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Short Paper

Digital Readiness of Faculty and Students at the State University using Modified General Technology Competency and Use Model with Rule-based Algorithm: Basis for Teaching and Learning Delivery Mode Policy

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Abstract

Purpose – As an academic institution, the Polytechnic University of the Philippines actively responds to the challenging effect of the COVID 19. One of the actions was to assess its faculty members and students' readiness in adopting digital and virtual worlds as an alternative to the traditional classroom-based learning and teaching method and to come up with appropriate decisions and policies.

Method – The Digital Assessing Profiler is an online-based survey to assess the readiness of Faculty and Students in an online-based delivery of teaching. The researchers adopted and modified the General Technology Competency and Use (GTCU) online-learning framework in developing the Digital Assessing Profiler with Rule-Based Algorithm to forecast and to determine the readiness of the students and faculty members in adopting the digital virtual class settings.

Results – This study grouped students and faculty into high and low-readiness based on technical, social, informational, and internet dimensions. By applying the rule-based model in the Digital Assessing Profiler, findings show that a large percentage of students are not that prepared for many online-learning activities, and there is generally greater readiness on mobile devices than desktops/laptops. However, large percentages of students appear in high-readiness segments for using social networks and technical and social interactions.

Conclusions – The generated assessment on readiness will help the University in crafting relevant policies and guidelines for teaching and learning delivery mode. The researchers recommended the use of a digital assessor profiler which is based on a modified General Technology Competency and Use (GTCU) online-learning framework to align these patterns of strengths with future educational innovation.

Keywords – digital readiness, on-line learning, digital assessing profiler, general technology competency, use

INTRODUCTION

Online learning readiness is a cognitive awareness and maturity that a student develops for successful learning in a web-based environment. It manifests in the attributes of recognizing the self-directed nature, formulating learning strategies, obtaining technology competencies, adjusting to digital etiquettes, and being open to help-seeking (Liu & Kaye, 2016).

The effect of COVID 19 in the Philippines directly affects our economic and social life activities, but most especially, our educational system. The national government immediately imposed an Enhanced Community Quarantine (ECQ) last March 17, 2020,

which causes citizens to stay in their houses for protection against the virus. The situation led to abnormal termination of the traditional learnings to the education system of the entire Luzon's including the National Capital Region (NCR). While the coronavirus disease 2019 (COVID-19) hits more countries worldwide, it brought changes to society, most especially in education. In the Philippines, to continue the learners' education, the Department of Education (DepEd) encourages the teachers to fully maximize the utilization of ICT in teaching to keep the learner's safe from the threat of the virus (Hero, 2020).

This caused disruptions to the normal education system of private schools, state colleges, and universities. The Commission on Higher Education (CHED) prescribed immediately an on-line mode of learning to cope and to complete the academic term (CHED Advisory No. 6, 7, S. 2020). But, most of the schools especially local government and state-owned colleges and universities are not ready for this type of learning mode. The Polytechnic University of the Philippines (PUP) thru its administrators took the action of validating the effect of immediate full on-line mode of learning by conducting a survey. The survey's primary objective is to assess the digital readiness of the students and faculty of the university for an online mode of learning and teaching. Online learning readiness is a cognitive awareness and maturity that a student develops for successful learning in a web-based environment. It manifests in the attributes of recognizing the self-directed nature, formulating learning strategies, obtaining technology competencies, adjusting to digital etiquettes, and being open to help-seeking (Liu & Kaye, 2016).

The research sector of the university developed a system that will help to assess the level of readiness of the students and faculty. The result levels could be high or low. The developed prototype was based on the modified General Technology Competency and Use (GTCU) framework (Desjardins et al., 2010) and applied the Rule-based Algorithm for measuring the digital readiness of the university. The high digital readiness and low digital readiness will help the administration creating relevant policy on how to classify the students based on digital readiness and what learning mode will be adapted.

Objectives

The researchers aimed to classify Digital Readiness of Faculty and Students using the developed Digital Assessing Profiler (DAP) System by applying the modified General Technology Competency and Use (GTCU) framework. It also predicted the readiness of the respondents in an online class mode of teaching and learning.

