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ICT Skills for Future Professional Performance of Biology Education Students of Papua

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Abstract: To date, ICT (information and Communication Technologies) integration have led to significant changes that transform many aspects of education world. The main objective of the research was to analyze the ICT skills for future professional performance of biology education students at Faculty of Teacher Training and Education of Universitas Cenderawasih. This research was a non-experimental and descriptive quantitative methodology, with an assistance of electronic survey to collect data. The 43-items questionnaire was completed by 75 students and concludes that students showed from medium to high average for all areas of ICT competences (technological literacy; the search and treatment of the information, critical thinking, problem solving and decision making; communication and collaboration; digital citizenship; creativity and innovation), and obviously need to be improved in some items formatively.

Keywords: Digital competence; Education; ICT; Papua; Prospective biology teachers

Introduction

Today, the rapid innovations and development of ICT (Information and Communication Technologies) have led to significant changes that transform many aspects of education world (Cabezas et al., 2022; Cervera & Cantabrana, 2014; Espejo-Villar et al., 2022; García-Martínez et al., 2023). Using and integrating ICT in teaching-learning process can be benefit for (Belland et al., 2017; Legrain et al., 2015; Li & Ranieri, 2010; Sung et al., 2017). Digital resources and educational platforms have been used in teaching and learning practices, which require digital competence (Ferrari, 2013; Redecker et al., 2011). Digital competence includes the confident, critical and responsible use of digital technologies in teaching-learning in education world or society (Lázaro-Cantabrana et al., 2019; Nurbaya, 2023; Sarkio et al., 2023). For this background, the education system should encompass new teaching-learning concepts, methodologies, resources and digital tools to replace the conventional classroom with technology-enabled classroom that can assist students' need in this network society era. The capability of integrating ICT into educational practice require well-trained and professional teachers (Cózar-Gutiérrez et al., 2015), because the successful of ICT-based learning depends on teachers' skills to optimize the service of communication and information literacy as well as to adapt to students' cognitive and potential characteristics (Casillas-Martín et al., 2020; Infante-Moro et al., 2019).

Students need to adapt to new competences that enable them to access what so-called information and knowledge digital-based society (Baş et al., 2016; Chaves-Barboza et al., 2017). Based on studies exist that the successful use of ICT in teaching practices demand considerate integration of technology and pedagogical process in classroom (Harris & Hofer, 2011; Janssen & Lazonder, 2016; Kirschner, 2015; Tondeur et al., 2017; Webb & Cox, 2004). According to the NETS's Project and developed by the International Society for Technology in Education (ISTE) (2007), ICT's indicators proposed in this paper encompasses Technological Literacy (include:

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understanding and utilizing information and communication digital technology systems; selectively using application; and transferring the existing ICT-based knowledge), The Search and Treatment of Information (include: planning strategies for investigation; organizing, analyzing and evaluating information from various sources; selecting sources and digital tools for specific tasks; processing and communicating data results), Communication and Collaboration (include: interacting, collaborating and publishing with others; communicating the information and ideas to people with various media and formats; developing an understanding and awareness to students from other cultures; participating in group to develop original projects or solving problems), Digital Citizenship (include: promoting and practicing the legal use of ICT-Integration; exhibiting the collaboration, learning and productivity; exercising leadership towards digital citizenship), and Creativity and Innovation (applying the knowledge existed to develop new ideas and products; creating original works whether in individual or groups; and identifying trend and foresee possibilities).

Studies about ICT have been conducted in several countries to see the abilities of integrating technology-based as learning resources. A study by Cetin (2016), conducted science pre-service teachers in the Turkey, stated that teacher candidates are seen to have acquired knowledge to operate computer as part of their teaching activities (distance learning, hypermedia and data-based management). The ability of teachers integrating basic ICT in Turkey can be found in study by Ozdemir (2017), which resulted the teacher's ability in very good category, based on their gender, teaching experience, and educations' degree. In Japan, a country with high density of development in technology, a study conducted on 61 Japanese teacher candidates found that the students demand the attitudes of improving their ICT-skills as significant tools to develop their teaching creativities. In stark contrast with that result, a study by Chikasha et al. (2014) indicated that not all teachers master the integrating of ICT as a learning source in class. In Indonesia, several facts have been shown during the teachers' training for certification. Many teachers do not have the ability to be called digital-native, which means their knowledge and skills in operating computers for on-line class session stood at low level.

