JURNAL UPI

Innovation of Vocational Technology Education

Available online at http://ejournal.upi.edu/index.php/invotec

invotec
Innovation of Vocational Technology Education

Readiness of Indonesian TVET Teachers in Receiving GIS Technology Using TAM 2

Arya Bakri, Yatti Sugiarti, and Didin Wahyudin

Study Program of Technology and Vocational Education, Post-Graduate School, Universitas Pendidikan Indonesia, No. 207, Dr. Setiabudhi Street, Bandung 40154, Indonesia

A R T I C L E   I N F O

Article history:
Received: 15 April 2020
Received in revised form: 01 June 2020
Accepted: 23 July 2020
Available online: 31 August 2020

Keywords:
Technology Acceptance Model (TAM 2);
Geographic Information System (GIS);
acceptance;
geomatics and geospatial engineering teachers;
vocational middle schools;
Perceived Usefulness (PU);
User Intention (UI)

Authors email:
aryabakri@upi.edu

A B S T R A C T

Since the enactment of curriculum changes in 2013, several factors have emerged that often become obstacles in geographic and geospatial technical vocational high schools in Indonesia, one of which is minimal acceptance of Geography Information System (GIS) technology. This teacher survey research is to explore the determinant factors that influence the acceptance of GIS technology, through identifying what obstacles are found when the acceptance of GIS technology is integrated in classroom learning. Using survey data from 94 teachers from 34 geographic and geospatial technical vocational schools, question assumptions were formulated using the technology acceptance model (TAM 2), with key determinants of Perceived Usefulness (PU) and User Intention (UI). The lack of knowledge, skills and experience of teachers following GIS training, has caused teachers to be slow in accepting GIS technology. These pressures prevent teachers from reflecting on their teaching, and ultimately result in substitution of teachers intellectual creativity with compliance culture and contribute to the tendency of teachers to prioritize learning experiences that they believe can be directly applied to their own classroom situations. It is clear that the benefits of implementing a classroom will not come alone if the teacher is not ready and trained for the use of GIS technology.

1. Introduction

A study was conducted on the perspective of Technical and Vocational Education and Training (TVET) vocational high school teachers to check the readiness of adoption (acceptance) of Geographic Information System (GIS) technology as part of the geomatics and geospatial engineering competency curriculum in Indonesia. This was motivated by the announcement of the 2013 curriculum changes (in 2013), including one of the changes in survey engineering and mapping majors into geomatics techniques. The survey and mapping curriculum underwent changes and GIS was one of the technologies included in its competency expertise. As a result, this minimal acceptance of technology usually raises several factors that often become obstacles, such as lack of: hardware, software, data, time to prepare the curriculum, time for teachers to learn software (training), support in national standards, and flexibility in structure school organization (Crechiolo, 1997; Şeremet & Chalkley, 2015; Sholarin & Awange, 2015).

Engineering teachers are said to be productive teachers. There is an assumption that engineering teachers have better access to computers than peer teachers in social science (Wardley, 1997), whether the arguments are true or not, it is quite clear that technical classrooms and social sciences initially access and use technology for reasons that different (Baker, 2005). Engineering teachers are increasingly trying to model class activities in the form of scientific investigations, fostering an environment where student data collection and analysis is common (National Research Council, 2000). Typical laboratories and field studies in vocational engineering schools, causing the logical development of these activities require some form of data analysis (Abd-El-Khalick & Lederman, 2000). Instead social studies education is often trained with an emphasis in history and lacks strong experience in research methodology and design for inquiry-oriented instruction and produces analytical needs using GIS (Baker et al., 2015). Therefore knowing how much geomatics and geospatial engineering teachers intend to adopt and use technology is very important for successful GIS education practices in TVET secondary schools in Indonesia.

A number of studies have been conducted to measure the acceptance of GIS in secondary schools. Human, organizational, and management factors can influence GIS adoption in American public agencies (Nedović-Budić, 1998). Teacher attitudes, curriculum requirements, school support, and perceived effectiveness of GIS are all important for the successful adoption of GIS in American secondary education (Kerski, 2003). In follow-up studies, Baker, Palmer and Kerski, observed that the lack of teacher time, different skill levels among students, and the complexity of software hampered the implementation of GIS in K-12 education (Baker, Palmer, & Kerski, 2009). In the case of Singapore, several obstacles that prevented teachers from integrating GIS into secondary education, such as the lack of GIS software and GIS-based resource packages and insufficient training and GIS exposure (Yap et al., 2008). While GIS adoption studies in Taiwan found that perceived usefulness and school support were important factors influencing GIS adoption for teachers (Lay, Chen, & Chi, 2013).