REVIEW OF RELATED LITERATURE

General Technology Competency and Use (GTCU) Framework

Desjardins and Van Oostveen (2015) designed the General Technology Competency and Use (GTCU) framework which identified four human-computer-object interaction types: computational, informational, communicational, and technical as shown in Figure 1.

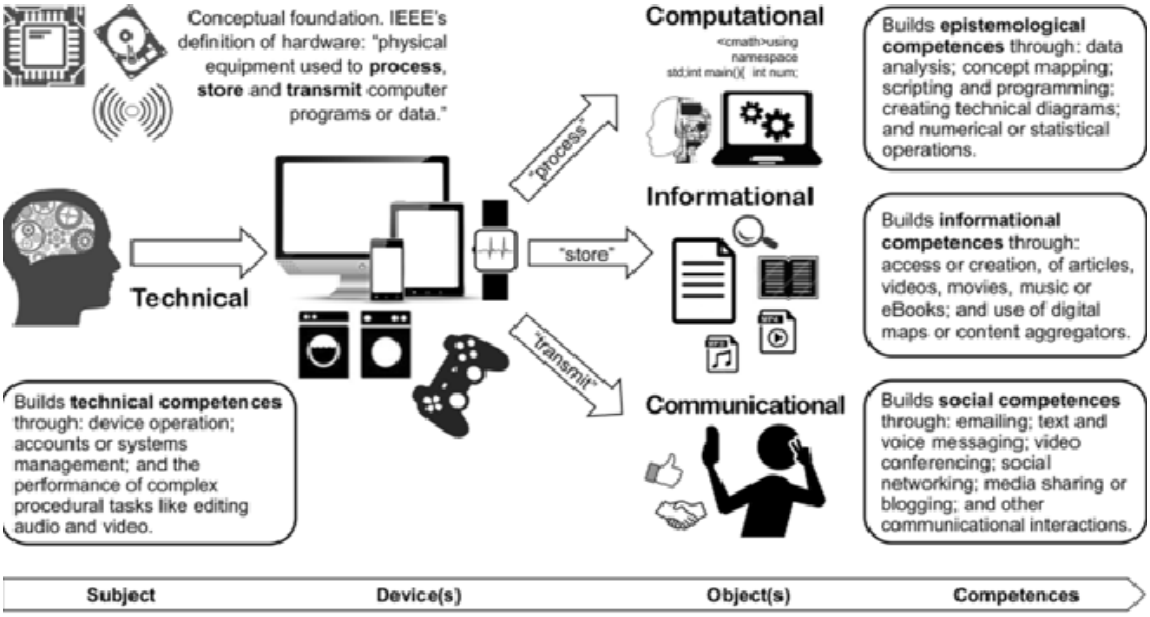

Figure 1. A conceptual overview of the GTCU framework

The GTCU framework is a multi-contextual and multi-dimensional framework for conceptualizing digital technology uses and related competencies. A technical order of interaction was introduced to account for operational skills and those instances when individuals focus on the technology itself (e.g., when a device fails). It is *effective* to use by matching interaction types to corresponding sets of knowledge and skills. It typically developed through frequent and confident computer-mediated activity to avoid complex competence descriptions like some other frameworks (Vuorikari et al., 2016).

The framework offers five key features: 1. The *core* capabilities of computer hardware to conceptualize digital uses and competencies insulates itself from the changing designs of hardware and software platforms, and environmental factors affecting technology use in particular contexts. 2. Technical, informational and social represent a common core among major frameworks (Iordache, Mariën & Baelden, 2017), and its computational dimension addresses competencies that are achieving prominence in the educational literature (Bocconi et al., 2016; Jun et al., 2014). 3. *online data-collection application (DPC)* has been used repeatedly to profile the technology uses of both students and professors in higher education (Barber et al., 2016; Desjardins & Van Oostveen, 2015). 4. The DCP provides a tremendously rich set of data points unmatched by other readiness instruments by incorporating behavioral and attitudinal indicators, and associating items with specific types of devices, 5. Owing to growing international adoption, the DCP has been translated into several languages and has been used previously in non-Western contexts (Blayone, et al., 2017).

