Digital Literacy of Elementary Teachers and its Relation to Performing their Various School Roles Amidst COVID-19 Pandemic

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ABSTRACT

Amidst the lengthy suspension of in-person classes brought by the unprecedented pandemic of Coronavirus Disease 2019 (COVID-19), widespread adoption of digital technology in education has become critical. However, there is a growing global worry about teachers' digital literacy. The purpose of this study, which was done in four core schools in Bataan's second congressional district, Philippines, is to investigate public elementary school teachers' digital literacy and its impact on the various duties and responsibilities they take on. The study included 225 teachers, four ICT coordinators, and four school leaders from the identified central schools. There were significant disparities in the assessment of digital literacy and performance among the three groups of respondents (teachers, ICT coordinators, and school principals). Furthermore, while there was no significant association established between teachers' characteristics (including age and sex) and their digital literacy, a substantial relationship was discovered between teachers' digital literacy and their overall performance. This study provides useful insights into the landscape of digital literacy among elementary teachers during the COVID-19 pandemic, with implications for educational policies, professional development, and the efficient integration of digital tools in many school roles.

Keywords: *digital literacy; Bataan teachers; elementary teachers; digital tools; Teachers' performance*

Introduction

School closure became a global trend at the onset of the COVID-19 pandemic. Generally, schools worldwide resorted to alternative modes of learning and other means, instead of in-person classes. Schools in the US have ceased in-person instruction and have shifted to remote learning. In the state of California, for example, it was reported that the Governor disallowed in-person education before the start of the fall season in 2020 and schools continued through online instruction or phone check-ups which affected at least 90% of the state's children (Cano, 2020). In this transition to a new teaching method, many California school districts were able to offer training programs to prepare teachers for distance learning, however, it was a challenge for others for they were not able to provide the same. Therefore, those teachers were forced to find training on their own (Lambert and Rosales, 2020).

Likewise, in Europe, schools adopted e-learning platforms that enable teachers and students to facilitate classes virtually. Aside from this, schools also benefited from national television programs and lessons posted on social media platforms. Books and other materials were also taken from schools. In Europe, the first country to implement a nationwide lockdown was Italy. The Italian government directed to shut down all schools commencing February 2020 and then continued online for large chunks of the school year from 2020 to 2021 to prevent the spread of COVID-19 (Bonati et.al, 2021; Varella, 2021). UNESCO (2020) explained in a report that education was continued through web platforms, videoconference tools, and social devices. Also, in Germany, teachers facilitated online teaching through the use of digital tools and resources to execute new teaching-learning approaches (Glutsch, 2020).

On the contrary, schools in many African countries found it hard to immediately shift their classes from in-person to online. The primary reason is that they lack appropriate gadgets to facilitate the transition to online learning which include smartphones and laptops, as well as reliable broadband internet (Morsy, 2021). However, in Egypt, it is a different story. The Egyptian Ministry of Education facilitated the use of an online portal that contains teaching materials for teachers, and which is also used by the students to submit their class requirements (Taha, 2020). According to the 2021 report of the Asian Development Bank, schools in eight of 46 economies in developing Asia had been closed for about 1 year or more. Another 11 economies in Asia have schools which had been closed for 200–300 days. Full school closures have been longest in Bangladesh and Myanmar; both countries have had over 300 days of government-mandated closures. Tan (2020) mentioned that in Singapore, students and teachers have stayed home and experienced the sudden switch to full online learning. The traditional classes were replaced by methods such as live broadcast lectures, video conference lessons, and online assessments.

In the Philippines, generally, the mode of teaching-learning has shifted from in-person classes to blended learning. Also, other major school activities including enrollment and extra-curricular activities of the student were facilitated through digital means. However, one article mentioned that the integration of digital technologies into various areas of education from teaching to assessment has not been an easy process, instead, it is complex and challenging for some reasons which include insufficient equipment or connectivity and inadequate technology training. Another reason is resistance to change and fear of technology because teachers are comfortable with what they are accustomed to like traditional teaching methods, thus they may resist getting out of their comfort zones (Obana, 2020). Likewise, the Organization for Economic Cooperation and Development or OECD (2019) has mentioned in its report that the country-specific challenge for digital education in the Philippines is the provision of more ICT infrastructure and trained teachers to schools. The same concern was also seen in the study of Hero (2019) from Bulacan province which found that technology integration exerts a significant impact on teaching performance. Although the use of digital technologies has been a global and local trend for learning continuity as well as for the beneficial impact on the teaching-learning experience, the study on the digital literacy of the teachers in the context of the Philippines, particularly in the province of Bataan, is limited. Hence, this study aimed to contribute to the body of knowledge on teachers' digital literacy and to serve as the basis for training programs that proper authorities may consider providing to the teachers.

Methodology

Research Design

To unfold the problems of this study, it utilized a descriptive correlational research design. The descriptive correlational design is deemed appropriate for the present study because the research investigated possible relationships among the identified variables.

Research Participants

The respondents for this study were from the central schools of Pilar, Orion, Limay, and the City of Balanga. The convenience sampling method was utilized. The total number of respondents was 233. It is composed of 225 teacher-respondents, 4 ICT coordinator-respondents, and 4 School Principal-respondents. Of this number 30 teacher-respondents, 1 ICT coordinator-respondent, and 1 School Principal-respondent were from Pilar Elementary School. Meanwhile, from Arellano Elementary School, there were 58 teacher-respondents, 1 ICT coordinator-respondent, and 1 School Principal-respondent. On the other hand, in Limay Elementary School, there were 57 teacher-respondents, 1 ICT coordinator-respondent, and 1 School Principal-respondent. Lastly, in Balanga Elementary School, there were 80 teacher-respondents, 1 ICT coordinator-respondent, and 1 School Principal-respondent.

Research Instrument

The researcher employed a combination of researcher-made questionnaires and a modified standardized tool. A researcher-made questionnaire gathered information on teachers' demographics, while a standardized tool assessed their digital literacy based on Yazon et al.'s (2019) framework. The digital literacy assessment comprised four categories with key performance indicators. Another researcher-made survey questionnaire evaluated teachers' performance in applying digital literacy across teaching, assessment, administrative tasks, and innovation. Consent from Yazon et al. was obtained for the digital literacy tool, and after approval, all questionnaires underwent validation by three experts. Their feedback led to revisions, including a change to a five-point Likert scale for the second questionnaire. The final versions were approved by the experts before being administered to the target respondents.