This article will explore the acceptance of GIS technology through teacher training experience and teacher compliance, as a result of the inclusion of geographic and geospatial engineering curricula in TVET schools in Indonesia. This survey involved 94 engineering teachers from 38 secondary schools focusing on geographic and geospatial vocational education in Indonesia. The survey results show that teacher experience using GIS technology is identified, new teachers use 1-2-year GIS technology by 62%, 3-4 years experience at 23.9% and experience using GIS for more than 5 years at 14.1%. The meaning of GIS acceptance for geomatics and geospatial engineering teachers is still relatively slow, considering that the acceptance of GIS in geomatics engineering schools has been going on since 2013. This situation was also followed by a lack of experience in training, 32.6% of teachers had never received training, experience attend GIS training 1-2 times by

40.2% and experience of taking GIS training 3-4 times by 27.2%. These results provide a significant insight that the level of GIS acceptance for technical teachers in Indonesia seems slow, so this study needs to measure the factors or determinants that will strengthen and weaken the acceptance of GIS technology for teachers as well as what obstacles can be identified when acceptance/ GIS adoption takes place in class. To achieve the objectives of this study, questions were formulated according to the TAM 2 technology acceptance model. TAM has been applied to many acceptance studies of educational technology, such as elearning adoption systems and distance learning modules (Katsanos, Tselios, & Xenos 2012; Liu, 2013; Sahin & Shelley, 2008) and GIS adoption (Lay, Chen, & Chi, 2013).

2. Literature Review

2.1 Integration of GIS technology in secondary education

Many people assume that once hardware and software have been purchased, the adoption of computer technology and its effective use will follow, but this situation has not proven to be a case in a country, including in Indonesia, as shown in the extensive literature examining factors which affects the failure or success of information technology adoption (Rogers, 2010). Internationally, researchers have shown that computer anxiety, a lack of perceived benefits (Venkatesh & Bala, 2008), and a lack of ease of use of information technology have led to low adoption and use of information technology (Bodzin, 2011; Davis, 1989; Venkatesh et al., 2003; Venkatesh, 2000). These factors have strong implications for the failure of the implementation of a technology, despite the good and sincere intentions of government policies intended to provide technology, but this is not enough to guarantee its use (Odedra, 1993).

Trautmann & MaKinster explained that a key component of the successful integration of technology into science and engineering teaching is technology literacy (Trautmann & MaKinster, 2010), defined by three dimensions, namely: i) *factual and conceptual knowledge of various technologies and functions, ii) the ability to use and solve the problem of choice of technology to be chosen,* and iii) *critical thinking and decision making about its appropriate use* (Garmire & Pearson, 2006). Even teacher beliefs are considered as part of the success perspective on teaching and learning (Buabeng-Andoh, 2012). According to perspective theory consists of a series of interrelated intentions and beliefs, which guide and justify behavior (Pratt, 2002). Intention and purpose refers to what the individual wants to achieve, while belief refers to the importance, reasonableness, and justification of intention and behavior (Oolbekkink-Marchand, Van Driel, & Verloop, 2014). In addition, there is also evidence to show that teacher self-efficacy towards technology integration is a significant determinant of the use of technology in learning (Lee & Lee, 2014). This situation is supported by the opinion that many teachers are categorized as "technophobic" about the use of information technology, and perhaps more importantly that trust often rejects change (Blömeke et al., 2014). The Kerski researcher concluded that teacher attitudes, curriculum requirements, school support, and perceived effectiveness of GIS are important for the successful adoption of GIS technology in secondary education (Kerski, 2003). In a follow-up study Baker, Palmer and Kerski, he observed that lack of teacher time, different skill levels among students, and software complexity hampered the implementation of GIS in secondary education (Baker, Palmer, & Kerski, 2009).

Integrating GIS into TVET secondary education is a necessary step, but teachers who are interested in involving their students in high-level learning using technology must also be able to integrate technology skills with pedagogical considerations and subject matter (Trautmann & MaKinster, 2010). Strategies for applying the GIS perspective do not have to focus on convincing teachers about GIS advantages and value added, but also reduce the constraints in the use of GIS as teachers' daily routines in schools (Schubert, Höhnle, & Uphues, 2012).

2.2 Adoption of GIS technology

Adoption and acceptance of GIS innovation in education usually occurs in four stages (Binko, 1989), namely: (i) awareness; (ii) understanding; (iii) guided exercises; and (iv) implementation. The Awareness Stage, characterized as the 'What is GIS?' Phase. A teacher becomes aware of GIS, maybe from a real-world meeting at a local government office, or in an educational environment such as at a conference, or from a school district staff development workshop. He has a potential relationship with the current curriculum; Mamahami stage, this is difficult, especially for geography and social science teachers. At this stage, the teacher must solve the problem, 'How can I teach geospatial with GIS? '; Guided training. At this stage how teachers teach about GIS, the need to develop pilot studies of curriculum development to investigate the usefulness of GIS; The Implementation Phase, a special field of expertise with a variety of geospatial analysis methods that are widely applied in academic circles and specialized fields of expertise. Stages of GIS adaptation are described in Table 1.

Table 1. Stages of GIS adaptation (Bednarz & Ludwig, 1997)

	Stage	Key Questions and Indicators
1	**Awareness**	What is GIS? - from real-world meetings at local government offices, - in an educational environment such as at conferences, - from school development workshops / training.
2	**Understand**	How can I teach with GIS? - the teacher must overcome the problem, "How can I teach with GIS?" - spatial analytical studies
3	**Guided Practice**	How do I do it with GIS? - how teachers teach about GIS - the need for examples from curriculum development to investigate uses. - as an analytical tool from the results of measurements in the field.
4	**Implementation**	How do I analyze it with GIS? - use various methods of geospatial analysis.