Therefore, it is reasonable to state that ICT skills for future professional performance at university students need to be studied. For this reasoning, the teaching university will establish the standards and technological skills in their students for their future professional performance. As a science subject which explore about living organism, their structures, forms, and functions, Biology need the integration of ICT, along with a motivating and captivating approach in teaching process (Kareem, 2018; Taiwo & Emeke, 2014). That is why this research will focus a little more on biology university students, as the continuing generation of future teachers. To be more specific, this study is aimed at analyzing the ICT skills for future professional performance of biology education students at Faculty of Teacher Training and Education of Universitas Cenderawasih.

Method

The method used to accumulate the data required in this study is non-experimental and descriptive quantitative, with the survey design. This methodology allowed the researcher to use questionnaire for data collection (Lumsden, 2007; Supardi et al., 2021). The research was carried out during the first semester of 2023-2024 academic years. The study population was made up of all biology prospective teachers at Universitas Cenderawasih, accounting for 305 students, who will be, in the near future, biology teachers. The sample was calculated with simple random sampling technique (±10% margin of error; 95.5% confidence interval) (Stovner et al., 2014), which resulted in a total sample of 75 students.

The questionnaire is consisted with 43 items, which formed and developed by Infante-Moro at al. (2019) and International Society for Technology in Education (ISTE) based on the indicators proposed by NETS'S Project (ISTE, 2007). General description of the five indicators/areas of ICT, with their 43 items of sub-competences, is presented in Table 1.

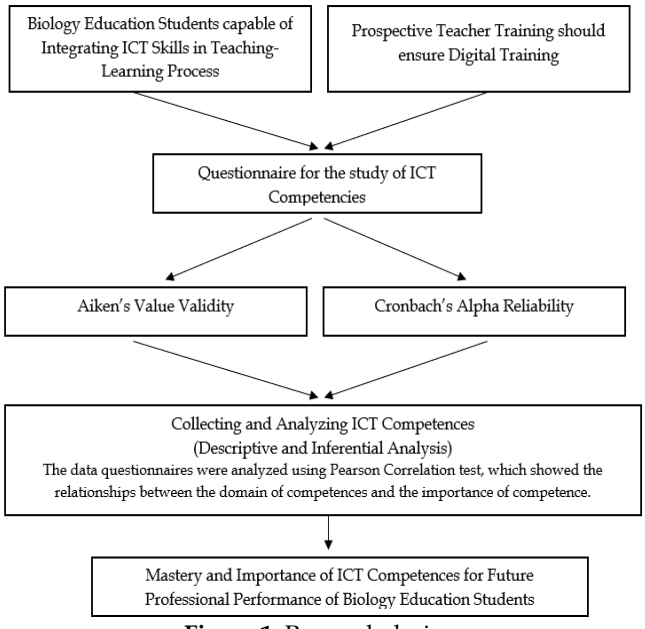

Figure 1. Research design

The validation of the questionnaire in order to see the clarity and no confusion of the questions is conducted previously with the application of pilot survey delivered to 4 lecturers who evaluated and verified the 43-items. Technique used for validation of questionnaire was the Aikens Value (coefficient value higher than 0.30). It can be seen from the Table 2 that 43-questionnaire items are valid and can be used to collect data (Bond et al., 2018; Nurgiyantoro, 2017; Rusydiyah et al., 2020). The Cronbach's Alpha statistic of IBM SPSS ver.22.0 is used to measure the reliability of the instrument, which conducted on 20 higher education students. All of the items indicated the score with high reliability (based on Table 2) and research design can be seen in Figure 1.

