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Influence of the Use of ICT in Biology Learning Junior High Schools West Sumatera, Indonesia

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Abstract: The purpose of this study was to describe the influence of biology teacher attitudes, biology teacher ICT facilities, biology teacher ICT knowledge and biology teacher skills in ICT in learning. It also examined teacher's abilities in developing ICT-based teaching materials in biology learning. The study used 5 variable including biology teacher's attitudes, biology teacher ICT facilities, biology teacher knowledge, biology teacher ICT skills and biology teacher abilities in making ICT-based teaching aids. It used statistical analysis t-test inference, Pearson correlation and multiple regressions. In terms of gender, the biology teacher's attitudes and biology teacher ICT knowledge influence biology learning. Contrastingly, biology teacher ICT facilities, biology teacher ICT skills and abilities in making ICT-based teaching material do not significantly influence. Moreover, the biology teacher ICT skills, biology teacher ICT facilities, biology teacher ICT knowledge and biology teacher ICT attitudes are some of the most influential variables. Facilities and attitudes are positively correlated with ICT just as knowledge and attitudes. The biology teacher skills in making teaching aids and their attitudes are positively correlated with ICT and have a positive and strong correlation.

Key words: Use of ICT, ICT facilities, ICT knowledge, ICT skills, biology learning, materials

INTRODUCTION

The rapid development in science and technology, especially in Information and Communication Technology (ICT), influences several aspects of human life including teaching and learning. Basically, the development of ICT was able to transform the virtual world to ensure humans could have access to various things. These developments have positive and negative influences in various aspects of life including education. For instance, the changes in values, norms, rules and morals have been in a negative direction. Increased knowledge of ICT-based learning should be complete and up-to-date. In modern life, ICT plays an important role in education and the effectiveness of its implementation requires a positive attitude and ability to use related facilities in educational environments. However, information to measure the influence of the attitudes and abilities of teachers in the use of ICT in education is not sufficient (Krause *et al*., 2017).

A study on teacher's attitude in one of the universities in Libya established that instructors are more positive in implementing ICT in the education sector. This finding is in line with the research by Abukhattala (2016) which stated that teachers use ICT as a means of promoting teaching and learning as long as the facilities are available. According to Nneji (2014), humans have cognitive, affective and psychomotor behavior representing dimensions of the overall scale of attitude which cannot be fully developed through the use of ICT. Krause *et al*. (2017) reported the effectiveness of the use of ICT is determined by the positive attitude and self-reliance of teachers. However, information to measure it has not been established. This study also examined the development of attitudes and self-reliance of prospective chemistry teachers on ICT. It focused on the attitude of junior high school teachers and their extent of self-reliance in using ICT.

Aduwa-Ogiegbaen and Iyamu (2005) reported that there is universal recognition of the need to use ICT in education since, satellites and the internet influence dissemination of information globally. Correspondingly, showed computerization of teaching provides the most appropriate response in instructing students. It is effective in education level requiring a didactic method of transformation and program content for the direction of connection and integration. In general, there are challenges in the use of ICT in teaching and learning in West Sumatra including the attitudes and motivations of teachers and students. This study therefore focused on the inhibiting factors in increasing the use of ICT in Indonesia, especially in West Sumatra region. Furthermore, it was believed that the results could be used as a reference for other related studies.

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The socio-cultural aspect of biology teaching involves new literacy for teachers and students. According to the use of ICT is expected to improve utilization of human resources and enable individuals to apply relevant skills in educating others. The most challenging aspects of the post-industrial era involve ways of dealing with the demands for information in the modern society. This requires the education system to pay attention to the changes in the community and learning system (Westera and Sloep, 2001). According to Carlson and Firpo (2001), teachers need effective tools, techniques and assistance in developing computer-based activities, specifically, designed to improve the quality of teaching and learning. From Martin (2003), motivation is an important factor apart from the ability and access of the internet in the use of ICT in teaching and learning Motivation refers to the individual's attitude towards learning through the use of ICT and the willingness to work together to acquire the necessary skills.

According to Puhek *et al*. (2013), the use of ICT in learning increase the digital skills of students, influencing them more than their teachers. Additionally, evidence show older teachers are less likely to apply ICT than their younger counterparts. Rusek *et al*. (2017) established that teachers mostly perceive ICT usage pragmatically and need proof before deciding to adopt it. There is a need to pay attention to the basics such as adopting innovation, observing teaching and learning and analyzing approaches influencing ICT-based teaching (Ferreira *et al*., 2013). Content analysis require teachers to use multimedia tools to teach certain concepts and skills (integrated approach) and be innovative in their presentations. In somecases, the teacher adopts structured assignments without being aware of the necessity to create multimedia tools and other activities. Generally, there are some problems faced regarding the pedagogical approach and discussing teacher knowledge. According to Bingimlas (2009), ICT help students learn effectively and allow teachers to improve their pedagogical practices, though using it has some obstacles.