2.3 Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) is proposed by Davis, Bagozzi and Warshaw (Davis, Bagozzi, & Warshaw, 1989). TAM theorizes that individual behavioral intentions to use the system are determined by two beliefs: Perceived Usefulness (PU) and Perceived Ease Of Use (PEOU). Perceived Usefulness (PU) is defined as *'the degree to which someone believes that using a system will improve his work performance'*, and Perceived Ease Of Use (PEOU) is defined as *'the degree to which someone believes that using the system will be free of effort'*. TAM also theorizes that the effects of external variables, for example: system characteristics, development processes, training, intention to use, will be mediated by PU and PEOU. According to him again, perceived usefulness is also influenced by perceived ease of use, because other things are considered the same, the easier a system is used it will be more useful. Perceived Usefulness (PU) is a fundamental driver of intention to use (BI). Consistently TAM is able to explain the substantial proportion of variance usually around 40% in intention and behavior using the system (Venkatesh & Speier, 1999).

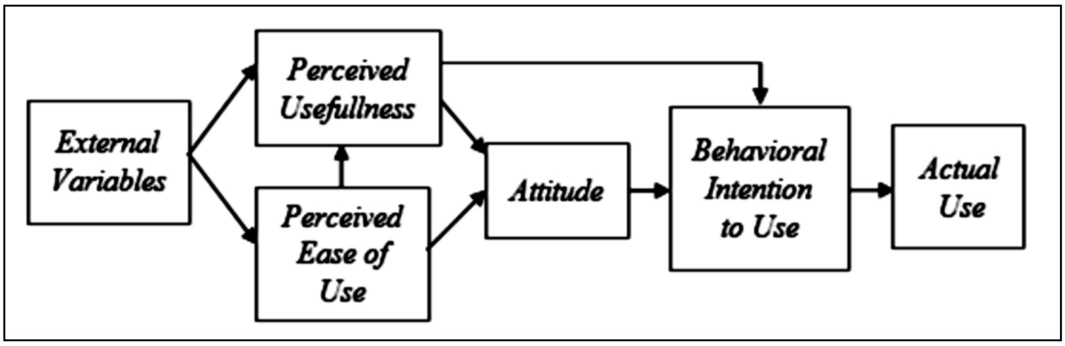

Figure 1. TAM theory framework (Davis, 1989)

Figure 1 show the TAM theory framework, using TAM as a starting point, TAM 2 broadens his theory to include additional key determinants of perceived usefulness and intention to use construction, namely to understand how these determinant effects change with increasing user experience over time in compliance with GIS use. TAM 2 combines additional theoretical constructs that include social influence processes (*subjective norm, voluntariness, and image*) and cognitive instrumental processes (*job relevance, output quality, demonstration results, and perceived ease of use*) and two moderator variables, *Experience* and *Voluntariness* (Venkatesh & Davis, 2000). The determinants of system characteristics according to the theoretical framework and definitions of the determinants of each variable are shown (Figure 2 and Table 2).

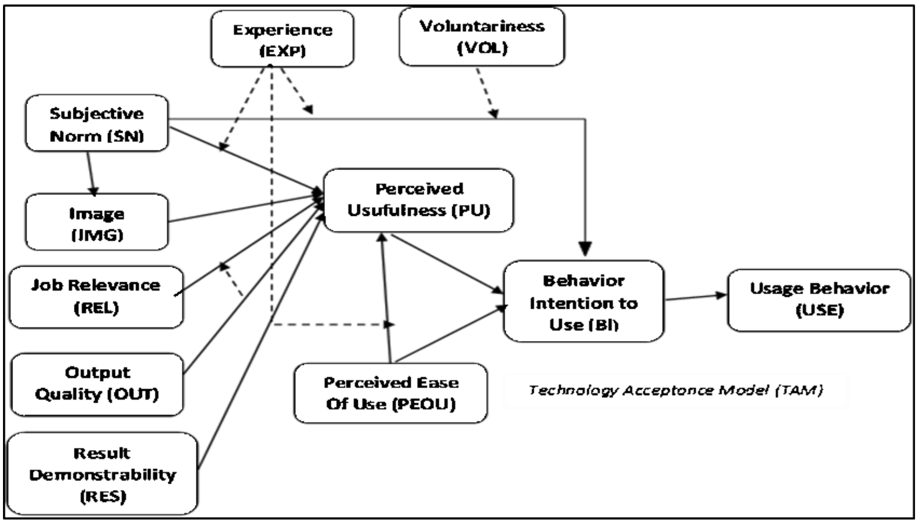

Figure 2. Reception technology model 2 (TAM 2) (Venkatesh & Davis, 2000)

TAM 2 theorizes that there are three mechanisms that arise due to the influence of social processes, namely: compliance, internalization, and identification. Compliance represents a situation in which an individual carries out behavior to achieve certain rewards or avoid punishment (Miniard & Cohen, 1979). Identification refers to a person's belief that doing a behavior will improve his social status in a group as a reference source, because trusted references will make the actor have to do it (Venkatesh & Davis, 2000). And Internalization is defined as the incorporation of trust from reference sources into the structure of a person's belief in doing that behavior (Warshaw, 1980).

