

Reliability of Geographic Information System-Spatial Thinking Skills (GIS-STS) Module

Ganesan Mayalagu, Mokhtar Jaafar, Lam Kuok Choy, Mohd Izwan Mahmud

Abstract: This is a pilot study designed in establishing the reliability of the 'Geographic Information System' module - Spatial Thinking Skills (GIS-STS) synthesized by the researcher. This module is composed of four sub-modules: Geography Skill, Physical Geography, Human Geography and Area Geography. The research outline adapted in this study is an experimental design. Additionally, the respondents of this study concerned 30 Form Two students in one of the schools in Jempol District, Negeri Sembilan. The subjects of this study were selected using random sampling. Respondents followed Learning and Facilitation (L&F) by following the activities as set out in the module and then answered the reliability questionnaire of GIS-STS module created by the researcher by using reliability analysis. The findings show that the GIS-STS module has a significant reliability value of reliability coefficient of .873. The module is anticipated to be implemented as an effective L&F material especially in enhancing STS and attracting students to Geography subjects.

Index Terms: GIS-STS, module, reliability.

I. INTRODUCTION

In the 21st century, computer and technology innovation in Learning and Facilitation (L&F) has now become a standard in the system of Malaysian education. Nonetheless, Geography subjects are one of the subjects that faces less integration of technology in comparison with other subjects like science and mathematics. Ergo, this situation resulted in the lack of interest in Geography subjects [1]. In Malaysia specifically, the implementation and significance of the Geographic Information System (GIS) in schools is only exposed theoretically, on articles and proceeding papers.

Spatial Thinking is construed as cognitive skills with the elements of knowing the concept of space, adopting representative equipment and using for a purpose [2]. Spatial thinking becomes the basic cognitive skills in Geography subjects [3]. This type of thinking allows researcher the opportunity to help solving the problem that is related to space. Consequently, the students' enthusiasm and motivation are predicted to hike. Ergo, the thinking of space should be applied amongst the students of Geography through the integration of GIS in Geography L&F.

Information technology in L&F is now a criterion in the Malaysian education system where the integration of the

Geographic Information System (GIS) in Geography L&F has become a vital nuance in the world-wide education system [4]. Ergo, the introduction of the Secondary School Standard Curriculum (KSSM) in 2017 has become a new shift in L&F, Geography in Malaysia. Generally, this Geography subject is one of the core subjects of the lower secondary level from Form One to Form Three, while for the upper secondary level of Form Four and Five students, this subject becomes elective ones. Commonly, most schools in Malaysia are no longer offering Geography subjects at Form Four and Five. Thus, these subjects have become progressively forgotten by students. They regard these subjects as boring and is not significant in SPM results. Consequently, the students become less interested in the subjects of Geography [1].

Accordingly, the Geographic Information System Module -Spatial Thinking Skills (GIS-STS) should be built for L&F Geography to fulfill the 21st century learning demand. Hopefully, the modules created will assimilate geospatial technology, spawn spatial thinking skills (STS), and further enhance the students' interest in this continually marginalized subject. This module is synthesized based on [42] model. Nonetheless, before this module can be adapted within the Geography L&F, the validity and reliability evaluation of the module should be carried out to insure the module level reaches great quality.

II. LITERATURE REVIEW

Module is construed as a set of teaching and learning that attends to certain systematic and sequential topic to help learners to master a unit of learning with ease and accuracy [5]. As for the context of teaching and learning, the module is a set or complete unit created to appreciate certain knowledge and skills [6]. Additionally, in [42] model was adapted to maneuver the creation of this module. The GIS-STS module has been created based on [42] model which is a more comprehensive integrated model in module creation.

The GIS-STS module is a technology intervention module as this module is a tool, resource, or material and drives a student to address numerous activities to attain the objective in L&F. In [7] describes the module as a teaching package related to one unit of subjects and is an effort to teach individually which allows a student to master a unit of subject matter before moving to another. At the same time, in [8] mention that the module is a complete and independent teaching unit that highlights on the fulfillment

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Ganesan Mayalagu, School of Social, Development and Environmental, National University of Malaysia, Bangi, Selangor, Malaysia.

Mokhtar Jaafar, School of Social, Development and Environmental, National University of Malaysia, Bangi, Selangor, Malaysia.

Lam Kuok Choy, School of Social, Development and Environmental, National University of Malaysia, Bangi, Selangor, Malaysia.

Mohd Uzwan Mahmud, Faculty of Education, National University of Malaysia, Bangi, Selangor, Malaysia.