Readiness for online learning

Readiness for online learning is an international research domain conceptualizing and measuring, various success factors and enabling conditions. There are numerous readiness models implemented and observed in different studies, specifically the micro-level perspective, which is focused primarily on students or Teachers (Parkes, Stein, & Reading, 2015; Gay, 2016; Hung, 2016). At the micro-level, digital competencies, defined as knowledge, skills, and attitudes supporting the purposeful and effective use of technology (Ala-Mutka, 2011), figure as the most prominent set of readiness factors within frameworks (Al-Araibi, et al., 2016; Demir & Yurdugül, 2015) and instruments (Lin, Huang, & Chuang, 2015). However, existing operationalization tends to be unidimensional and inconsistent, showing little awareness of current, multidimensional digital-competency frameworks (Blayone et al., 2017). To address these shortcomings, researchers at the EILAB, University of Ontario Institute of Technology, Canada, are leveraging the General Technology Competency and Use (GTCU) framework (Desjardins, et al., 2001) and the accompanying Digital Competency Profiler (DCP) for measuring digital readiness for online learning (Desjardins, 2015).

Importance of Internet Access in Online Learning

Internet technologies are influencing not just the management of products and services but also the rethinking of business processes, firm structure, industry boundaries, and even the educational system. Academics and practitioners increasingly consider the effective use of this technology as a major determinant of competitive advantage, productivity, and even individual competency (Torkzadeh & Dyke, 2002). They also believed that the cyber environment served as the vehicle for developing an individual's information competency. Internet activity is also associated with shaping oneself relative to independence and autonomy, with the extent of self-presentation, and with the easiness of making interpersonal contacts (Tabachuk, et al., 2018).

Online access can affect how successful students will be in Web-based classes (Anawati & Craig, 2006). Previous researches focused on online collaboration as essential to the educational success or students' affective and cognitive development. This involved keeping students in online projects and builds an online community which essential to success in education (Vogel et al., 2001). A study conducted in Nigerian universities showed that the internet provides far quicker access to electronic information sources (electronic books/electronic journals) than is obtainable with print sources (books/journals). The internet was also the most effective and efficient medium of knowledge transfer and dissemination from the advanced nations to the developing nations in the digital age (Okun, 2010).

In this study, internet access is included in the model to define the digital readiness of the students and faculty. Based on the Internet Society Organization, the internet has immense potential to improve the quality of education which is one of the pillars of sustainable development. In various public schools, including state colleges and universities, internet access is a major challenge to achieve quality education. For

internet access to be meaningful, it must also be affordable for schools and individuals, and teachers and students (Internet Society, 2017).

RESEARCH DESIGN AND METHODOLOGY

Development Details

The Digital Assessing Profiler (DAP) is referenced to the GTCU (the General Technology Competency and Use (GTCU) framework is a multi-contextual (i.e., applicable to education, work, home, etc.) and multi-dimensional framework for conceptualizing digital technology uses and related competencies. The DAP inherits the five features of the GTCU framework. First, the core capabilities of computer hardware to conceptualize digital uses and competencies, The second feature is modified, three of its four dimensions (technical, informational, and social) representing a common core among major frameworks is adapted by DAP, but the fourth dimension which is Computational (referring to advanced computing skill) is not applicable in assessing the entire faculty and students digital competencies in the university, in the study, internet connectivity, the fourth dimensional is used to assess the digital preparedness or developing Information Competency (Tabachuk et al., 2018). Third, the GTCU's online data-collection application—the DAP—has been adapted to profile the technology uses of both students and professors in the university. Fourth, by incorporating behavioral and attitudinal indicators, and associating items with specific types of devices, the DAP provides an action list under the four (4) variables to measure readiness.