Table 2. Determinants of variables in TAM 2

Determinants		**Definition**
Perceived Usefulness	PU	The extent to which a person believes that using a system will improve his work performance (Davis, Bagozzi, & Warshaw, 1989).
Perceived Ease of Use	PEOU	The extent to which someone believes that using IT will be free from effort (Davis, Bagozzi, & Warshaw, 1989).
Experience	EXP	User experience from time to time
Voluntariness	VOL	An individual carries out behavior to achieve certain rewards or avoid punishment (Miniard & Cohen, 1979)
Subjective Norm	SN	The extent to which an individual perceives that most people are important to him thinks he must or does not use the system (Venkatesh & Davis, 2000).
Image	IMG	The extent to which an individual feels that the use of a system / innovation will improve his status in the social (Moore & Benbasat, 1991).
Job Relevance	REL	Individual perceptions regarding the extent to which the target system applies to his work. The extent to which a person believes that the target system is relevant to his work (Venkatesh & Davis, 2000).
Output Quality	OUT	The extent to which a person believes that the system does its job well (Venkatesh & Davis, 2000).
Result Demonstrability	RES	The extent to which someone believes that results use a real, observable, and communicative system (Moore & Benbasat, 1991).

3. Research Methodology

3.1 Questions and significance of research

The purpose of this teacher survey study is to explore what factors have the potential and have the effect of direct or indirect influence on the acceptance of TVET secondary school GIS technology in Indonesia, by identifying what obstacles are found when the acceptance/ adoption of integrated GIS technology in classroom learning. To achieve the objectives of this study, the researcher posed the question: Do teacher behaviors intend to support acceptance (adoption and use) for themselves, teachers, and students?, or at the purpose of only obtaining hardware and software, without considering organizational change and cultural substance needed to support the integration of appropriate technologies in improving student learning.

To achieve the objectives of this study, question assumptions are formulated using the technology acceptance model (TAM 2), where additional key determinants of perceived usefulness (PU) and user intention (BI), namely by understanding how these determinant effects will continue to change with increasing user experience (EXP) from time to time with the target system. This study will add empirical evidence and can be used to determine the level of stages of GIS acceptance for secondary school geomatics and geospatial techniques, and provide solutions to reduce barriers to the implementation of acceptance of GIS technology in TVET vocational secondary schools in Indonesia.

The research hypothesis is formulated based on two determinants, namely the influence of social processes (H1 to H6) and the influence of cognitive instrument processes (H7 to H13).

H1 : Subjective Norms (SN) will have a direct influence on user intentions (BI);

H2 : Subjective Norms (SN) that are moderated by the experience of using the system (EXP) will have an effect on the user's intentions (BI);

H3 : Subjective Norms (SN) that are moderated by volunteerism (VOL) will have a direct influence on user intentions (BI);

H4 : Subjective Norms (SN) will have a direct influence on perceived usefulness (PU) ;

H 5: Subjective Norms (SN) will have a direct effect on Image (IMG);

H6 : (IMG) will have a direct influence on perceived usefulness (PU);

H7 : The relevance of the work (REL) will have a direct effect on perceived usefulness (PU);

H8 : The relevance of work (REL) which is moderated by quality of results (OUT) has an effect of influence on perceived usefulness (PU);

H9 : The results shown (RES) will have a direct influence on perceived usefulness (PU);

H10: The perceived ease (PEOU) will have a direct effect on perceived usefulness (PU);

H11: Moderated experience (PEOU) experience (EXP) has an effect of influence on perceived usefulness (PU);

H12: The perceived ease (PEOU) will have the effect of a direct influence on user intentions (BI);

H13: The perceived usefulness (PU) will have a direct influence on user intentions (BI);
H14: The user intention (BI) will have the effect of directly influencing user behavior (USE).

3.2 Population

The study population was all geomatics and geospatial engineering teachers from 63 TVET vocational secondary schools in Indonesia; This number includes all public and private vocational secondary schools in the country. Of the 63 schools, 59 are state vocational high schools and 4 private vocational secondary schools are spread in 30 provinces of 34 provinces in Indonesia. The tracked respondents were geomatics and geospatial teachers involved in teaching using GIS (see Table 3). This means that respondents have the same qualifications and equal opportunities because they are considered to have adopted GIS as part of the expertise competency curriculum that has been in school since the enactment of the 2013 curriculum. tracked for a period of one month. Deliveries are done repeatedly (ten times on average), this is because the teacher is still slow in responding to research interests. Finally, 94 respondents returned from a total of 134 questionnaires distributed, and all respondents deserved to be studied.

Table 3. Data on geomatics and geospatial engineering vocational schools in Indonesia (Direktorat PSMK, 2017)

Expertise Program	**Number of Vocational Schools**		**Number of Teachers**	
	Public	Private	Public	Private
Geomatics and Geospatial Engineering	59	4	896	33
Total	63		929	

3.3 Research materials

This research uses quantitative descriptive analysis surveys with respondents' answers as the key to building a causal relationship between the variables that influence it (De Vaus, 2013). Based on previous research and TAM 2 proposed by Venkatesh and Davis, this study applies TAM 2 which focuses on exploring teacher intentions and behavior in using GIS technology (Venkatesh & Davis, 2000). All variables were analyzed using structural equation modeling techniques SEM-PLS (Structural Equation Modeling-Partial Least Square).

Although TAM applies to various technologies, TAM construction must be expanded by including additional factors. Additional factors depend on the target technology, user, and context (Shyu & Huang, 2011). Consistent with the construction of TAM, most of the sample instruments were adopted like the questions in TAM 2, only a few changes such as the use of the word 'work' became 'teaching'. Except for rewriting and adding TAM questions to capture perceived aspects of usability, namely by adding questions "I need this system in my teaching". The inclusion of this question is because GIS technology has been adopted and has become an expertise competency in the geomatics and geospatial engineering secondary school curriculum.