The use of ICT in developing countries such as Indonesia is not effective and modifications are needed to identify problems occurring at all levels. Lack of infrastructure and inadequate funding makes the use of ICT difficult. Research by Al-Oteawi (2002) and Hatlevik *et al*. (2015) found that low ICT skills were attributed to the resistance of the use of computers by young teachers. The level of resistance was even higher than older teachers with lower computer skills (Watson *et al*., 2005). The inclusion of ICT in curriculum and the availability of computer facilities help teachers complete computer-based tasks and improve their professionalism (Hsu, 2016; Lawless and Pellegrino, 2007). Structural Equation Modeling (SEM) shows the initial ICT skills model using data from elementary school students has a good fitness level (Wu *et al*., 2018). Additionally, revision of the ICT skills model with flexibility and fitness produce better results. Moreover, this new model explains the complex phenomenon of ICT skills for students. However, there is no difference between basic school students and their colleagues in junior high school.

Purpose: The purpose of this is to describe the effect of gender on teachers attitudes toward ICT, related facilities, knowledge, skills and abilities in making ICT-based teaching aids and the influence of these factors. It also studied the relationships the aforementioned variables. Research questions were formulated as follows:

- Does gender affect teacher's attitudes towards ICT, its related facilities, knowledge, skills and abilities to make ICT-based teaching materials?
- Do teacher's attitudes toward ICT and its facilities, knowledge and skills in using ICT in learning affect their abilities in making ICT-based teaching materials at junior high school?
- Do these variables affect each other?

MATERIALS AND METHODS

General characteristics of research: This was quantitative research which used instruments as the primary data collection tool and for describing variables. The aspects functioning as predictors include teacher's attitudes toward ICT, its related facilities, knowledge, skills in using ICT and the abilities in making ICT-based teaching aids. The study was conducted for two semesters in the 2018/2019 academic year and was carried out in West Sumatra Junior High School, Indonesia.

Sample of research: The sample was determined using the Krejci Morgan formula and involved 800 Junior High School biology teachers in West Sumatra. Basically, it consisted of 260 randomly selected biology teachers distributed in four zones (West zone, East zone, South zone and North zone). Importantly, the validity and reliability analysis of instruments used the SPSS program ver. 17 (Krejcie and Morgan, 1970).

Instrument and procedure: The questionnaire consists of five parts. The first section was made of the socio-demographic of the respondents. The second part handles teacher's attitudes towards ICT, its facilities, knowledge, skills and abilities in making ICT-based teaching aids. The study used a 5-point Likert scale (strongly disagree to strongly agree) and used 31 Likert scale items.

This study was granted permission by the Head of the Education Office of the city of Padang (West Zone),

Table 1: Research variable reliability

Variables	No. of instruments before reliability	No. of instruments after reliability	Cronbach's alpha
Teacher's attitude towards ICT	14	7	0.77
Teacher's ICT facilities	11	5	0.80
Teacher's ICT knowledge	11	5	0.78
Teacher's skills in using ICT in learning	12	8	0.84
Skills for making based teaching aids	9	6	0.93
No. of item	57	31	

Pesisir Selatan (South Zone), Padang Pariaman (North Zone) and Head of Service of Tanah Datar district (East Zone) (Table 1).

Data analysis: The SPSS version 17 was used to process data from questionnaires in order to determine their validity and reliability. Furthermore, the invalid and unreliable items were deleted from the research . Also, the descriptive statistics were calculated to determine the items categories and their averages, linear regression inference statistics and to determine the effect of each variable. All statistical procedures were carried out using SPSS 17.0.

RESULTS AND DISCUSSION

Statement of each variable (Teacher's attitudes towards ICT, facilities, knowledge and skills in and teacher's abilities in making ICT-based teaching materials).

As highlighted in the previous section, the teachers completed all Likert scales. Table 2 shows the average and standard deviation. From the table, ICT is the determinant in improving education (M = 4), encouraging students to use it in learning (M = 4), enhancing its use in the learning process (M = 4.1) and attitude toward teachers who use ICT (M = 4.1). Moreover, the schools provide computers and internet access (M = 4.0), use these facilities to access teaching aids (M = 4.0), utilize all the menus on the computer properly (M = 3.8), keep up with technology (M = 3.8), ICT facilitates communication between teachers and students for learning to be effective (M = 3.8).