Data Gathering Procedure

In floating the survey questionnaire, a request was made to the DepEd-Bataan Schools Division Superintendent which immediately gained approval. For teacher-respondents, three questionnaires were administered. The ICT coordinators and School Heads acted as raters who assessed the teachers using the second and third questionnaires. Retrieval of

responses from the respondents took three months to complete. Confidentiality and anonymity were observed during the entire process.

Data Analysis

To describe the profile of the respondents, frequency and percentage count were utilized. To determine digital literacy, mean and frequency counts were applied. To determine the performance in terms of utilization of digital tools, mean and frequency counts were applied. To identify the difference between the assessment of the 3 groups of respondents on the digital literacy of the teachers, a T-test and analysis of variance (ANOVA) were utilized. To identify the difference between the assessment of 3 groups in the performance of teachers in terms of utilization of digital tools, t-tests, and analysis of variance (ANOVA) were utilized. To describe the relationship between the teachers' profile and their digital literacy, the Pearson Moment Correlation was applied. To describe the relationship between teachers' digital literacy and teachers' performance in terms of the utilization of digital tools, the Pearson Moment Correlation was also applied.

Results and Discussion

Demographic Profile of the Respondents

Table 1 presents the demographic profile of the respondents.

Table 1: Profile of teacher-respondents

Age	**f**	**%**
54-61	32	14.22
47-53	61	27.11
40-46	54	24.00
33-39	54	24.00
25-32	24	10.67
Sex	f	%
Female	209	92.89
Male	16	7.11
Educational Attainment		
Doctorate Degree	1	0.44
With Doctoral Units	1	0.44
Master's Degree	11	4.89
With MA Units	156	69.33
Baccalaureate	56	24.89
Years in Service		
16-18	101	44.89
13-15	20	8.89
10-12	35	15.56
7-9	33	14.67
4-6	15	6.67
0-3	21	9.33
Training		
More than 16	6	2.67
13-16	31	13.78
9-12	55	24.44
5-8	88	39.11
1-4	43	19.11
None	2	0.89

N = 225

The age group with the lowest number 24 or 11% of the total respondents was 25-32. Together with the age group of 33-39, they collectively comprised 35% of the respondents and they all belong to Millennials. Meanwhile, the age group with the highest number of 61 or 27% of total respondents was 47-53. They belong to the group Gen Z. Together with the age group of 40-46 and 54-61, they collectively comprised 65% of the total respondents who belong

to the group of Gen Z up to Boomers. This means that the majority of the respondents are relatively old. On the other hand, regarding sex, the central schools in District 2 of Bataan are largely dominated by female teachers comprising 93% of the total number of respondents.

While many teachers are taking master's degrees, very few can get graduate degrees. Only 11% have completed their master's degree program. It was also surprising to know that there is only one teacher with a doctorate among the 225 teachers from the four participating central schools. It means that there is only a handful of teachers who are motivated to pursue and finish graduate studies. Regarding years in service, those teachers with 10 to 18 years of service comprised 69% of the respondents, while those with nine years and below comprised the remaining 31%. It means that the population is dominated by teachers with longer experience. Meanwhile, all of the teacher-respondents were able to attend relevant training programs, except for 1% of the teacher-respondents. In detail, 43 of them, or 19.11% have 1-4 attended training programs. Moreover, 88 of the respondents, or 39.11% have attended 5-8 training programs while 55 of them, or 24.44% have participated in 9-12 training programs. Also, 31 of them, or 31.78%, have completed 13-16 training programs. Lastly, 6 of the respondents, or 2.67% have attended more than 16 training programs.

Digital Literacy of the Teachers

Table 2 presents the data analysis regarding the digital literacy of the teachers. The overall mean per group was 3.51 as rated by principals, 3.37 by teachers, and 3.60 by ICT coordinators. Generally, the respondents obtained a 3.49 average with "Very High" as a descriptive rating. It was manifested in this table that each of all indicators has a "Very High" average. This could be interpreted as, in general, teachers from Central Schools in the second congressional district of Bataan have very high digital literacy. The result of the study supported the discussion of Kumari and D'Souza (2016). They discussed that creation is at the top of the ladder and the most difficult competency to obtain. Also, the output of this study has similarities with the result of the study of Zhao, et.al (2021) who investigated the in-service teachers' self-perception of digital competence. They found out that teachers rated positively their skills in information and data literacy, but their digital content creation was rated negatively.

Table 2: Summary of the digital literacy of the teachers

DIGITAL LITERACY	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Understanding Digital Practices	3.52	3.43	3.65	3.54	Very High
Finding Information	3.53	3.55	3.65	3.58	Very High
Using Information	3.49	3.33	3.51	3.44	Very High
Creating Information	3.52	3.16	3.59	3.42	Very High
Overall Mean	3.51	3.37	3.60	3.49	Very High

In terms of understanding digital practices (see Table 3), the overall average was 3.54 which was described as very high. Likewise, all indicators have a descriptive rating of very high. It means that teachers were assessed to be highly literate to know what categories of users they can expect to find online, to determine what happens to the information they put online, to present themselves online, to identify what online information they can legally re-use, and to determine the owner of information and ideas they find online. While the component mean from each of the three groups was very high, the self-perception rating of the teachers showed that they thought they had an average level only when it comes to knowing what categories of users can be or are expected to find online. This study has similar findings to the study of Peled (2021) wherein it was found that most of the teachers have basic information research and retrieval skills and know-how to manage their collected data.