3.4 Research procedure

We use Partial Least Squares (PLS), a component-based structural equation modeling technique, to analyze our data. SmartPLS version 3, is used to analyze data. PLS has minimal limits in terms of distribution assumptions and sample size (Chin, Marcolin, & Newsted, 2003). When analyzing data, we follow the guidelines specified (Chin, Marcolin, & Newsted, 2003). All constructions are modeled using reflective indicators. Experience is coded as ordinal and voluntary variables considered compliance / compulsory users, considering all geomatics teachers must use GIS technology in accordance with curriculum changes (Venkatesh & Davis, 2000; Venkatesh et al., 2003). When conducting an analysis we intend to focus variables on the indicator level (outer model) before creating the term interaction between variables (inner model) (Aiken, West, & Reno, 1991; Chin, Marcolin, & Newsted, 2003). Centering variables help limit the potential for multicollinearity, as evidenced by low inflation variation factors (VIFs) for all constructs in the model. Next we conducted a sample bootstrapping method (500 times) which was chosen randomly to test the interaction relationship between latent variables.

The analysis of the PLS model that we use is PLS Path Modeling. All variables and indicators that have been scored we enter into the SmartPLS program version.3, as many as 94 samples and 42 indicators detected and no data missing. Next, we construct the relationship between variables according to TAM 2's recommendations to test the outer model (the relationship between variables and indicators built) and proceed with the inner model test (coefficient of relationship between exogenous variables and endogenous variables). All indicators tested are reflective, namely the direction of causality from latent variables to indicators, between indicators are expected to correlate with each other (instruments must have consistency reliability). Eliminating / removing indicators that do not meet the requirements, will not change the meaning and meaning of the measured variables, and measurement errors (error) at the indicator level (Haenlein & Kaplan, 2004). There are as many as 16 loading value indicators that do not meet the requirements and then each of these indicators is removed / removed. Then the second validity test is done again, and the results show that all indicators have AVE values> 0.50, which means all indicators are statistically significant and support the construct of latent variables (see Table 4).

Table 4. Construct reliability and validity value

Variable	Test 2			
	Cronbach's Alpha	**Composite Reliability**	**Average Variance Extracted (AVE)**	**√AVE**
BI	1,000	1,000	1,000	1,000
EXP	0,756	0,859	0,672	0,785
IMG	1,000	1,000	1,000	1,000
OUT	0,804	0,909	0,833	0,864
PEOU	1,000	1,000	1,000	1,000
PU	0,910	0,928	0,621	0,921
REL	1,000	1,000	1,000	1,000
RES	0,715	0,875	0,778	0,817
SN	0,781	0,901	0,820	0,881
USE	1,000	1,000	1,000	1,000
VOL	1,000	1,000	1,000	1,000

Data that has fulfilled the convergent validity test requirements, followed by a discriminant test, namely whether the construct has adequate discriminant. By comparing the value of AVE with √AVE, if the value of √AVE for each construct is greater then it is said that it has good discriminant validity (Venkatesh & Davis, 1996). At this stage the √AVE value of all indicators and moderation is higher than the AVE value, so all variable indicators meet the discriminant test requirements (see table 4). Next to assess whether an indicator is truly trustworthy in measuring the construct, a composite reliability test or a reliability construct test is carried out. Reliability testing is done by looking at the composite reliability value of the indicator block that measures the construct. The results show that all constructs have a strong composite reliability value of> 0.7 (Chinn, 1998). Reliability testing also shows all cronbach's alpha value variables> 0.6 (Sayyida & Anekawati, 2012).

After the estimated model meets the Outer Model criteria, the next structural model is tested (Inner Model). Inner Model is done to examine the relationship between latent constructs (exogenous variables with endogenous variables). The value of R Square is the coefficient of determination in endogenous constructs. The value of R Square: equal to 0.67 is identified as having a strong relationship; 0.33 has a moderate / predictor relationship; and 0.19 have a weak relationship (Chinn, 1998). From the results of testing the relationship of latent constructs (see Table 5), the value of R Square which has a strong constructive relationship is: the Perceived Usefulness (PU) variable of 0.607 which means that PU is able to explain the relationship of the variable (60.7%). Followed by a moderate relationship namely Job Relevance variable (REL) of 0.454, which means that REL is able to explain the relationship of the variable (45.4%), the Perceived Ease Of Use (PEOU) variable of 0.231 means that the PEOU is able to explain the variable relationship (23.1%), and the Behavior Intention to Use (BI) variable is 0.218, meaning that BI is able to explain the relationship of the variable (21.8%) and the rest is explained by other variables. The last variable that has a weak relationship occurs at SN (0.178); IMG (0.030) and USE (0.020). This situation is consistent with the findings Venkatesh and Davis, where PU is a fundamental driver of intention to use, consistently explaining a substantial proportion of variance (usually around 56.8%) in usage intentions and system-using behavior, but not for PEOU which is only able to explain the substantial proportion of the variance of 23.1% (Venkatesh & Davis, 2000).