The system architecture of the Digital Assessing Profiler (DAP) was presented in Figure 2. The user will provide his/her basic personal information by filling up the Respondent's Profile form. The DAP was able to define the action list from the survey which is the devices owned by the respondents as Technical, the non-online academic activities action list as social, the academic activities as Informational. The fourth dimension which is internet connectivity defines the action list covering the internet connection, internet subscription, service provider, and the speed of internet connectivity. The user will then proceed in answering the questionnaire which involves the (1) technical, (2) social, (3) informational, (4), and internet connectivity categories. Upon finishing the survey assessment, the system will compute the percentage of the 'Yes' and 'No' answers for each question, and use these values to apply the concept of the rule-based algorithm before the computation of the level of overall preparedness. The levels are measured by 'High' or 'Low'. If the percentage of the computed overall preparedness is below 60%, the preparedness level will be considered as 'Low', otherwise it will be considered as 'High'.

The four (4) variables of the modified GTCU for Digital Assessing Profiler (DAP) namely *Technical, Social, Informational,* and *Internet Connectivity,* which are necessary to compute the percentage of overall preparedness was set with weights of 30%, 25%, 25%, and 20%, respectively. To get the percentage value for the *Technical* variable, the system

will count the frequency of the students/faculties with at least one (1) gadget, which is either desktop, laptop, smartphones, or computer tablets; for the *Social* variable, the system will count the frequency of students/faculties with at least 1 social media used; for the *Informational* variable, the system will count the frequency of students/faculties with at least 1 online academic activity; lastly for the *Internet Connectivity* variable, was divided into 2 more variables: *frequency* and *confidence*. The *frequency* will be identified by counting the frequency of students/faculties with an internet connection at home. On the other hand, the *confidence* will be determined based on the counts of those users with a high-speed internet connection (5mbps and above).

System Architecture of Digital Assessing Profiler

Figure 2 illustrates the system architecture of the proposed study. Digital Assessing Profiler system (modified GTCU) is a web-based application that was created using HTML (Hypertext Markup Language), CSS (Cascading Style Sheets), and Javascript. For the functionalities of the system, Python programming language will be used for coding. It will be compiled and executed in PyCharm which is an IDE (Integrated Development Environment) used specifically for the Python language. A rule-based algorithm was used to determine the overall preparedness of students and faculty for online Technology-Based Learning.

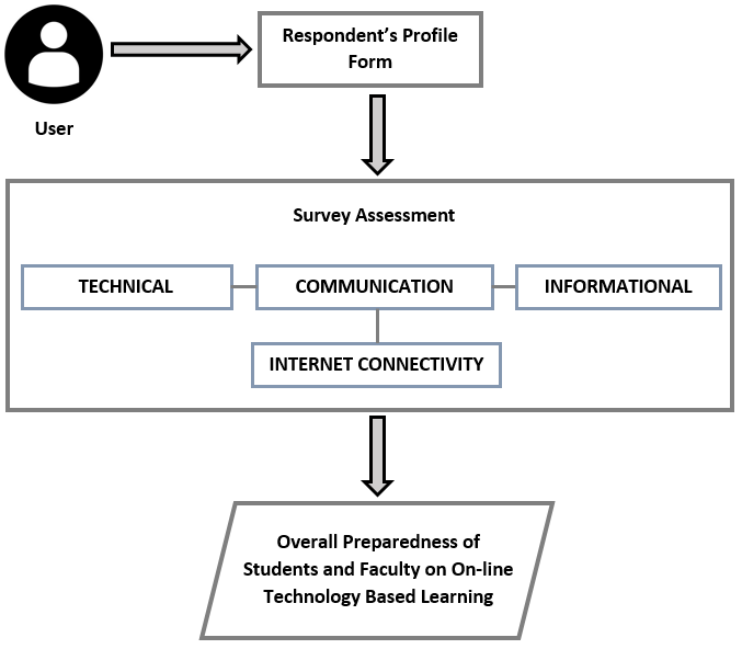

Figure 2. System Architecture of the study

Rule-Based Algorithm

Classification is an important problem in machine learning and data mining. Rule learning or rule-based classification is valuable due to the following advantages: (1) rules are very natural for knowledge representation, as people can understand and interpret

them easily; (2) classification results are easy to explain and the logic behind the inference of the rules and input data is clear; (3) rule-based classification models can be easily enhanced and complemented by adding new rules from domain experts on their domain knowledge; and (4) rule-based classification systems are competitive with other classification algorithms and in many cases are even better than them (Aggarwal C., 2014). The rules are commonly represented and expressed as follows:

IF (condition AND condition)
THEN (1) *conclusion*.