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of considerable objectives. While, in [9] says that the modules are small but vital components which are closely related to one small section to the other.

Conclusively, the modular approach can benefit the L&F process and engage students to study Geography subjects. Even though there are many L&F modules are created but there are only few studies are related to the value of the reliability coefficients of a module. As in [5], says, studies related to the reliability coefficients of a module are scarce. Despite that, among the studies that were conducted are done by [10]-[18].

According to [7] , [5], the reliability of a module can be assessed when respondents are capable to comprehend the objectives and successfully carry out the activities in the module. They claim that the module's effectiveness assessment tool can be completed through items formed based on objective or based on the activities described in a module, too. For this reliability study, the researcher built the item based on all the activities in the module. In order to gauge the reliability level of the module, the reliability coefficient value known as the alpha value of Cronbach has been used. In actuality, there is no standard resolution is created in relation to the reliability coefficients of the modules either by researchers locally or overseas. According to Valette [44] , the acceptable minimum reliability coefficient is .50 [12]. Nonetheless, in [13] suggested that the value of reliability of .60 is sufficient, too for instruments in the social sciences of the field of education. As being proposed by [14] which is .70, in [45] stated .80 [15]. On top that, in [16] stated that .85 and in [17] said that the minimum reliability coefficient of value is .90.

There are a lot of researchers propose that the value of reliability coefficient of more than .80 usually indicates great level of reliability [19]-[25]. Ergo, it is evident that the minimum value of reliability coefficient is .60 and reflects that the module has a good degree of reliability. On contrary, the value of the reliability coefficient that does not reach .60 makes the module having a low level of consistency and should be fixed.

A. Accuracy and Reliability of GIS-STs Module

The accuracy and reliability of the module is the initial process to be completed for expert assessment. The objective of this assessment is to examine the accuracy of the questionnaire to prove the reliability of the module. In accordance to this, the researcher sent the questionnaire to four experts to observe the validity and accuracy of the questionnaire and the reliability of the module. Among the experts are; (Experienced in GIS teaching) chosen are lecturers of The National University of Malaysia (UKM), Pahang Malaysia University (UMP) lecturer, module specialist from Faculty of Education (UKM) and ICT specialist (UKM).

The Geographic Information System-Spatial Thinking Skills (GIS-STs) module is composed of four sub-modules: Geography Skill submodule, Physical Geography submodule, Human Geography submodule and Area Geography submodule. The Geography Skill submodule have two units of scale and topography maps. While the Physical Geography submodule has two units, the unit of

influence of earth's movements on weather and climate, weather and climate in Malaysia. The Human Geography submodule has one unit that is transport in Malaysia. The last submodule which is the Area Geography has one unit of climate importance and its impact on human activity in Asia. All these submodules and unit details are applied into 13 activities as shown in Table 1.

Table 1: Summary of GIS-STs module content

Sub Modules	Units	Activities
Geography Skill	1. Scale and Distance 2. Topographic Map	1. Straight Distance 2. Curved Distance 3. Width 4. East Line and North Line 5. Physical Ground View (PGV) and Culture Land View (CLV)
Physical Geography	3. Movement Effects of Earth on weather and climate 4. Weather and Climate in Malaysia	6. Effects of Earth Rotation 7. Four seasons Occurrence 8. Area with High Concentration of Rain Annually 9. Area with Low Concentration of Rain Annually
Human Geography	5. Malaysian Transportation	10. Land Transportation 11. Air Transportation 12. Water Transportation
Area Geography	6. Importance of Climate and its Influence on Human Activities in Asia	13. Identifying four climate zones in Asia

B. Research Objectives

This pilot study's role is to identify the module reliability coefficients (GIS-STs) that have been applied in secondary schools among Form Two Geography students. This pilot study was carried out to assess and determine the reliability coefficients of the GIS-STs module composed of four sub-modules and 13 activities.

Roughly, this study aims to measure the value of reliability of the GIS-STs Module. The specific objectives of this study are:

1. To generally determine the reliability coefficients of the GIS-STs module
2. To determine the accuracy of the contents of the GIS-STs module questionnaire

III. METHODOLOGY

This pilot study adopts an experimental composition which is an approach to ascertain the effect of a dependent variable process (GIS-STs Module) on independent

variables (Students' Skills and Spatial Thinking Skills on Geography) [16]. The group involved in this study has been equipped with GIS technology intervention. Activities are done according to GIS-STS module. Respondents in this study will be given the opportunity to answer the questionnaire to demonstrate the value of the reliability coefficient of the module. If the value of reliability coefficients is high, then the GIS-STS module can decide the effects of independent variables on dependent variables.