"Teacher's skills in using ICT" includes preferring to teach using ICT (Mean = 4.0), they use computers well (Mean = 3.9) and are able to use the power point application properly (Mean = 3.9). The variable "teacher's skills in making ICT-based teaching aids" includes being able to make Macro Media Flash well (Mean = 2.5), provide Power Point in the learning process (Mean = 2.5) and use all the menus in a computer device (Mean = 2.0). The differences in biology teacher's attitudes towards ICT, biology teacher's ICT facilities, biology teacher's ICT knowledge and skills in and biology teacher's abilities in making ICT-based teaching aids by gender. The attitude of junior high school biology teachers on ICT based on gender is shown in Table 3-7. The t-test on the attitude of biology teachers towards ICT by gender showed a significant difference between male and female teachers ($t = -2.286$, $p = 0.023$). From the t-test ($p = 0.023<0.05$), there was a significant difference between the attitudes of male and female biology teachers in junior high school towards ICT. The mean score of male biology teachers was 29.04 while their female mean score have 28.02. The success of teaching is determined by the process used and student's abilities, teachers, curriculum, teaching methods, facilities and infrastructure as well as teaching and learning media (Hassard, 2005). Table 4 shows ICT facilities teacher differences by gender.

Table 4 shows the results of t-tests on biology teacher's ICT facilities by gender. There were no significant facility differences between male and female biology teachers ($t = -1.129$, $p = 0.260$). The mean score of male biology teachers is 31.04 while their female mean score 31.71. This means the male and female biology teachers access the same ICT facilities. The differences in biology teacher ICT knowledge based on gender are shown in the following Table 5.

The results of the t-test on the differences in biology teacher ICT knowledge based on gender showed a significant difference between male and female biology teachers ($t = -1.949$, $p = 0.050$). The t-test scores ($p = 0.05<0.05$) showed significant differences in ICT knowledge between the two genders. The mean score of male biology teachers is 24.17 while their female mean scored 23.19. Table 6 shows the differences in skills in using ICT based on gender.

Table 6 shows the results of the t-test on the differences in biology teacher skills in using ICT by gender. Evidently, no significant differences between male and female biology teachers ($t = -1.071$, $p = 0.285$). Besides, the value of the t-test ($p = 0.285>0.05$) indicates there is no significant difference in teacher's skills in using ICT between the two genders. The mean score of male biology teachers is 44.0192, while their female colleagues have 45.1434, implying that they have the same ICT skills. The differences in teaching skills in making ICT-based aids based on gender are shown in Table 7.

The results of t-test on the differences in teaching skills in making ICT-based teaching aids based on gender showed no significant differences between male and female biology teachers ($t = -0.890$, $p = 0.374$). Moreover,

Table 2: Statements of biology teacher attitudes towards ICT, facilities for biologys, their knowledge and skills and their abilities in making ICT-based teaching aids at junior high schools in West Sumatra

The attitude of junior high school biology teachers to ICT	Mean	SD
I like students understanding ICT	3.6	0.94
ICT is the backbone of improving education	4.0	0.75
I encourage students to learn more about ICT	4.0	0.73
I am motivated to learn ICT	4.1	0.55
I like teachers who use ICT in delivering content	4.1	0.60
I feel unencumbered by the development of information and communication technology	3.8	0.84
ICT helps in learning biology	3.9	0.67
ICT facilities for junior high school biology teachers		
I have a computer at home for accessing teaching aids	3.9	0.76
I have internet access with adequate capacity	3.8	0.76
I have a printer at home	3.8	0.85
The school provides computer facilities and internet access	4.0	0.81
I use school facilities to access teaching aids	4.0	0.75
I also use Android phones to access teaching aids and other information	3.8	0.82
Knowledge of ICT for biology teachers at junior high schools		
I understandall the menus on the computer	3.8	0.70
I follow the development of ICT	3.8	0.73
I have learning material in my gadget	3.4	0.91
I learn through information on the internet	3.8	0.89
ICT makes it easier for teachers to communicate with students, therefore , learning is effective	3.8	0.84
Teacher skills in using ICT		
I use a computer properly	3.9	0.65
I use the menu on the computer to make interactive learning media	3.7	0.79
I use the Power Point application well	3.9	0.65
I use the Flash Macro Media application effectively	3.7	0.88
I use all the menus on a computer device	3.7	0.81
I use Power Points during learning	3.9	0.79
ICT makes learning more interesting	3.6	0.79
I prefer to teach using ICT	4.0	0.84
The teacher's skills in making ICT-based teaching aids		
I make Flash Media Macro well	2.5	0.69
I create interactive learning media to make learning more interesting for students	2.4	0.61
I use Microsoft Office properly	2.4	0.67
I use all computer menus	2.0	0.61
I use Power Points in the learning process	2.5	0.75
I provide teaching material through ICT	2.6	0.76