Validity and reliability

The original Digital Competency Profiler (DCP) survey instrument is the basis of Digital Assessing Profiler (DAP). The survey made and process included in the DAP was approved by the higher management of the research sector and the College of Computer and Information Sciences (CCIS). The Weighting method applied in *Technical, Social, Informational,* and *Internet Connectivity,* which are necessary to compute the percentage of overall preparedness was set with weights of 30%, 25%, 25%, and 20%, respectively to assess the overall readiness preparedness was approved by to be used in the DAP. Based on further study, besides simplicity, it allows the dataset to be corrected so that results more accurately represent the population being studied by GeoPoll Research Services (Elliot, 2020). The DAP was able to define the action list from the survey which is the devices owned by the respondents as Technical, the non-online academic activities action list as social, the academic activities as Informational. The fourth dimension which is internet connectivity defines the action list covering the internet connection, internet subscription, service provider, and the speed of internet connectivity. The initial DAP was approved by the management and still subject to improvements as recommended by higher administration.

Description of Data

Data was collected thru a survey from 11,960 students and 848 faculty members (with a total of 12,808 respondents). Survey questionnaires were used to answer what available devices they are using, their platform (operating systems), accessible internet connectivity and its speed, their academic and non-academic online activities, real-time online communications, problems during online sessions.

Data privacy was strictly observed in collecting, processing, and storing information from the respondents. Information was processed by Digital Assessing Profiler to determine the high and low readiness based on technical, social, informational, and internet dimensions of the faculty members and students. Also, application of a rule-based algorithm determines the readiness of the respondents in an online class mode of teaching and learning.

RESULTS AND DISCUSSIONS

Overall Digital Readiness of Teachers and Students

The overall readiness of the faculty and students is computed as shown in Table 1 and Table 2.

Table 1. Computed Over-all readiness of the faculty using the modified GTCU for DAP

Variables	Weight	Basis	Count	Preparedness	Preparedness * Weight
1. Technical (Frequency)	30%	Number of faculty with at least 1 gadget to use	847	(847 / 848) * 100 = **99.88%** (**HIGH**)	99.88 * 0.3 = **29.35%**
2. Social (Frequency)	25%	Number of faculty with at least 1 social media to use	848	(848 / 848) * 100 = **100%** (**HIGH**)	100 * 0.25 = **25%**
3. Informational (Frequency)	25%	Number of faculty who do at least 1 online academic activity (Email, Internet, Research, etc.)	848	(848 / 848) * 100 = **100%** (**HIGH**)	100 * 0.25 = **25%**
4. A. Internet (Frequency)	10%	Number of faculty with internet services at home	800	(800 / 848) * 100 = **94.34%** (**HIGH**)	94.34 * 0.1 = **9.43%**
5. B. Internet (Confidence)	10%	Number of faculty with an internet speed of at least 5mpbs	480	(480 / 848) * 100 = **56.6%** (**LOW**)	56.6 * 0.1 = **5.66%**
OVERALL					**95.05%** (**HIGH**)

With high frequencies for technical, social, informational, and internet variables for faculty, the assessment for readiness is very high. The Confidence is based on the internet speed acquired by the faculty. Out of 848, there were 480 faculties able to have better internet access because of the higher Mbps (at least 5 Mbps).

With high frequencies for technical, social, informational, and internet variables for students, the assessment for readiness is very high. The confidence is based on the internet speed acquired by the faculty. Out of 11,960, there were 8,779 students have Internet access in their homes but 4,530 were having higher Mbps (at least 5 Mbps).