Table 3: Digital literacy of the teachers in terms of understanding digital practices

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator DL 1.1	3.57	3.36	3.66	3.53	Very high
Indicator DL 1.2	3.46	3.41	3.63	3.50	Very high
Indicator DL 1.3	3.52	3.46	3.68	3.55	Very high
Indicator DL 1.4	3.56	3.46	3.66	3.56	Very high
Indicator DL 1.5	3.50	3.48	3.64	3.54	Very high
Overall Mean	3.52	3.43	3.65	3.54	Very high

In terms of finding information (see Table 4), the overall average was 3.58 which was described as very high. Likewise, all indicators have a descriptive rating of very high. This indicates that the teachers were assessed to be highly literate in determining what information they can find on the web, using social networks as a source of information, filtering large numbers of search results quickly, scanning/skimming a web page to get to the key relevant information quickly and being aware of what information they can find in an online library. Likewise, the component means of each of the groups of respondents showed a Very High rating in this area. The result of this study has similarities with the findings of Perifanou et. al. (2021). In their pursuit to investigate teachers' perspectives on their digital competencies in carrying out their teaching and professional duties during the COVID-19 pandemic, they found out that most of the respondents used digital tools extensively for finding educational resources along with other areas.

Table 4: Digital literacy of the teachers in terms of finding information

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator DL 2.1	3.60	3.59	3.75	3.65	Very high
Indicator DL 2.2	3.66	3.76	3.90	3.77	Very high
Indicator DL 2.3	3.43	3.46	3.56	3.48	Very high
Indicator DL 2.4	3.48	3.48	3.55	3.51	Very high
Indicator DL 2.5	3.48	3.44	3.48	3.47	Very high
Overall Mean	3.53	3.55	3.65	3.58	Very high

In terms of using information (see Table 5), the overall average was 3.44 which was described as very high. Likewise, all indicators have a descriptive rating of very high. This specifies that the teachers were assessed to be highly literate in applying information in different media taking podcasts or videos as examples, assessing whether an online resource person is credible and trustworthy, using other people's work found online without committing plagiarism, citing a reference to an online resource using the correct format, and utilizing social bookmarking to organize and share information. While the component mean from ICT coordinators and Principals were both described as Very high, the component means of the teachers' rating showed that they have an average level of digital literacy in understanding digital practices, particularly on all the indicators except on citing a reference to an online resource. Likewise, the results of the study were parallel with the study of Ata and Yildirim (2019) which investigated digital literacy perceptions of pre-service teachers to determine their patterns of knowledge and use of digital literacy. They found out that teachers' perceptions and views relating to digital literacy are concentrated on the usefulness and benefits aspects of digital skills.

Table 5: Digital literacy of the teachers in terms of using information

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator DL 3.1	3.50	3.31	3.49	3.43	Very High
Indicator DL 3.2	3.51	3.37	3.49	3.46	Very High
Indicator DL 3.3	3.53	3.18	3.51	3.41	Very High
Indicator DL 3.4	3.45	3.48	3.57	3.50	Very High
Indicator DL 3.5	3.44	3.29	3.52	3.42	Very High
Overall Mean	3.49	3.33	3.51	3.44	Very High

In terms of creating information (see Table 6), the overall average was 3.42 which was described as very high. Specifically, three of the indicators were described as very high while the other two were average. It means that teachers were assessed to have high literacy to communicate with others online, to work with others online to create a shared document or presentation, and to use media-capture devices. Meanwhile, they were on average level in terms of adding comments to blogs, forums, or web pages observing netiquette and appropriate social conventions for online communications, and writing in different media for people to read on-screen. While the component mean from ICT coordinators and Principals were both described as Very high, the component means of the teachers' rating showed

that they have an average level of digital literacy in creating information, particularly on all the indicators under it. The result of the study was congruent with USC Rossier's (2020) discussion on the ladder of skills. USC Rossier (2020) elaborated that in the ladder of skills related to digital literacy, deeper learning happens while going up the ladder from remembering to creating. This means that creation, being at the peak of the ladder, is the highest in the order of digital literacy skills. Moreover, the findings are also aligned with the discussion made by Media Smart (2016). They implied that creation is the most complex process among the three categories of competency because it goes beyond the knowledge of how to use a word processor or write an email.

Table 6: Digital literacy of the teachers in terms of creating information

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator DL 4.1	3.51	3.07	3.52	3.36	Average
Indicator DL 4.2	3.45	2.98	3.47	3.30	Average
Indicator DL 4.3	3.54	3.28	3.64	3.48	Very High
Indicator DL 4.4	3.58	3.31	3.73	3.54	Very High
Indicator DL 4.5	3.50	3.19	3.59	3.43	Very High
Overall Mean	3.52	3.16	3.59	3.42	Very High

Teachers' Performance in the Utilization of Digital Tools

Table 7 shows the summary of the performance in the utilization of digital tools. The overall mean for performance per group was 3.70 by principals, 3.60 by teachers, and 3.81 by ICT coordinators. As a whole, the overall average was 3.70 with a "Very High" descriptive rating. The result of the study is in contrast with the findings of Caluza et al. (2017) who assessed the level of ICT competencies in public schools. They found out that most of their teacher-respondents have a basic knowledge of ICT, but they are not competent enough in the field. Moreover, the result of the present study has similarities and differences with the study of Perifanou et.al. (2021). In their study, it was revealed that about two-thirds of the respondents used digital tools extensively for finding, evaluating, and developing educational resources as well as for teaching while about half of the participants used digital tools extensively for self-study and students' formative assessment. In contrast to the present study, Perifanou et.al reported that the teachers hardly used digital tools for other teaching activities such as feedback and final evaluation of the students or revising the educational resources.

Table 7: Summary of performance in the utilization of digital tools

PERFORMANCE IN DIGITAL UTILIZATION	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Teaching Process	3.68	3.60	3.80	3.69	Very High
Student assessment	3.72	3.59	3.81	3.71	Very High
Administrative Tasks	3.84	3.91	4.03	3.93	Very High
Innovation	3.55	3.31	3.58	3.48	Very High
Overall Mean	3.70	3.60	3.81	3.70	Very High

In terms of teaching process (see Table 8), the overall average was 3.69 which was described as very high. Likewise, all indicators have a descriptive rating of very high. It means that teachers were assessed to be highly literate in using the internet to find interesting sources of information that can be used in the development of learning materials and/or in teaching, to download and use presentations in facilitating learning among pupils when needed, to get multimedia content like online videos and use them in teaching or provide them to students as additional learning resources, to find electronic educational games then provide to students as learning materials, and to use any instructional support from DepEd like DepEd tv, radio-based instruction, commons or equally as supplementary learning materials. While the component mean from each of the three groups of respondents was described as Very high, the teachers' self-perception rating showed that they have an average level of performance in terms of finding electronic educational games.