Table 3: Differences in attitudes of biology teachers at junior high school on ICT based on gender

	Independent test of t-test sample				
Variable	Gender	N	Mean	t-value	Sig.
The biology teacher's attitude to ICT based on gender	Male	68	29.04	2.286	0.023
	Female	192	28.02		

*Sig. p<0.05

Table 4: Differences between biology teacher's ICT facilities by gender

	Independent test of t-test sample				
Variable	Gender	N	Mean	t-value	Sig.
Biology teacher's ICT facilities based on gender	Male	68	31.04	-1.129	0.260
	Female	192	31.71		

*Sig. p<0.05

Table 5: Differences in biology teacher ICT knowledge based on gender

	Independent test of t-test sample				
Variable	Gender	N	Mean	t-value	Sig.
Biology teacher's ICT knowledge based on gender	Male	68	24.17	1.949	0.050
	Female	192	23.19		

*Sig. p<0.05

Table 6: Differences in biology teacher skills use ICT based on gender

	Independent test of t-test sample				
Variable	Gender	N	Mean	t-value	Sig.
Teacher skills in using ICT in learning based on gender	Male	68	44.0192	-1.071	0.285
	Female	192	45.1434		

*Sig. p<0.05

Table 7: Differences in biolgy teacher skills in making ICT-based teaching materials based on gender

	Independent test of t-test sample				
Variable	Gender	N	Mean	t-value	Sig.
Biology teacher skills in making ICT-based	Male	68	13.6667	-0.890	0.374
teaching materials based on gender	Female	192	14.3785		

*Sig. p<0.05

Table 8: Multiple regression analysis on the influence of biology teacher's skills in using ICT, facilities and knowledge and skills in making ICT-based teaching materials

Independent variables	B	Errors	Beta (β)	t-value	Sig.	r	R^2	Contribution
Teacher skills in using ICT	0.666	0.049	1.327	13.688	0.000	426.20	0.789 (a)	78.9
Teacher's ICT facilities	-0.421	0.073	-0.561	-5.732	0.000	36.65	0.819 (b)	3.0
Teacher's ICT knowledge	-0.053	0.026	-0.074	-1.991	0.048	3.96	0.822 (c)	0.3
Constant	6.633	1.178		5.633				

R multiple = 3.963; R^2 = 0.822; Errors = 1.178

Table 9: Variant analysis

Source	No. of squares	Degree of freedom (DK)	Minimal squares	F	Sig
Regression	1230.854	3	410.285	177.250	0.000(c)
Residual	592.570	256	2.315		
Total	1823.424	259			

the value of the t-test (p = 0.374>0.05) indicates there is no difference in the skills in making significant ICT-based aids between male and female biology teachers. The mean score of male biology teachers was 13.6667 and 14.3785 for their female counterparts, showing they have the same skills.

Effect of ICT elements on biology teacher skills in making ICT-based teaching materials: Table 8 shows the results of multiple regression analysis (Stepwise) on all respondents which show a significant effect (sig. p<0.05) on biology teacher skills in making ICT-based aids (Table 2).

Table 2 shows ICT skills have the greatest influence (78.9%), followed by Teacher's ICT facilities (3.0%) and biology teacher's ICT knowledge (0.3%). The results showed a correlation between ICT skills and all independent variable groups was 0.822 (R multiple). The level of variance in variables allied significantly with all independent variables is explained through R multiple which shows the regression model with the R^2 is 82.2% Table 9.

The first most influential variable on biology teacher skills in making ICT-based teaching materials is skills (β = 1.327, t = 13.688 and Sig. = 0.000) with 78.9% effect. The increase of 1 unit in ICT skills increases biology teacher skills in making ICT-based teaching materials by 1.327 units. The second most influential variable is biology teacher's ICT facilities (β = -0.561, t = -5.732 and Sig. = 0.000) with an effect of 3.0%. The increase by 1 unit in ICT facilities improves teacher skills in making teaching aids by -0.561 units. The third most influential variable is knowledge (β = -0.074, t = -1.991 and Sig. = 0.048). An increase in 1 unit of biology teacher's ICT knowledge improves skills in preparing teaching aids by -0.074 units.