Table 5. R Square

Variable		R Square	Construct Relations
Behavior Intention to Use	BI	0,218	Moderate
Image	IMG	0,030	Weak
Perceived Ease of Use	PEOU	0,231	Moderate
Perceived Usefulness	PU	0,607	Strong
Subjective Norm	SN	0,178	Weak
Job Relevance	REL	0,454	Moderate
Use Behavioral	USE	0,020	Weak

4. Findings

4.1 Hypothesis results

Next we do hypothesis testing with Estimate for Path Coefficients, which is to test the value of path coefficients or the relationship / influence that occurs between latent constructs. Hypothesis testing is done by looking at t-statistics and original sample values. The t-statistic value shows the construct significance, while the original sample value shows the nature of the relationship between constructs (positive or negative), which is done by the Resampling Bootstrapping procedure (1000). The relationship will be significant if the t-statistic is greater than t-table (significant t-table 5% = 1.96). The estimate value for variable path coefficients can be seen in Table 6.

Table 6. Estimate value for variable path coefficients

	Construct Relationship Hypothesis	Original Sample (O)	T Statistics (O/STDEV)	P-value	Information
H1	**SN → BI**	0,14	1,061	0,121	Rejected
H2	**SN → BI : EXP**	**0,31**	**3,747**	**0,000**	Accepted
H3	**SN → BI : VOL**	**0,28**	**2,849**	**0,005**	Accepted
H4	**SN → PU**	**0,13**	**2,079**	**0,046**	Accepted
H5	**SN → IMG**	-0,17	1,586	0,467	Rejected
H6	**IMG → PU**	-0,09	1,100	0,076	Rejected
H7	**REL → PU**	**0,26**	**2,622**	**0,001**	Accepted
H8	**REL → PU : OUT**	**0,67**	**8,870**	**0,000**	Accepted
H9	**RES → PU**	**0,50**	**5,620**	**0,000**	Accepted
H10	**PEOU → PU**	0,11	1,433	0,944	Rejected
H11	**PEOU→ PU : EXP**	**0,48**	**6,393**	**0,000**	Accepted
H12	**PEOU → BI**	0,01	0,076	0,440	Rejected
H13	**PU → BI**	0,14	1,051	0,274	Rejected
H14	**BI → USE**	0,14	1,441	0,169	Rejected

The results of a significant hypothesis test through the relationship of social influence processes are:

H2: The indirect relationship of subjective Norm (SN) which is moderated by experience (EXP) of the teacher has a significant influence on teacher intention (BI) to use GIS technology (0.31);

H3: Indirect relationship of subjective norms (SN) which is moderated by compliance/ obligation, has a significant influence on teacher intention (BI) to use GIS technology (0.28)

H4: A significant direct relationship occurs between subjective norms (SN) for perceived usefulness (PU) by the teacher of 0.13.

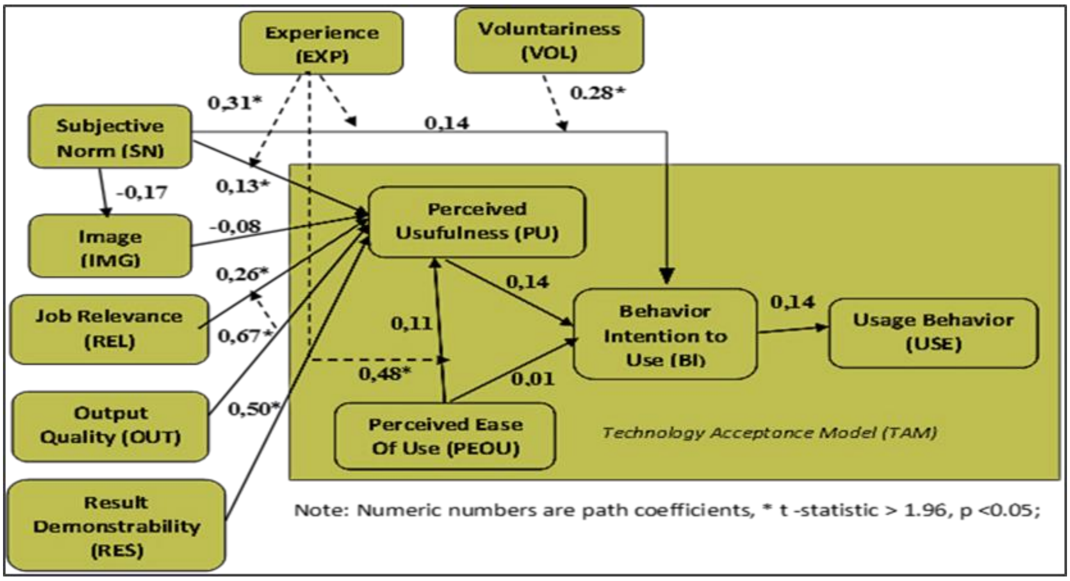

Figure 3. Result of a significant hypothesis test

While the results of a significant hypothesis test through the relationship of the process of cognitive instruments are:

H7: The relevance of work (REL) has the effect of a direct effect on perceived usefulness (PU) by the teacher of 0.26;

H8: The relevance of work (REL) moderated by the quality of output (OUT) has an indirect effect on perceived usefulness (PU) of 0.67;

H9: The results of using the system (RES) have a direct effect on perceived usefulness of 0.50;

H11: Moderated user experience (PEOU) experience (EXP) has an effect on effect on perceived usefulness (PU) of 0.48.