Table 8: Level of teachers' performance in the utilization of digital tools in terms of teaching process

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator P 1.1	3.92	3.77	4.00	3.89	Very High
Indicator P 1.2	3.60	3.68	3.88	3.72	Very High
Indicator P 1.3	3.66	3.64	3.81	3.70	Very High
Indicator P 1.4	3.53	3.34	3.60	3.49	Very High
Indicator P 1.5	3.68	3.58	3.73	3.66	Very High
Overall Mean	3.68	3.60	3.80	3.69	Very High

In terms of student assessment (see Table 9), the overall average was 3.71, which was described as very high. Likewise, all indicators have a descriptive rating of very high. This means that teachers were assessed to be highly literate in designing rubrics for assessing student performance through the use of Microsoft applications or similar applications, using electronic means in administering quizzes and examinations, analyzing students' performance assessment data using spreadsheets and statistical applications, to access and use the required Electronic Class Record (e-Class Record) in recording the results of academic performance of the pupils and to access the required Learner Information System (LIS) for the reporting/encoding of grades of the students. Likewise, the component means of each of the three groups of respondents showed a Very High rating in this area.

This outcome was supported by the discussion of Majid (2020) who recognized that technology can support teachers by assessing students' learning in terms of their performance in the classroom. It has become a common practice to utilize ICT in assessment where teachers can apply digital devices that can help in the construction of assessment tasks for students as well as in evaluation and feedback. With the study of Perifanou et. al. (2021) which investigated teachers' perceptions regarding their digital skills for performing their teaching and professional responsibilities during the COVID-19 pandemic, the present study has similarity in the way that digital tools were used by teachers in student assessment. Perifanou revealed that about half of the respondents used digital tools extensively for self-study and students' formative assessments. Furthermore, the study of Caballes and Deabanico (2023) may explain the driver of why teachers have very high ratings on the use of electronic means in student assessment. Their study revealed that eGamification was able to improve learning outcomes by fostering engagement and motivation among the students.

Table 9: Level of teachers' performance in the utilization of digital tools in terms of student assessment

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator P 2.1	3.64	3.42	3.61	3.56	Very High
Indicator P 2.2	3.66	3.46	3.64	3.59	Very High
Indicator P 2.3	3.64	3.42	3.68	3.58	Very High
Indicator P 2.4	3.88	3.81	4.05	3.91	Very High
Indicator P 2.5	3.78	3.87	4.08	3.91	Very High
Overall Mean	3.72	3.59	3.81	3.71	Very High

In terms of administrative tasks (see Table 10), the overall average was 3.93 which was described as very high. Likewise, all indicators have a descriptive rating of very high. This means that teachers were assessed to be highly literate in using online messaging applications, social media platforms, or any available online communication channel in disseminating information and coordinating with colleagues, parents, and students, to operate video conferencing apps in conducting/facilitating virtual activities such as re-echo webinar, lac session, meeting, election, school contests, or similar events at the school involving teachers, parents and/or students, to access and use the required Learner Information System (LIS) in facilitating the enrollment of the pupils, to submit reports in softcopy via online messaging applications, social media platforms or any available online communication channel, to keep records/reports through a cloud-storage platform then access them when needed. Likewise, the component mean of each of the three groups of respondents showed a Very High rating in this area.

A closer look at the table revealed that "accesses and uses the required Learner Information System (LIS) in facilitating the enrollment of the pupils" was given the highest average of 4.08 with the description of "Very High". The last one which was "Keeps records/reports through a cloud-storage platform such as Google Drive, one drive or

similar applications then accesses them when needed" was given 3.76 as average and "Very High" as descriptive rating. The result of the study posits that teachers have very high competency in utilizing digital tools to perform their administrative tasks. The result of this study supported the paper of Hassan & Mirza (2021) entitled "The Digital Literacy in Teachers of the Schools of Rajouri (J&K)-India: Teachers Perspective" which promotes the use of technology in administrative activities as well as admissions and assessment, among others. Similarly, this is also aligned with the discussion of Flecknoe (2020) where it was reiterated that ICT technologies employed in education to facilitate student learning shall also be applied by teachers to do administrative tasks more efficiently.

Table 10: Level of teachers' performance in the utilization of digital tools in terms of administrative tasks

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator P 3.1	3.88	3.92	4.13	3.97	Very High
Indicator P 3.2	3.79	3.90	3.95	3.88	Very High
Indicator P 3.3	4.00	4.00	4.23	4.08	Very High
Indicator P 3.4	3.87	3.99	4.04	3.97	Very High
Indicator P 3.5	3.70	3.75	3.83	3.76	Very High
Overall Mean	3.84	3.91	4.03	3.93	Very High

In terms of innovation (see Table 11), the overall average was 3.48 which was described as very high. Four of the indicators were rated as very high while the other one was on average level. This means that teachers were assessed to be highly literate to modify or create audio, video, or similar material for use of the students in support of their learning experience, to modify or create their presentation through the use of MS PowerPoint, Canvas, Prezi or any available similar online application, to modify or create educational games through the use of digital tools and to use digital tools to improve personal productivity through proper time management like the use of Notes application or similar or any needed application. Meanwhile, teachers were assessed to have average literacy to apply and get the necessary Intellectual Property certification/license for the ownership of modified/new innovative material. While the component mean from each of the three groups of respondents was described as Very high, the teachers' self-perception rating showed that they have an average level of performance in this area, particularly in terms of integration of educational games, intellectual property application, and personal productivity improvement.