The value R = 3.963 shows a correlation between teacher skills in preparing teaching aids and the three predictor variables. Additionally, R squared (R^2 = 0.822) shows the correlation and influence of independent variables on skills in making ICT-based teaching aids. Table 1 shows the value of F = 177.250, (DK = 3,256) sig at the level of p (sig. p = 0.000)<001. The value of R^2 was 82.2%, the skills in using ICT were 78.9%, facilities 3.0% and ICT 0.3%. Overall, these variables have significantly influenced the skills of teachers in preparing teaching aids. The regression equation of the explanation is as follows:

$$Y = 6.633+0.666X^1+(-0.421X^2)+(-0.053\ X^3)+1.178$$

$$\text{Errors} = 1.178$$

$$\text{Constant} = 6.633$$

Where:

Y : The biology teacher's skills in making ICT-based teaching aids

X^1 : The biology teacher skills in using ICT

X^2 : The biology teacher ICT facilities

X^3 : The biology teacher's ICT knowledge

The influence of biology teacher's attitude on ICT, facilities, knowledge and abilities in using ICT on the teacher's skills in making ICT-based teaching materials. Pearson correlation on ICT and junior high school teachers is explained in Table 10.

Table 10: Description of Pearson correlation on ICT and junior high school teachers in West Sumatra

Variables	1	2	3	4	5
The biology teacher's attitude towards ICT					
The biology teacher's ICT facilities	0.379(**)	-			
The biology teacher's ICT knowledge	0.178(**)	0.036	-		
The biology teacher's skills in using ICT	0.078	0.066	0.117	-	
The biology teacher's skills in making ICT-based teaching aids	0.167(**)	0.654(**)	0.034	0.033	-
Mean	3.32	3.88	3.77	3.43	2.36
SD	0.73	0.79	0.71	0.72	0.89

**Correlation is significant at the 0.01 level (2-tailed). Sig. p<0.05

Table 2 shows a positive correlation between biology teacher's ICT facilities with an attitude towards it with a correlation coefficient r = 0.379 (**). Also, ICT knowledge and attitude towards it have a positive correlation with a coefficient r = 0.178 (**). Biology teacher's skills in making teaching aids and attitude towards ICT have a positive correlation with the coefficient r = 0.167 (**). Besides, the teaching aids and facilities have a positive and strong correlation with the correlation coefficient r = 0.654 (**)

This study was conducted in West Sumatra with a population sample made of biology teachers in junior high school. The purpose of the study was to describe the differences in the influence of gender on biology teacher's attitude towards ICT, biology teacher's ICT facilities, biology teacher's ICT knowledge, biology teacher's skills in using ICT and the abilities in making ICT-based teaching subject. It also focused on the relationship between the aforementioned variables. The success of teaching is determined by the process used and student's abilities, teachers, curriculum, teaching methods, facilities and infrastructure as well as teaching and learning media (Hassard, 2005). A study by one university in Libya shows teachers have a positive attitude towards the use of ICT in education. According to Hew and Brush (2007), teachers adopt ICT where it is effective in promoting teaching and learning. The ICT might also be applied in education in case teachers have adequate facilities. Anonymous (2006) stated that the absence of adequate infrastructure and facilities is one of the main obstacles in implementing ICT. Teachers are faced with a lack of hardware, internet access, technical support, etc. From Hatlevik *et al*. (2015), inadequate ICT infrastructure results in low ICT skills, a finding in line with the results of Abukhattala (2016). Bingimlas (2009) stated several advantages and barriers to the use of ICT in education. Basically, ICT help students in learning and teachers in improving their pedagogical practices. According to

Aduwa-Ogiegbaen and Iyamu (2005), there is universal recognition of the need to use ICT in education, especially in the era of globalization where satellites and the internet influence the spread of information globally. Furthermore, established that the computerization of teaching provides the most adequate response to the integrity of junior high school teaching which requires a didactic method of transformation. Importantly, the content of the program determines the direction of connection and integration. In general, West Sumatra and other regions in Indonesia still have problems in the use of ICT in teaching and learning.

CONCLUSION

The results of this study have theoretical and practical implications. The research show biology teacher's attitude towards ICT, its biology teacher ICT facilities and their biology teacher ICT knowledge were a determining factor of their skills in using ICT and preparing teaching aids. Furthermore, gender has a significant effect on teacher's attitude towards ICT and their knowledge. However, it does not have a significant effect on facilities, skills in using ICT and the knowledge in making teaching materials. The first most influential variable on the teacher's skills in making ICT-based teaching aids is their skills while the second is facilities and the third their knowledge. The positive correlations are shown in the relationship between teachers 'ICT facilities and their attitude ICT knowledge and attitude towards it, skills in preparing teaching aids and their attitude and teacher's skills in making ICT-based teaching aids and the facilities. There is a need for policies to increase ICT facilities and teacher's knowledge as well as their attitude towards ICT through funding adequate education, training and workshops.

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