4.2 Summary of results

Including influencing social processes (subjective norms, obedience, and image) and cognitive instrumental processes (job relevance, output quality, ability of the results shown, and perceptions of ease of use), TAM 2 provides a detailed account of the main strengths that underlie perceived and capable uses explain the relationship of 26% to 67% of each variance to the user perceived usefulness. In addition, TAM 2 shows that subjective norms have a significant direct effect on usage intention and perceived benefits, on perceptions of system use for compliance / mandatory users (28%). The influence of subjective norms erodes (13%), along with the implementation, when teachers know more about the strengths and weaknesses of the system through direct experience (31%), causing the process of 'internalization' of the teacher's subjective norms to subside. Whereas in the identification process, where the teacher uses the system to obtain status and influence in the work group and their work performance increases is inconsistent because the effect of the effect is not significant, both in the relationship of subjective norms to image (-0.17), as well as relationship image for perceived usefulness (-0.08).

The effects of cognitive instrumental processes are also consistent with TAM 2. An interesting finding appears is the interactive influence between job relevance and quality of results in determining perceived usefulness (67%). This implies that the assessment of the usefulness of the GIS system is influenced by individual cognitive matching of the purpose of the work with the consequences of using the system (job relevance), and the importance of proportional quality of results to be greater with the relevance of the system work. Although the interaction was not explicitly explained in the relationship of ease of use because the interaction effect on usability and intention to use was not significant (11% and 14%). This is in accordance with the teacher's answer "I feel the system is easy to use" as many as 80% of teachers said they did not agree, this explained the task characteristics and characteristics of GIS technology was not easy for teachers, and 59.8% of teachers said there was a need for ongoing training. The perceived ease of use after cognitive instrumental processes from time to time through experience significantly affects the usefulness of the system (48%), so the ability of the results shown by the system has a positive effect on perceived usefulness (50%). Unlike the process of social influence, the effect of cognitive instrumental processes still has significance as the use of gaining experience over time.

5. Conclusion

Since the implementation of the GIS curriculum six years ago (2013), researchers refer to the level / stage of adaptation of GIS technology acceptance for geomatics engineering teachers in Indonesia only in the "awareness" stage, with the question "What is GIS?". These results are based on the influence of the social process identifying teachers as adopters of GIS technology still based on the process of compliance / obligation and internalization. Compliance represents a situation in which an individual performs a behavior to achieve certain rewards or avoids punishment, and Internalization is defined as a combination of trustworthiness in the structure of one's beliefs. The lack of experience in training, as many as 32.6% of teachers have never received any training at all, and (40.2%) have only participated in one training session, causing teachers to be slow in accepting GIS technology. These pressures prevent teachers from reflecting on their teachings, and ultimately result in substitution of teachers' intellectual creativity with a culture of compliance (Groundwater-Smith & Mockler, 2009) and contribute to the tendency of teachers to prioritize learning experiences that they believe can be directly applied in their own class situations (McRae et al., 2001). It seems clear that the benefits of implementing a classroom will not come alone if the teacher is not ready and trained for the use of geospatial technology (GIS).

References

Abd-El-Khalick, F., and Lederman, N. G. (2000). Improving science teachers' conceptions of nature of science: a critical review of the literature. education. *International Journal of Science Education*, *22*(7), 665-701.

Aiken, L. S., West, S. G., and Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions.* New York: Sage.

Baker, T. R., Battersby, S., Bednarz, S. W., Bodzin, A. M., Kolvoord, B., Moore, S., ... and Uttal, D., Baker, T. R., Battersby, S., Bednarz, S. W., Bodzin, A. M., Kolvoord, B., Moore, S., Sinton, D., and Uttal, D. (2015). A research agenda for geospatial technologies and learning. *Journal of Geography, 114*(3), 118–130.

Baker, T. R., Palmer, A. M., and Kerski, J. J. (2009). A national survey to examine teacher professional development and implementation of desktop GIS. *Journal of Geography*, 108(4-5), 174-185.

Baker, T. R. (2005). Internet-based GIS mapping in support of K-12 education. *The Professional Geographer*, *57(1)*, 44-50.

Bednarz, S. W., and Ludwig, G. (1997). Ten things higher education needs to know about GIS in primary and secondary education. *Transactions in GIS*, *2*(2), 123–133.

Binko, J. B. (1989). *Spreading the word about geography: A guide for teacher-consultants in geography education.* Washington: National Geographic Society.

Blömeke, S., Buchholtz, N., Suhl, U., and Kaiser, G. (2014). Resolving the chicken-or-egg causality dilemma: The longitudinal interplay of teacher knowledge and teacher beliefs. *Teaching and Teacher Education, 37,* 130-139.

Bodzin, A. M. (2011). The implementation of a geospatial information technology (GIT)-supported land use change curriculum with urban middle school learners to promote spatial thinking. *Journal of Research in Science Teaching*, *48*(3), 281–300.

Buabeng-Andoh, C. (2012). Factors influencing teachersâ adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development using ICT*, 8(1), 136–155.

Chin, W. W., Marcolin, B. L., and Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research*, *14*(2), 189-217.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research,* 295(2), 295-336.

Crechiolo, A. L. (1997). *Teaching secondary school geography with the use of a geographical information system (GIS).*

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35(8), 982-1003.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *IT Usefulness and Ease of Use Perceived*, *1*(1), 319–340.

De Vaus, D. (2013). *Surveys in social research.* Abingdon: Routledge.

Direktorat PSMK, I. (2017). *Program Keahlian Teknik Geomatika dan Geospasial*.