Research data analysis technique used in this paper are descriptive and inferential analysis to see the difference between the mastery of ICT competences and the importance of ICT for their future professional performance of the selected prospective biology teachers in this research (Çebi & Reisoğlu, 2020; Deore, 2012; Supardi et al., 2021). An inferential analysis is conducted to see the correlation between the mastery and the importance of ICT competences. This study used parametric hypothesis comparison testing based on parametric assumptions checking (the normality and homogeneity test). The Kolmogorov-Smirnov aimed to choose the most suitable analysis technique, which resulted the normal distribution for the data. In line with that, the homogeneity test indicated the data were all have the same distribution. Likewise, the data questionnaires were analyzed using Pearson Correlation test, which showed the relationships between the domain of competences and the importance of competence (Casillas-Martín et al., 2020; Lumsden, 2007; Norman et al., 2001).

Table 1. ICT's Indicators

Area	Items	General Description
Technological Literacy	01, 02, 03	The ability to understand and use of information and communication technology systems.
	04, 06, 07, 08, 09, 10	The ability to select and use various application effectively and productively.
	05	The ability to investigate and solve technical problems in systems.
The Search and treatment of Information	11, 12	The ability to apply existing knowledge to ICT-based learning.
	13	The ability to guide investigation of information.
	18	The ability to locate, organize, analyze and use information stored from various sources.
	14, 15	The ability to evaluate and select information for specific purpose.
	16, 17	The ability to process and communicate resulted data.
Critical Thinking, Problem Solving and Decision Making	19	The ability to identify and point out specific problems for further investigation.
	20	The ability to organize activities to complete a project.
	21	The ability to accumulate and analyze solution.
	22	The ability to explore different processes and viewpoint of solutions.
Communication and Collaboration	23, 26, 29, 30, 31	The ability to associate and publish along with colleague using various digital tools.
	24, 28	The ability to communicate information and ideas to other people using digital media.
	25	The ability to accommodate students for a cultural understanding and universal awareness towards other cultures.
	27	The ability to participate in collaborative team to work together and solving problems.
Digital Citizenship	32, 33, 34	The ability to practice the permitted, safe and responsible use of ICT.
	37	The ability to use positive approach in the utilize of ICT-based learning.
	35, 36	The ability to perform leadership for digital citizenship.
Creativity and Innovation	38, 39, 40	The ability to integrate the existing knowledge to invent new ideas or products.
	43	The ability to produce original works as personal/group expression.
	41, 42	The ability to identify the trends and future needs.

Table 2. Result of the Aiken's Value and Cronbach's Alpha Statistic

Area	Items	Aiken's Value	Cronbatch's Alpha for All Items	Description
Technological literacy	01-12	0.677-0.833	0.740	Valid and Reliable
The search and treatment of the information	13-18	0.750-0.833		Valid and Reliable
Critical thinking, problem solving and decision making	19-22	0.677-0.833		Valid and Reliable
Communication and collaboration	23-31	0.677-0.916		Valid and Reliable
Digital citizenship	32-37	0.677-0.916		Valid and Reliable
Creativity and innovation	38-43	0.750-0.916		Valid and Reliable

Result and Discussion

The descriptive analysis conducted to observe the differences between mastery of ICT-domain of the students and how importance of these competence for their future professional performance as a biology teacher. Below are the general basic descriptive statistics of all areas of ICT-skills (technological literacy; the search and treatment of information; critical thinking, problem solving and decision making; communication and collaboration; digital citizenship; creativity and innovation). Average rating (means) of biology students to the proficiency of ICT competences and the importance of these competences.