As assessed from the table, the highest average was 3.68 with the descriptive rating of "Very High". This was "Creates own presentation through the use of MS PowerPoint, Canvas, Prezi or any available similar online application". On the other hand, the indicator "Applies and gets necessary Intellectual Property certification/license for the ownership of modified/new innovative material" has the lowest average which is 3.28 with the descriptive rating of "Average". The result of the study supported the claim of Narayanan (2018) which said that many higher education institutions were moving forward by applying innovation and creativity in their teaching and learning activities. It was elaborated that both creativity and innovation can create design thinking which is known to be an approach to learning that focuses on developing students' creativity, and confidence through hands-on activities focusing on empathy, promoting a bias toward action, encouraging indention, and fostering active problem-solving skills and competencies.

Table 11: Level of teachers' performance in the utilization of digital tools in terms of innovation

INDICATORS	MEAN			OVERALL MEAN	DESCRIPTIVE RATING
	Principal	Teacher	ICT		
Indicator P 4.1	3.60	3.43	3.69	3.57	Very High
Indicator P 4.2	3.63	3.57	3.84	3.68	Very High
Indicator P 4.3	3.50	3.26	3.50	3.42	Very High
Indicator P 4.4	3.44	3.02	3.38	3.28	Average
Indicator P 4.5	3.59	3.28	3.47	3.45	Very High
Overall Mean	3.55	3.31	3.58	3.48	Very High

Differences in the Level of Digital Literacy

Table 12 shows the difference in the assessment of the teachers, principals, and the ICT coordinators on the formers' level of digital literacy using the ANOVA, to determine the group's difference, and the multiple analysis (post hoc) to

determine if there is a specific difference between any of the members of the group. As a result of the assessment of principals, ICT coordinators, and teachers, the difference in the assessment of the three groups on the digital literacy of the teachers is significant as revealed by the F-value of 8.71 at .05 level. Specifically, there is a significant difference between the assessment of ICT coordinators and teachers on understanding digital practices, using information, and creating information. Meanwhile, significant differences between the assessment of teachers and principals appeared only in using information and creating information. No significant difference was detected in finding information. This suggested that teachers were not as satisfied as the ICT coordinators regarding their general understanding of digital practices. The difference might be due to limited interactions between ICT coordinators and teachers. Teachers might think that there is still an area to improve their comprehension of digital practices. In the study of Cote and Milliner (2018), they found out that most of their teacher-respondents are willing to further develop their understanding and control of digital practices because of weaknesses in some areas.

Table 12: Difference in the level of digital literacy

DEPENDENT VARIABLE	GROUP		MULTIPLE COMPARISONS		ANOVA	
			Absolute mean difference	Sig (0.05)	F	Sig (0.05)
Understanding Digital Practices	Teachers	Principal	0.08800	0.279	7.295	0.001
		ICT	0.21867*	0.000		
	Principal	ICT	0.13067	0.061		
Finding Information	Teachers	Principal	0.01422	0.969	2.321	0.099
		ICT	0.10311	0.193		
	Principal	ICT	0.11733	0.119		
Using Information	Teachers	Principal	0.16089*	0.027	5.362	0.005
		ICT	0.18844*	0.007		
	Principal	ICT	0.02756	0.897		
Creating Information	Teachers	Principal	0.35289*	0.000	23.33	0.000
		ICT	0.42400*	0.000		
	Principal	ICT	0.07111	0.533		
Overall	Teachers	Principal	0.14689*	0.026	8.708	0.000
		ICT	0.23356*	0.000		
	Principal	ICT	0.08667	0.277		

Difference in the Level of Teachers' Performance in the Utilization of Digital Tools

Table 13 reports the difference in the level of teachers' performance as assessed by the three groups of respondents.

Table 13: Difference in the level of performance in the utilization of digital tools

DEPENDENT VARIABLE	GROUP		MULTIPLE COMPARISONS		ANOVA	
			Absolute mean difference	Sig (0.05)	F	Sig (0.05)
Teaching Process	Teachers	Principal	0.07911	0.474	4.532	0.011
		ICT	0.20267*	0.008		
	Principal	ICT	0.12356	0.164		
Student Assessment	Teachers	Principal	0.12533	0.139	5.457	0.004
		ICT	0.21689*	0.003		
	Principal	ICT	0.09156	0.347		
Administrative Task	Teachers	Principal	0.06667	0.605	3.797	0.023
		ICT	0.12267	0.184		
	Principal	ICT	0.18933*	0.019		
Innovation	Teachers	Principal	0.23733*	0.001	9.343	0.000
		ICT	0.26311*	0.000		
	Principal	ICT	0.02578	0.922		
Overall	Teachers	Principal	0.09378	0.277	5.403	0.005
		ICT	0.20133*	0.003		
	Principal	ICT	0.10756	0.186		

Statistics used were the Analysis of Variance to determine if there exists a significant difference within the groups and the post hoc analysis to determine which among the members yielded the significant difference. It was revealed from the findings that the difference in the assessment between the three groups of respondents in terms of the performance of the teachers in the utilization of digital tools is significantly supported by the sig-values which are all less than the .05 level. Specifically, significant differences in the assessment between teachers and ICT coordinators were discovered in the teaching process, student assessment, and innovation. On the other hand, the significant difference in the assessment between principals and ICT coordinators was found only in administrative tasks. Likewise, only on innovation, there was a significant difference in the assessment between principals and teachers. This implied that the ICTs are more satisfied with how the teachers use digital tools in teaching while the teachers themselves aim for a better utilization or seek other digital tools to satisfy their needs as implied by the lower mean they gave to their self-assessment. The reason for the difference could be the personal experiences of the teachers to the challenges encountered. Jana (2021) mentioned that some school dilemma includes limited Internet access and ICT equipment and intrinsic factors such as teachers' knowledge of technology, their perspectives toward digital technology, and the dedication of students to implementing digital literacy.

Relationship Between Profile and Level of Digital Literacy

Table 14 unfolds the relationship between the profile of the teachers and their level of digital literacy. It was found that teachers' training programs attended and their educational attainment were significantly correlated to their level of digital literacy having a correlation coefficient of .321 and .255, respectively, both significant at .05 level. Likewise, the two were both correlated to each of the components of digital literacy namely understanding digital practices, finding information, using information, and creating information. This inferred that teachers with sufficient training or with better education have better digital literacy. Similarly, years in service were significantly correlated with total digital literacy, but a negative relationship was detected with a correlation coefficient of -.241. This showed that teachers with shorter years in service have better digital literacy. Meanwhile, age and sex were both found to be insignificantly related to teachers' digital literacy having a correlation coefficient of -0.067 and 46.437, respectively. For that reason, there is no significant relationship between the profile of the teachers and their digital literacy. The result of the study supported the study of Cabero-Almenara et al. (2021) and Caluza et.al (2021) whom both agreed that training in ICT or digital competence of teachers is an avenue to provide quality education amidst the new educational paradigm brought about by COVID-19 pandemic.