Gamire, E., and Pearson, G. (2006). *Tech tally: Approaches to assessing technological literacy.* Washington: Island Press.

Groundwater-Smith, S., and Mockler, N. (2009). *Teacher professional learning in an age of compliance: Mind the gap (Vol. 2)*. Berlin: Springer Science & Business Media.

Haenlein, M., and Kaplan, A. M. (2004). A beginner's guide to partial least squares analysis. *Understanding statistics*, 3(4), 283-297.

Katsanos, C., Tselios, N., and Xenos, M. (2012). Perceived usability evaluation of learning management systems: A first step towards standardization of the system usability scale in Greek. *Proceedings of the 2012 16th Panhellenic Conference on Informatics*. Piraeus, 75, 302–307.

Kerski, J. J. (2003). The implementation and effectiveness of geographic information systems technology and methods in secondary education. *Journal of Geography,* 102(3), 128–137.

Lay, J. G., Chen, Y. W., and Chi, Y. L. (2013). GIS adoption among senior high school geography teachers in Taiwan. *Journal of Geography*, 112(3), 120-130.

Lee, Y., and Lee, J. (2014). Enhancing pre-service teachers' self-efficacy beliefs for technology integration through lesson planning practice. *Computers and Education*, *73*, 121–128.

Liu, W. H. (2013). Student Perceptions and Satisfaction with Online and Distance Learning. *Applied Mechanics and Materials*, 347(350), 3340–3342.

McRae, D., Ainsworth, G., Groves, R., Rowland, M., and Zbar, V. (2001). *PD Australia: A national mapping of school teacher professional development.* Canberra: Commonwealth of Australia, Department of Education, Training and Youth Affairs.

Miniard, P. W., and Cohen, J. B. (1979). Isolating attitudinal and normative influences in behavioral intentions models. *Journal of Marketing Research,* 16(1), 102-110.

Moore, G. C., and Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, 2(3), 192-222.

National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning.* Washington: National Academies Press.

Nedović-Budić, Z. (1998). The impact of GIS technology. *Environment and Planning B: Planning and Design*, *25*(5), 681–692.

Odedra, M. (1993). *Information technology policies and applications in the commonwealth developing countries*. London: Commonwealth Secretariat.

Oolbekkink-Marchand, H. W., Van Driel, J. H., and Verloop, N. (2014). Perspectives on teaching and regulation of learning: a comparison of secondary and university teachers. *Teaching in Higher Education*, 19(7), 799-811.

Pratt, D. D. (2002). Good teaching: One size fits all?. *New Directions for Adult and Continuing Education*, *2002*(93), 5-16.

Rogers, E. M. (2010). *Diffusion of innovations.* New York: Simon and Schuster.

Sahin, I., and Shelley, M. (2008). Considering students' perceptions: The distance education student satisfaction model. Journal of Educational Technology & Society, 11(3), 216-223.

Sayyida, S., and Anekawati, A. (2012). Penggunaan Analisis Structural Equation Modelling (SEM) Dalam Mengidentikasi Pengaruh Variabel Moderasi Struktur Desentralisasi Terhadap Hubungan Partispasi Dalam Penyusunan Anggaran Dan Kinerja Manajerial SKPD Di Kabupaten Sumenep. *Prosiding Univeritas Wiraraja*. Sumenep, 1(1).

Schubert, J. C., Höhnle, S., and Uphues, R. (2012). Which chances do teachers see in GI (S) usage in the classroom. *Geovizualisation, society and learning*, 283-291.

Şeremet, M., and Chalkley, B. (2015). Student perspectives on the teaching of geographical information systems (GIS) in geography degrees. *Journal of Geography in Higher Education*, *39*(1), 18–36.

Sholarin, E. A., and Awange, J. L. (2015). Geographical information system (GIS). In *Environmental Science and Engineering (Subseries: Environmental Science)* (Issue 9783319276496, pp. 239–248).

Shyu, S. H. P., and Huang, J. H. (2011). Elucidating usage of e-government learning: A perspective of the extended technology acceptance model. *Government Information Quarterly*, *28*(4), 491–502.

Trautmann, N. M., and MaKinster, J. G. (2010). Flexibly adaptive professional development in support of teaching science with geospatial technology. *Journal of Science Teacher Education*, *21*(3), 351–370.

Venkatesh, V., and Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, *46*(2), 186-204.

Venkatesh, V., and Speier, C. (1999). Computer technology training in the workplace: A longitudinal investigation of the effect of mood. *Organizational Behavior and Human Decision Processes*, *79*(1), 1-28.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.

Venkatesh, V., and Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision sciences,* 39(2), 273-315.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information systems research,* 11(4), 342-365.

Venkatesh, V., and Davis, F. D. (1996). A Model of the Antecedents of Perceived Ease of Use: Development and Test. *Decision Sciences*, *27*(3), 451–481.

Wardley, C. S. (1997). *Geographic information systems in high school geography education: a feasibility study.*

Warshaw, P. R. (1980). A new model for predicting behavioral intentions: An alternative to Fishbein. *Journal of marketing research,* 17(2), 153-172.

Yap, L. Y., Tan, G. C. I., Zhu, X., and Wettasinghe, M. C. (2008). An assessment of the use of geographical information systems (GIS) in teaching geography in Singapore schools. *Journal of Geography*, *107*(2), 52–60.