Table 3. Descriptive Statistics (Means) of Mastery and Importance of ICT Competences

Items	Domain of Competences	Importance of Competences
01 Using different types of operating systems on a personal computer (Microsoft Windows, Linux, Mac, …)	3.85	4.00
02 Using various devices (Android, BlackBerry OS, …).	3.84	4.00
03 Using different browsers (Mozilla Firefox, Google Chrome, Internet Explorer, Oprea)	3.87	4.01
04 Mastering different kinds of office tools (spreadsheets, database, …).	3.81	3.96
05 Solving the problems in the systems and application (configure of email and antivirus, rearranging the data on HDD, …).	3.83	3.96
06 Mastering the processing tools of: the digital image (.png, .jpg, …), audio (mp3,..), and video (.mp4., .avi., …).	3.81	3.92
07 Optimizing the use of communication tools through digital Application/Paltform (WhatsApp, WeChat, Telegram, Skype, …).	3.89	4.01
08 Understand the knowledge of web design with application, text, images, audio.	3.89	3.96
09 Know how to use digital tools for collaborative works (Google Apps, Basic Support for Cooperative Work, …).	3.87	4.07
10 Mastering digital tools to share information and data (YouTube, WordPress, Slideshare, …)	3.93	4.08
11 Mastering the support face-to-face University tools for Hybrid Learning (GoogleMeet, Zoom, …).	3.89	4.04
12 Know how to access virtual digital library	3.92	3.97
Technological Literacy (Average)	3.86	3.99
13 Know how to specify information in different sources online.	3.81	3.88
14 Know how to evaluate various sources of data whether relevant or not to information needed.	3.79	3.84
15 Organizing and analyzing information through different sources and media.	3.88	3.92
16 Know ho to construct and assimilate new media from information selected, by means of tables, graphs, chart, bar or diagram.	3.89	3.95
17 Mastering graphic organizer and software (Collaborative Mind Map Software/Mindomo, …).	3.80	3.81
The Search and Treatment of Information (Average)	3.83	3.88
18 Organizing information before searching it to solve problems.	3.64	3.75
19 Identifying and defining information using ICT.	3.68	3.76
20 Using the reliable resources and digital technology to browse the trend issues and personal/social problems, and professional needs.	3.49	3.65
21 Analyzing the potentialities and limitations of ICT-resources	3.76	3.85
22 Fixing the problem related to system, hardware and application	3.61	3.73
Critical Thinking, Problem Solving and Decision Making (Average)	3.63	3.74
23 Sharing data and information reliable to colleagues using various forms of digital media.	3.55	3.68
24 Ability to communicate and share idea/information to multiple audiences with different media and formats.	3.65	3.95
25 Developing a cultural understanding and global awareness using social media with other students from different cultures.	3.60	3.81

Items	Domain of Competences	Importance of Competences
26 Ability to use programs (SlideShare, Google Docs, Pdf, …) and digital tools to share information and data to other students.	3.63	3.87
27 Ability to organize and cooperate group activities in digital media.	3.68	3.77
Communication and Collaboration	3.62	3.81
28 Interacting and communicating with other students using social media (Telegram, Instagram, WhatsApp, WeChat, Facebook, Twitter, …).	3.65	3.80
29 The ability to work in professional networks (Linkedin)	3.67	3.85
30 The ability to create and design a website (WordPress, BlogSpot, …).	3.48	3.59
31 The ability to tag importance information link (bookmark)	3.64	3.73
32 Understand the copyright and licenses of data sources	3.67	3.83
33 Sharing the awareness of safe, legal and responsible use of ICT	3.68	3.87
34 Understand the responsibility for lifelong learning of ICT	3.68	3.95
35 Competence in making constructive criticisms and making contribution in ICT	3.60	3.79
36 Understand leadership for digital citizenship in my community	3.65	3.85
Digital Citizenship	3.63	3.80
37 Have a good attitude towards ICT integration in collaboration, learning, and productivity.	3.64	3.95
38 Understand primary and useful ideas of ICT-integration	3.60	3.88
39 The ability to create digital media using various resources of ICT	3.57	3.85
40 The ability to identify possible use of ICT	3.53	3.79
41 Understand how to explore the complexity of the systems and topics ICT	3.68	3.88
42 Ability to develop materials using ICT in innovative ways based on my knowledge.	3.61	3.88
43 The ability to adapt to new upgrade of ICT	3.51	3.64
Creativity and Innovation	3.59	3.83

Questionnaire for the study of ICT Competencies (Infante-Moro et al., 2019).