Table 2. Computed Over-all readiness of the Students using the modified GTCU for DAP

Variables	Weight	Basis	Count	Preparedness	Preparedness * Weight
1. Technical (Frequency)	30%	Number of students with at least 1 gadget to use	11, 699	(11, 699 / 11, 960) * 100 = **97.82%** (**HIGH**)	97.82 * 0.3 = **29.35%**
2. Social (Frequency)	25%	Number of students with atleast 1 social media to use	11, 960	(11, 960 / 11, 960) * 100 = **100%** (**HIGH**)	100 * 0.25 = **25%**
3. Informational (Frequency)	25%	Number of students who do at least 1 online academic activity (Email, Internet, Research. etc.)	11, 960	(11, 960 / 11, 960) * 100 = **100%** (**HIGH**)	100 * 0.25 = **25%**
4. A. Internet (Frequency)	10%	Number of students with internet services at home	8, 779	(8, 779 / 11, 960) * 100 = **73.40%** (**HIGH**)	73.4 * 0.1 = **7.34%**
5. B. Internet (Confidence)	10%	Number of students with an internet speed of at least 5mpbs	4, 530	(4, 530 / 11, 960) * 100 = **37.88%** (**LOW**)	37.88 * 0.1 = **3.79%**
OVERALL					**90.48% (HIGH)**

***Screenshot of Digital Assessing Profile**r (Registration part)*

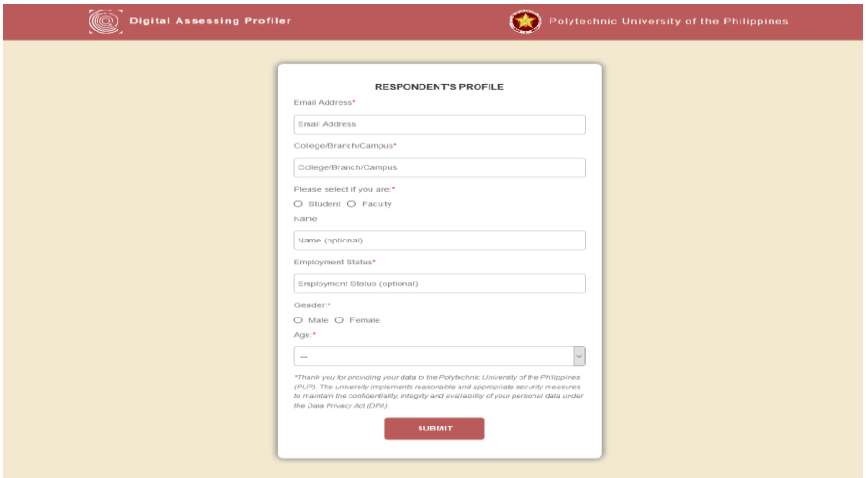

Figure 3. The interactive response of the Students or Faculty (Digital Assessment)

Figure 3 is an interactive interface for the respondent's profile (Student or Faculty) to enter in the Digital Assessing Profiler Main Process.