In general, there is no significant relationship between the profile of the teachers and their digital literacy. The reason for this is that the age and sex are not significant.

Table 14: Relationship between the profile and level of digital literacy

PROFILE	STATISTICS	DIGITAL LITERACY				OVERALL DIGITAL LITERACY
		Digital Practices	Finding Information	Using Information	Creating Information	
Age	Correlation Coefficient (rho)	-0.053	-0.058	-0.101	-0.047	-0.067
	Sig. (2-tailed)	0.428	0.385	0.130	0.486	0.320
Sex	Chi-Square	11.89	26.70*	13.43	15.07	46.44
	Sig. (2-tailed)	0.537	0.014	0.641	0.446	0.655
Education	Correlation Coefficient (rho)	0.219**	0.269**	0.220**	0.229**	0.255**
	Sig. (2-tailed)	0.001	0.000	0.001	0.001	0.000
Years in Service	Correlation Coefficient (rho)	-0.190**	-0.264**	-0.214**	-0.196**	-0.241**
	Sig. (2-tailed)	0.004	0.000	0.001	0.003	0.000
Training attended	Correlation Coefficient (rho)	0.287**	0.290**	0.253**	0.324**	0.321**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000

Relationship Between Level of Digital Literacy and Utilization of Digital Tools

Table 15 reflects the relationship between the digital literacy of the teachers and their performance in the utilization of digital tools. With a strong correlation coefficient of .793, the total digital literacy of the teachers is significantly correlated with their total performance in the utilization of digital tools. This inferred that, to a strong correlation, the higher the digital literacy, the higher the performance in the utilization of digital tools. Similarly, each component of performance, namely the teaching process, student assessment, administrative task, and innovation has a strong relationship with teachers' total digital literacy. Likewise, a strong relationship was also discovered between each component of digital literacy namely finding information, understanding digital practices, using information, and

creating information, and the total performance of the teachers in the utilization of digital tools. These findings inferred that any or all of the digital literacy in this study directly influences the performance of the teachers.

This correlated with the study of Al-Rahmi, et al., (2020) which explained the connection between the utilization of digital devices and job performance. They revealed that the enjoyment and efficacy in the use of digital devices were closely linked in their usage which means that if teachers can utilize digital devices, they are more likely to utilize them in the course of service delivery and the effect will be high job performance. They expounded that it is not sufficient for these teachers to possess these devices but to ensure that these devices are put to communicative usage which will improve their job performance.

Table 15: Relationship between digital literacy and utilization of digital tools

DIGITAL LITERACY	STATISTICS	PERFORMANCE				
		Teaching Process	Assessment	Adm. Tasks	Innovation	Overall Performance
Digital Practices	Correlation Coefficient	0.701**	0.671**	0.599**	0.640**	0.728**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Finding Information	Correlation Coefficient	0.743**	0.700**	0.695**	0.670**	0.784**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Using Information	Correlation Coefficient	0.656**	0.654**	0.550**	0.601**	0.692**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Creating Information	Correlation Coefficient	0.621**	0.577**	0.508**	0.659**	0.661**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
Total Literacy	Correlation Coefficient	0.759**	0.720**	0.645**	0.704**	0.793**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000

Conclusion and Recommendation

The results of the study on teacher's digital literacy, which was assessed in terms of four indicators namely understanding digital practices, using information, and creating information, showed a "very high" average rating. Regarding the performance of the teachers in the utilization of digital tools which was assessed in terms of the teaching process, student assessment, administrative tasks, and innovation, the result unfolded a "very high" average rating. Moreover, the difference in the assessment of the three groups on the teachers' digital literacy is significant as revealed by the F-value of 8.71 at the .05 level. Considering that central schools have big organizations which is reflected in the number of teachers, the difference might be due to limited interactions between the groups. Teachers might think that there is still an area to improve their digital literacy. This is aligned with the results of a study by Cote and Milliner (2018) where they determined that most of their teacher-respondents are willing to further develop their understanding and control of digital practices. Likewise, the difference in the assessment of the three groups of respondents in terms of the performance of the teachers in the utilization of digital tools is significant. This implied that the ICTs are more satisfied with how the teachers use digital tools in teaching while the teachers themselves aim for better utilization or seek other digital tools to satisfy their needs. The reason for the difference could be the personal experiences of the teachers to the challenges encountered. Furthermore, the study found that there is no significant relationship between the profile of the teachers and their digital literacy. The reason for this is that the age and sex are not significant. Despite that, there is a significant relationship between the teachers' digital literacy and their performance.

Since the finding revealed that educational attainment influences the digital literacy of the teachers, it is therefore suggested that teachers should have the motivation to pursue graduate studies, if possible. As evidenced by the study, very few among the teachers in the participating Central Schools in District 2 of Bataan have gained a Master's Degree and only one has a Doctorate Degree. It is highly recommended that DepEd should encourage every school to increase the number. One way to motivate the teachers is to recognize their efforts. A gathering may be conducted where teachers with completed Master's or Doctorate degrees will be given proper recognition. About this, there might be a need for DepEd to review its human resource development program, if there is any, to determine how they may further support the formal education of teachers. Other national government agencies provide scholarships to qualified employees to pursue graduate studies which DepEd may consider the same. The more teachers attain higher

education the more teachers to be digitally literate. In return, these teachers will be the catalysts of change to uplift the quality of education in the country. DepEd should lobby with lawmakers including district representatives and senators to translate this into law and allocate a proper budget for its implementation.