Based on Table 3, the average calculated of the mastery of ICT and the importance to master the skills for future performance as biology teacher can be seen in a positive result. The first area measured in this study is technological literacy, consisted of 12 items, which considered 'high' in terms of the mastery of ICT (average 3.86). to begin with, the use of technological, informational and multimedia are highly correlate with ICT skills and digital competence (Esteve-Mon et al., 2020; Lázaro-Cantabrana et al., 2019). Regarding of the result, skill mastery in which higher education students are considered high level of practicing the ICT integration (with average value 3.86, on a Likert scale of 1-5) are found on: students have the ability of using different browsers (Mozilla Firefox, Google Chrome, Internet Explorer, Opera,…) belonging to item 03 with a value 3.87; students can optimize the use of communication tools through digital Application/Platform (WhatsApp, WeChat, Telegram, Skype, …) belonging to item 07 at 3.89 in average; students understand the knowledge of web design with application, text, image, audio, belonging to item 08 (average 3.89); students know how to use digital tools for collaborative works (Google Apps, Basic Support for Cooperative Work,…) belonging to item 09 with average 3.87; students mater digital tools to share information, data (YouTube, WordPress, SlideShare,…) belonging to item 10 with a average 3.93; students master the face-to-face University tools for Hybrid Learning (Google Meet, Zoom,…), belonging to item 11 with average of 3.89; and students know how to access virtual digital library, belonging to item 12 (with average 3.92), regarding the items analyzed in this area, average biology students have high level of using different browser to access biology material or task, as well as combine the use digital tools such as YouTube. They happened to understand the use of face-to-face tools that commonly used at Cenderawasih University like Zoom Meeting and Google Meet that pin on their LMS. According to Bond et al. (2018), integrating ICT as institutional tools of university considered enhancing teaching and learning processes at higher level education, as well as a challenge given to student to master the ICT skills. Students also know how to access digital library and find reliable books they need. According to research studies, ICT competence is an effective way to boast educational opportunities, therefore ongoing professional development must be provided for prospective teachers to improve teaching-learning process (Agbo, 2015). This also means that the prospective teachers will, in one way or another, be role models for their future pupils in terms of pedagogical use of digital technologies (Krumsvik et al., 2016; Røkenes & Krumsvik, 2016).

The Search and Treatment of Information is the second area that measured in this study. In this case, biology students indicated with 'high' in terms of mastering the competencies, with a value of 3.83 (slightly lower than the first area). The highest score is found on item-15 indicate that students know how to

organize and analyze information through different sources and media, with average of value at 3.88, and item-16 state that students know how to construct and assimilate new media from information selected by means of table, graph, chart, bar or diagram (average of value at 3.89). The analysis of the perception of biology students gives the first view of student understanding on specifying information and evaluating information they found on internet. These skills are important as they have to make sure that the information is readable with courses they work on. New information needed to be constructed and assimilate with old ones, as it is essential to help them be conscious of the important of digital technology in their professional work as lifelong learners (Kirkwood & Price, 2005; O'Callaghan et al., 2017), and based on data analyzed, students already have the skill to apply.

As for the third area, Critical Thinking, Problem Solving and Decision Making, students have the average of value in mastering these skills at 3.63, lower than the previous-two that already mentioned. The highest competence is found on item 21, that students can analyze the potential and limitation of ICT-resources (with a value of 3.76, considered 'high' level). In contrast, competency mastery in which students are indicated 'medium' level is found on item 20 (with the average of value only 3.49). This item recognized that students have medium level on using the reliable resources and digital technology to browse the trend issues, personal/social problems, and professional needs. Solving problems indicated that students can use ICT competence on accessing digital media to help them find solution on cases or work they work on. To begin with, identifying, defining and using reliable resources are the easiest way for students to finish the problem. But unfortunately, they still lack on using reliable resources and digital technology to browse the trend biology issues, personal/social problems, and professional needs. Students prefer the information sources they know without updating or expand the search. This problem will be taken on account so that in near future they can improve this skill. Research on this assessment has drawn interest in these past years, according to Cabezas-Gonzales et al. (2022), students who master digital problem solving demonstrate a better competence of their use for school and non-activities, as long as they use it for academic purpose and associated with leisure and entertainment activities (Hortigüela-Alcalá et al., 2020; Vila-Counago et al., 2020).

