without examining in details of the course content, the amount of time spent on each session, and the assessment and evaluation of learning. Therefore, future researchers can focus into these details. Although there tends to be a positive association between high self-efficacy and high performance, it is not always the case (Sang et al., 2018). This study exclusively focused on perceived self-efficacy without comparing it to actual activity performance. Hence, future research should provide evidence on how perceived self-efficacy using the UDL rubric and principles can predict an actual performance.

The main aim of this study was to reach out to the proper authorities in the education sector of the Philippines so that they can use the results of this study for the advancement of science education in the country. An additional aim was for curriculum designers to see the role of UDL not only in providing equitable education to diverse and disabled students but also its potential in mending a disabled curriculum.

Abbreviations

CAST	The Center for Applied Special Technology
DepEd	Department of Education
EDDIS	Educational District
ETU	Educational Technology Unit
ICT	Information and Communication Technologies
NCR	National Capital Region
PISA	The Programme for International Student Assessment
TIMSS	Trends in International Mathematics and Science Study
UDL	Universal Design for Learning

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Publication Consideration

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Ethical Consideration

Approval to conduct this study was granted by the Daegu University Institutional Review Board (IRB No.: 1040621-202021-HR-033). The data collected from this project were obtained with the necessary clearance from the partner

institutions, guardians, and the students involved in the study. The names of the school and participants used in this study are all pseudonyms.

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