It was evident from the study that the higher the number of training attended, the better the digital literacy of the teachers. It is therefore recommended that teachers shall attend more training programs, if possible. Upskilling which means teaching the teachers new skills shall be implemented to get mastery of digital literacy and be able to have excellent performance. Reskilling or the process of training teachers to do a different job may also be considered so that they may get a new set of digital literacy skills and be able to apply them in performing tasks other than teaching. Moreover, it is suggested that the conduct of digital literacy training programs should be timely to upgrade the digital literacy of teachers with new tools and technologies. Aside from formal training, informal means like personal study and relevant exercises by teachers may also help them to develop better digital literacy.

The results of this study may also be used in the identification of proper training for the teachers. Though the findings showed that the number of training programs directly influences the teachers' digital literacy, it is encouraged that DepEd should appropriately program an annual training plan for teachers where participation in several training would not be a burden on the part of the teacher and that their obligation at school would not be compromised. DepEd should encourage every school to review their training plan, if there is any, or prepare a training plan that is based on the literacy needs of the teachers. Teachers should have active participation in the identification of the training programs because they know better about their literacy. Based on this study, teachers are on average level on the following key performance indicators. On digital literacy of the teachers in terms of understanding digital practices, the emphasis should be put on knowing what categories of users can be or are expected to find online. On digital literacy of the teachers in terms of using information, attention should be given to the application of information in different media, assessment of whether an online resource or person is credible and trustworthy, use of other people's work without committing plagiarism, utilization of social bookmarking to organize and share information. On digital literacy of the teachers in terms of creating information, the focus should be given to adding comments to blogs, forums, or web pages, observing netiquette and appropriate social conventions for online communications, writing in different media for people to read on-screen, communicating with others online, working with others online to create a shared document or presentation, and using media-capture devices. On the level of teachers' performance in the utilization of digital tools in terms of the teaching process, the emphasis should be put on finding electronic educational games and then provide to students as learning materials. On the level of teachers' performance in the utilization of digital tools in terms of innovation, attention should be given to the use of educational games through the use of digital tools, application for necessary intellectual property certification/license for the ownership of modified/new innovative material, and use of digital tools to improve personal productivity through proper time management like the use of notes or similar or any needed application.

Following the finding on the negative relationship between digital literacy and length of service which means that teachers that are younger in service have better digital literacy, those teachers who are relatively older in service shall be provided with training programs to improve their digital literacy. It may also sound alarming that the study found out that the teacher population at the sample schools is aging. DepEd should provide proper intervention so that older teachers are capable of adapting to the fast-changing technology and be able to appreciate their pedagogical application. Aside from this, the schools may explore the adoption of a buddy system wherein an older teacher will be partnered with a younger teacher or capable one so that the latter may assist the former when needed. The buddy system could be helpful when implemented properly and when all teachers are cooperative, the school head needs to gather full support from all teachers to do this. If teachers do not have available time to perform that because of the demands of their work, DepEd may study the possibility of hiring and assigning one ICT staff to each school who may focus on ICT concerns and who may guide the day-to-day ICT needs of the teachers particularly that technology nowadays are becoming sophisticated.

On the premise that teachers have better digital literacy when they attend more training programs, the DepEd or the schools should further invest in ICT infrastructure that can be used by teachers to develop or hone skills related to digital literacy. For example, internet connectivity at the school, if available for every classroom, can open a wide array of opportunities for teachers because they will be able to access various online resources which they may use to facilitate better ways of learning. With the advent of more ICT technologies, it is also suggested that schools should find and build better ways to exploit the full potential of blended learning. This can be lobbied with policy makers at DepEd, the Local and Provincial School Board as well as congressional district representatives.

One notable observation gathered from this study is the easy retrieval of the questionnaires from one of the participating Central schools. It was noticed that the said school, unlike the other three schools, has an ICT coordinator for every grade level who assisted the school's overall ICT coordinator in rating the literacy and performance of the teachers. The presence of grade-level ICT coordinators might be the best practice of the said school that makes communication and coordination within them faster. Thus, these ICT coordinators were able to know their colleagues better which made it easier for them to rate them. Thus, for schools as big as Central Schools, it is recommended to consider assigning grade-level ICT coordinators to facilitate agile coordination in the school, which in turn may impact the school's efficiency.

Because differences in the perception between the teachers, principals, and ICT coordinators exist, further studies may consider looking at the reasons and factors that caused such significant differences which were not covered in the present study. Also, means to verify performance output may be considered in future studies to arrive at an objective assessment of the teachers' literacy and performance. The same study but with a wider scope may be conducted to include other districts or divisions, hence will get a clear picture of the overall digital literacy of the teachers and a more tailored capacity program may be crafted. On the other hand, although the present study was able to find significant differences in the responses of the three groups in terms of digital literacy and performance, there might be a need to take a look closely at the reasons for the differences in their perceptions. \

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References

Al-Rahmi, W. M., Alzahrani, A. I., Yahaya, N., Alalwan, N., & Kamin, Y. (2020). Digital Communication: Information and Communication Technology (ICT) usage for education sustainability. Sustainability, 12(12), 5052. https://doi.org/10.3390/su12125052

Asian Development Bank. (2021). Learning and earning losses from COVID-19 school closures in developing Asia: special topic of the Asian development outlook 2021. https://www.adb.org/sites/default/files/publication/692111/ado2021-special-topic.pdf

Ata, R., & Yıldırım, K. (2019). Exploring Turkish Pre-Service teachers' perceptions and views of digital literacy. Education Sciences, 9(1), 40. https://doi.org/10.3390/educsci9010040

Cabero-Almenara, J., Guillén-Gámez, F. D., Palmero, J. R., & Palacios-Rodríguez, A. (2021). Digital competence of higher education professors according to DigCompEdu. Statistical research methods with ANOVA between fields of knowledge in different age ranges. Education and Information Technologies, 26(4), 4691–4708. https://doi.org/10.1007/s10639-021-10476-5

Caluza, L. J. B., Verecio, R. L., Funcion, D. G. D., Quisumbin, L. A., Gotardo, M. A., Laurente, M. L. P., Cinco, J. C., & Marmita, V. (2017). An Assessment of ICT Competencies of Public School Teachers: Basis for Community Extension Program. IOSR Journal of Humanities and Social Science, 22(03), 01–13. https://doi.org/10.9790/0837-2203040113