Communication and Collaboration area, with a value of 3.62, indicated that students have 'high' level of mastering the ICT-skills in sharing data and information that reliable to colleagues using various forms of digital media, have the ability to communicate and share idea and information to audience, have a good ability on developing a cultural understanding and global awareness, have the ability to use programs (SlideShare, Google Docs, …) and digital tools, and also have good ability to organize and cooperate group activities in digital media. Based on study by Almerich et al. (Almerich et al., 2018), owning technological devices influence the use of digital application and digital media. As expected from the students, in terms of using digital technology on communication and collaboration, they identify their skills at 'high' level, as the students can afford the devices. Biology students know how to shared data/information various forms of digital media. In line with that, students have a good ability on working in groups as they aware of cultural and global understanding along with other students. Diverse people gather at Cenderawasih University in different background, without the mastery of cultural understanding, working together will be difficult for students. Based on research by Margaryan et al. (2011), Ng (2012), and Thompson (2013), student at university have already used digital technology for learning rather that use them in on content creation and collaborative activities. Higher education students reflected the lack of collaborative environments (Margaryan et al., 2011). In line with that Lai et al. (2015) found that students rarely use virtual chat apps, podcasts, YouTube or Blog for learning purpose, however it is essential for student to develop the communication and collaborative skills (OECD, 2010; Oliver et al., 2018; Punie & Redecker, 2017). As prospective biology teacher, in near future professional work, students are highly encouraged to integrate collaborative tools within their class, which indicate the understanding of TPACK purpose (Biasutti, 2017; Peterson, 2012; Tanta et al., 2023; Tømte et al., 2015).

Digital Citizenship have an average of value 3.63, slightly higher than the Communication and Collaboration. The highest score is found on item 34 and 35 (with the same value, 3.68). Students have high level of understanding the responsibility for lifelong learning of ICT as well as knowing how to make constructive criticisms and contribution in ICT. On the other hand, the ability to create and design a website (WordPress, BlogSpot,…), belonging to item 30, stood at value of 3.46 which considered medium level of mastering the ICT skills. Based on competence, students have high level skill in interacting and communicating using social media (mostly WhatsApp and Facebook) but lack of knowledge on create and design website. The respondents know to access but have no intention on creating such a website. As for the copyright and license data sources as well as the legal and responsible use of ICT, students have average knowledge. According to Napal Fraile et al. (2018), the ability in developing digital content, integrating and reworking of digital

media/content must align with in applying content rights and license. Working on project, students should know how to properly addressed the right owner of the data/information, therefore this skill are essential to master by academic students on in near future working as professional biology teachers (Nurbaya, 2023).

As for the last area measured in this research, Creativity and Innovation has the lowest average of value compared to all areas mentioned, accounting for 3.59 in average. However, the lowest score took place on item 30, items that scored low are found on items 39, 40, and 43. Each of item represent the ability of students to create digital media using various resources of ICT, the ability of students to identify the possible use of ICT, and the ability of students to adapt to new upgrade. Even though these items considered at low score, in terms of mastering ICT competence this area indicated in high level category. Based on data analyzed, biology students have good attitude towards ICT integration but has limited confidence on creating digital media as well as adapting on possible use and new upgrade of ICT. Research by Gutierrez Porlan et al. (2016) indicate that student at Murcia University stood at low level, which showed that they still lack on knowledge on digital content-creation media. In line with that, Hinojo-Lucena et al., (2019) found that teachers at Permanent Education Centers still at low level of creating digital media using ICT tools due to some factors, such degree, experience in teaching and the training of ICT.