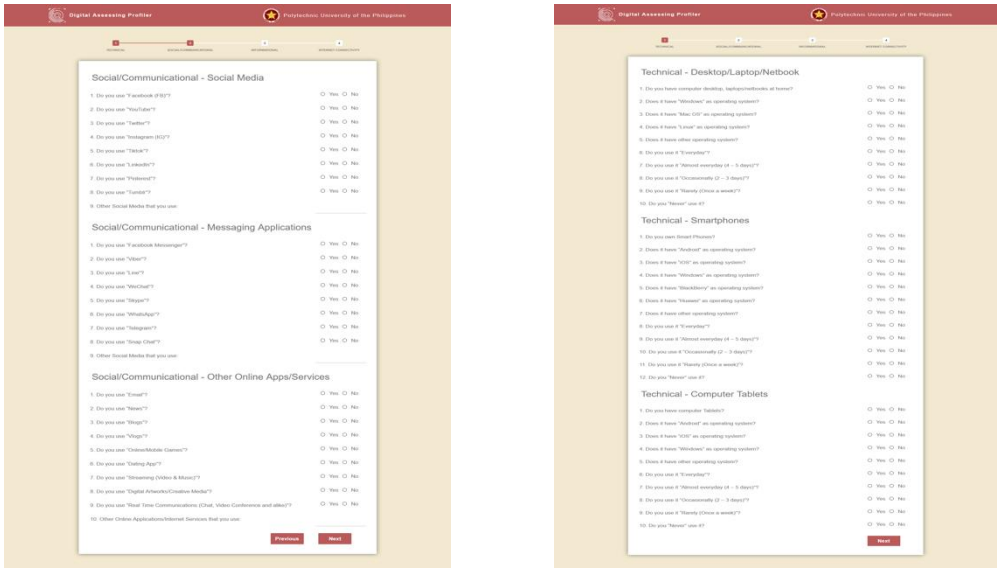

Figure 4. Main Figure Process Interface of the Digital Assessment

In Figure 4 the user will then proceed in answering the questionnaire which involves the (1) technical, (2) social, (3) informational, and (4) internet connectivity categories. Upon finishing the survey assessment, the system will compute the percentage of the 'Yes' and 'No' answers for each question, and use these values to apply the concept of the rule-based algorithm before the computation of the level of overall preparedness. The levels are measured by 'High' or 'Low'. If the percentage of the computed overall preparedness is below 60%, the preparedness level will be considered as 'Low', otherwise it will be considered as 'High'.

Figure 5. Overall readiness of Teachers and Students from Digital Assessing Profiler

As aforementioned before, the four (4) variables or categories namely *Technical, Social, Informational,* and *Internet Connectivity* (modified GTCU) were provided with weights of 30%, 25%, 25%, and 20%, respectively. These weights were used to determine

each of the variables' total percentages. The overall readiness of both students and faculties were computed by the summation of the values from each variable. As shown in Figure 5, the overall readiness of the students and faculties was measured as *High* (90.58%) and *High* (95.05%), respectively for online technology-based learning.

CONCLUSIONS AND RECOMMENDATION

Based on the results discussed in the previous section, only the internet connection has a low percentage of preparedness because most of the students and faculty doesn't have a fast internet connection of at least 5mbps, which is considered good for checking emails, using social media, and online researches. The two variables namely *Social* and *Informational*, both garnered an overall preparedness of 100%, for both the students and faculty. This is because every student and faculty use at least one social media and performs at least one online academic activity. The remaining variable namely, *Technical*, garnered an overall preparedness of below 100%, which indicates that there are still few students and faculty that doesn't have possession of any gadget to participate in online based learning.

Given the results for each variable presented, the overall preparedness garnered a high percentage of above 90% for both students and faculties. Thus, it can be concluded that most of the PUP faculty members and students are prepared for online technology-based learning, in contrast to the few individuals that need assistance to be able to participate in online classes. Low technology devices, no internet connectivity, time and commitment of the faculty, and no available devices are also hindrances to do an online class in which the majority of students still preferred traditional class setting (face to face).

And for the state university to decide the basis for Teaching and Learning Delivery mode, since the result for the digital readiness is positive for both the students and faculty using modified General Technology Competency and Use Model (GTCU) with Rule-based Algorithm, the university must develop surveys that will measure properly the other factors affecting the digital readiness and the learning pattern. As of now, the university was able to identify the students into two groups: Online mode if the digital readiness is either high and low and Correspondence mode with no internet access. For both modes, the instructional materials are required to have a higher percentage of learning pattern.

Still, the researchers are refining the process and weight allocation method by consulting other mathematicians and further review of the survey instrument. The total number of respondents for faculty and students must be improved to make the results more valid.

IMPLICATIONS

Digital readiness in this study is based on General Technology Competency and Use (GTCU) framework. The developed prototype is a helping device for creating policy helping the University administrators for adapting new normal in higher education. The prototype is the basis for the learning mode and the basis for the learning outcome must be different. As of now, the national government, Commission on Higher Education (CHED), and local government units (LGUs) are providing the digital needs of the students and the faculty for Blended learning and full-on line learning and teaching, still, the learning outcome of both the students and faculties must be taken into consideration. The total shift from a traditional setting to an on-line mode is unexpected and immediate because of the effect of the COVID 19. The new normal in education must be prioritized and be the focus of our government in order not to compromise the learning outcome future of our students.

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