Cano, R. (2020, July 29). Nearly all California schools were ordered to shut down. Online classes are mandatory. CalMatters. https://calmatters.org/education/2020/07/california-schools-shut-down-reopening/

Deabanico, G. J., & Caballes, D. G. (2023). Revolutionizing Learning: How eGamification Assessment is Changing Teaching? Zenodo (CERN European Organization for Nuclear Research). https://doi.org/10.5281/zenodo.8168422

Flecknoe, M. (2020). How can ICT Help us to Improve Education? Innovations in Education and Teaching International, 39(4), 271–279. https://doi.org/10.1080/13558000210161061

Hassan, M. M., & Mirza, T. (2021). The Digital Literacy in Teachers of the Schools of Rajouri (J&K)-India: Teachers Perspective. International Journal of Education and Management Engineering, 11(1), 28–40. https://doi.org/10.5815/ijeme.2021.01.04

Hero, J. (2019). The impact of technology integration on teaching performance. international journal of Sciences: basic and applied research (ijsbar), 101. https://core.ac.uk/download/pdf/249336742.pdf

Jana, P., Soifah, U., & Pratolo, B. W. (2021). Unlocking digital literacy practices of EFL teachers. Journal of Physics: Conference Series, 1823(1), 012030. https://doi.org/10.1088/1742-6596/1823/1/012030

Karsh, S. (2018). New technology adoption by business faculty in teaching: analyzing faculty technology adoption patterns. https://www.ijtes.net/index.php/ijtes/article/view/7

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. European Journal of Teacher Education, 43(4), 608–622. https://doi.org/10.1080/02619768.2020.1809650

Kumari, V. & Souza, F. (2016). Secondary school teachers' digital literacy and use of ICT in teaching and learning. International Journal of Computational Research and Development, 1(1), 141–146. https://doi.org/10.5281/zenodo.220927

Lambert, D. (2020, October 16). California school districts struggled to prepare teachers for distance learning this fall. EdSource. https://edsource.org/2020/california-school-districts-struggled-to-prepare%20teachers-for-distance-learning-this-fall/641442

Mafang'ha, M. (2016). Teachers' experience on the use of ICT to facilitate teaching: A case of Ilala district secondary schools. University of Tanzania. Retrieved from https://core.ac.uk/download/pdf/79425244.pdf

Majid, I. (2020). ICT in assessment: a backbone for teaching and learning process. ResearchGate. https://www.researchgate.net/publication/348489222

Media Smarts (2016). Digital Literacy Fundamentals. https://mediasmarts.ca/digital-media-literacy/general-information/digital-media-literacy-fundamentals/digital-literacy-fundamentals

Morsy, H. (2021). Africa urgently needs to get its pupils back to school. Arab news. https://www.arabnews.com/node/1834631

Narayanan, S. (2018). A Study on the Relationship between Creativity and Innovation in Teaching and Learning Methods toward Students' Academic Performance at Private Higher Education Institutions, in Malaysia. International Journal of Academic Research in Business & Social Sciences, 7(14). https://doi.org/10.6007/ijarbss/v7-i14/3647

Obana, J. (2020, June 22). Digital learning strategy for K-12 schools and higher education. The Manila Times. https://www.manilatimes.net/2020/06/17/business/columnists-business/digital-learning-strategy-for-k-12-schools-and-higher-education/732354/

OECD (2019). Economic outlook for Southeast Asia, China, and India 2020: rethinking education for the digital era. Paris: OECD publishing. https://doi.org/10.1787/1ba6cde0-en

Peled, Y. (2021). Pre-service teacher's self-perception of digital literacy: The case of Israel. Education and Information Technologies, 26(3), 2879–2896. https://doi.org/10.1007/s10639-020-10387-x

Perifanou, M. (2021). Teachers' digital skills readiness during covid-19 pandemic. international journal of emerging technologies in learning, 16(8), 238–251. https://doi.org/10.3991/ijet.v16i08.21011

Reyes, F. J. F. D., & Caballes, D. G. (2022). Digital Technology as a Mode of Instruction: An analysis. ResearchGate.https://www.researchgate.net/publication/361070806_Digital_Technology_as_a_Mode_of_Instruction_An_Analysis

Rossier (2020, November 30). 7 Reasons Why Digital Literacy is Important for Teachers | USC Rossier. USC-MAT. https://rossieronline.usc.edu/blog/teacher-digital-literacy/

Scarpellini, F., Segre, G., Cartabia, M., Zanetti, M., Campi, R., Clavenna, A., & Bonati, M. (2021). Distance learning in Italian primary and middle school children during the COVID-19 pandemic: a national survey. BMC Public Health, 21(1). https://doi.org/10.1186/s12889-021-11026-x

Taha, E. (2020, November 26). Impact of COVID-19 on education in Egypt: a new world order in the education realm - Al Tamimi & Company. https://www.tamimi.com/law-update-articles/impact-of-covid-19-on-education-in-egypt-a-new-world-order-in-the-education-realm/

Tan, A., & Tan, A. (2021, April 23). Zoom is your new classroom: Will online education become the norm after COVID-19? Vulcan Post. https://vulcanpost.com/701216/university-online-education-covid-19-singapore/

UNESCO. (2020). Education: from disruption to recovery, https://en.unesco.org/covid19/ education response

Varella, S. (2021, September 12). Parents' views on problems of online education in high school in Italy 2021. https://www.statista.com/statistics/1234906/parents-views-on-problems-of-online-education-in-high-school-in-italy/

Yazon, A. D., Manaig, K. A., Buama, C. a. C., & Tesoro, J. F. B. (2019). Digital Literacy, digital competence and Research Productivity of educators. Universal Journal of Educational Research, 7(8), 1734–1743. https://doi.org/10.13189/ujer.2019.070812

Zhang, Y., Pinto-Llorente, A. M., Sánchez-Gómez, M. C., & Zhao, L. (2021). The Impact of Gender and Years of Teaching Experience on College Teachers' Digital Competence: An Empirical Study on Teachers in Gansu Agricultural University. Sustainability, 13(8), 4163. https://doi.org/10.3390/su13084163