Average rating (means) of biology students to the proficiency of ICT competences and the importance of these competences can be seen on Table 4.

Table 4. Relationship between the Domain and Importance of ICT Competences

Items	The Domain of Competences	The Importance of competence
Pearson Correlation	0.817	0.817
Sig (2-tailed)	0.000	0.000
N	43	43

The homogeneity and normality had been previously checked which pointed to parametric conditions. Further analysis of the data was done by applying Pearson's Correlation coefficient (Table 4), that indicated a significant correlation between the mastery of domain IICT and the importance of ICT skills for future performance as teachers. Based on table provided, there is a significant correlation at the 0.01 level of the mastery and the importance of ICT skills. In general, the relation to the importance prospective biology teachers give to ICT competence is very positive, which indicated that these students know how significant those ICT competences for their future work performance.

In today's society, in the labor market for future workers, ICT has essential roles in making future professional performance as a biology teacher. Higher education students demand to have the vital knowledge in ICT to adjust to the next stage they must take after graduating at university, the beginning of the professionalism of the world of work. That is the reason why ICT skills and digital competence have become the main research at university (Cabero-Almenara & Marín Díaz, 2012; Cabero-Almenara & Palacios-Rodríguez, 2020; Rodríguez-Hoyos et al., 2021). The trend educational scenario for student at Higher Education demands prospective teachers to master digital attitudes and skills that show them to assimilate and adequate which transform and improve the quality of teaching-learning processes (Durán-Cuartero et al., 2019; Padilla-Hernández et al., 2018). In the specific case, some prospective biology teachers in this research obtained medium average value for ICT skills on applying the reliable resources for data/information or using digital technology to find update issues for professional needs, as well as they need to improve the competences in creating digital media, identifying the possible use of ICT, and adapting to new upgrade. Students at university are considered part of a generation born and lived in technology era, proved with a high density of interaction with ICT in their everyday life (Prensky, 2001). The ability to access digital devices at home, from frequency use to their implementation for completing academic tasks improve ICT skills (Almerich et al., 2018; Chaudron et al., 2018; García-Martín & Cantón-Mayo, 2019; Marsh et al., 2017). However, as in other researches, the level of ICT's skills and digital competence is not in accord with their being 'digital natives', that proved to insufficient to integrate ICT in their academic life and for their future professional career (Akçayır et al., 2016; Bellini et al., 2016; Bennett et al., 2008; Li & Ranieri, 2010; Ottestad et al., 2014).

In terms of owning digital devices, most of the students in the survey mainly used smartphones and laptops. As future teachers, whom properly qualified to integrate such digital tools, developing an information and knowledge will be easier to aim (Cabero-Almenara & Marín Díaz, 2012). The participants believe they have high level of knowledge related in concepts and assess on ICT. These students have very positive self-assessment results in using social networks and communication tools. The prospective biology teachers acknowledge the need and importance of ICT for future academic purpose and state their preference to become fluent in their use. As future workers, prospective biology teachers must be upskilled in the integration of digital technologies, which developed technological literacy, research, critical thinking, problem solving,

communication, collaboration, digital citizenship, creativity, and innovation in the world of work.

Conclusion

Taking into account the study obtained, students have the necessary knowledge in ICT and acknowledge how importance these competences for their future professional performance. In general, students showed from medium to high average for all areas of ICT competences (technological literacy; the search and treatment of the information, critical thinking, problem solving and decision making; communication and collaboration; digital citizenship; creativity and innovation). To be more specific, student need to improve their ability in creating digital media, identifying the possible use of ICT, and adapting to new upgrade which students show training needs. This result important so the study program can foster an attitude of learning ICT skills for professional practice before entering the labor market/world of work. This study only cover student from biology education department, neand it should be extended to other department, other Faculties and other degree.

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The authors declare no conflict of interest.

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