As being suggested by [21], a measure of non-compliance about reliability will be assumed defective and the information extracted from it is illegal and not holistically accepted. At the same time, in [14] suggested that a measuring device is considered stable and robust if there is evidence of reliability coefficients. Ergo, to ascertain the reliability of the GIS-STS module, the following questions have been highlighted: is the intervention module known as the GIS-STS module has a great reliability coefficient? Hence, this pilot study was completed to determine the reliability of the GIS-STS module in one of the secondary schools among Form Two Geography students.

A. Research Area

This study was operated at SMK Bahau 2, (Mahsan) Jempol Negeri Sembilan. The selection of this school as the location of the study is due to the suitability of the study objective is assessing the reliability of the module.

B. Subject of Study

This pilot study was conducted on Form Two Geography students. A total of 30 students from three classes were randomly selected from a total of 92 students and were the subject to this study. The selection procedure of the subject is all Form Two students are given STS test and based on the test, the score procured will be analyzed using the SPSS version 23 software to choose the sample of the study; (which gets a score of z in the range of -1 and +1). The z-score was chosen as a sample of the study for this pilot study. Table 2 reflects the mean score, STS pretest for form 2 students at SMK Bahau 2.

Table 2: Mean score pre-STS test for pilot study team

Team	Variable	Classes	N	Mean	SD
Pilot Team	STS	2 Arif	28	63.01	1.0800
		2 Bestari	32	53.03	1.09774
		2 Cerdik	32	41.81	1.06931
Total (3 Classes)			92	52.61	1.08239

The sample selection and matching process was completed to make certain that the sample of this pilot study was in accordance with the mean score in the range of -1 and + 1. Referring to Table 2, the number of N = 92 was successful in Pre-STS Test of class 2 Arif (n = 28), Class 2 Bestari (n = 32) and Class 2 Cerdik (n = 32). Following that, the pair random sampling is done to make certain the same mean score [22]. Table 3 shows results after "pair random sampling" for this pilot study group. Based on the findings, the selected sample will be involved in the study and the selected pilot group is 2 Arif (n = 28, M = 63.01, SP = 1.08000437) class 2 Bestari (n = 32, M = 53.03, SP =

1.09774512) Class 2 Cerdas (n = 32, M = 41.81, SP = 1.1.06942159).

Table 3: Number of form two students who are chosen as the subject for reliability coefficients' value in GIS-STS module

No.	Classes Names	Number of Selected Respondents
1.	2 Arif	14
2.	2 Bestari	12
3.	2 Cerdik	4
Total		30

C. Data Analysis

This article highlights only on data related to the objective of the study is deciding the value of reliability coefficients of the GIS-STS module holistically and deciding the accuracy value of the contents of the module's reliability questionnaire from experts. The data were evaluated using Statistical Package for the Social Sciences (SPSS) version 23 software.

D. Measurement Instruments

The instrument to establish the value of reliability of the GIS-STS module has been built by the researcher. The items in the questionnaire form are based on the steps of each activity contained in the GIS-STS module. This view was employed from [20] who suggested that the formation of question items to assess the value of the reliability coefficients of the module is based on the activities in the module. Consequently, modules that have been created and purified by the expert's content of expertise will be tested through a pilot study to evaluate the reliability of the module. In the process of deciding the reliability of this module, the development of items requires a high degree of research based on every activity in the module.

Following that, the pretest process and the process of refinement and purification will be instantly carried out. Then, a set of reliability questionnaire forms based on the activities in the module was given to the expert to determine the accuracy level of the reliability questionnaire. This assessment consists of the scale of five points of choice: 1 (Strongly Disagree), 2 (Disagree), 3 (Unsure), 4 (Agree) and 5 (Strongly Agree). The accuracy and validity of the questionnaire formed by the researcher refers to the extent to which the questionnaire measures what parameters to be measured [23], [24]. Concurrently, in [25] mentioned that the questionnaire has a great validity is a questionnaire that has high degree of reliability.

Suggested by [7] that even though a module that has a reliability coefficient, supervising should also be made on the ability and competence of the student while managing the modules given. He also pointed out that the repetition should be enforced if the student cannot master the module's objectives. Fig. 1 shows the process of testing the reliability coefficients of the GIS-STS module.

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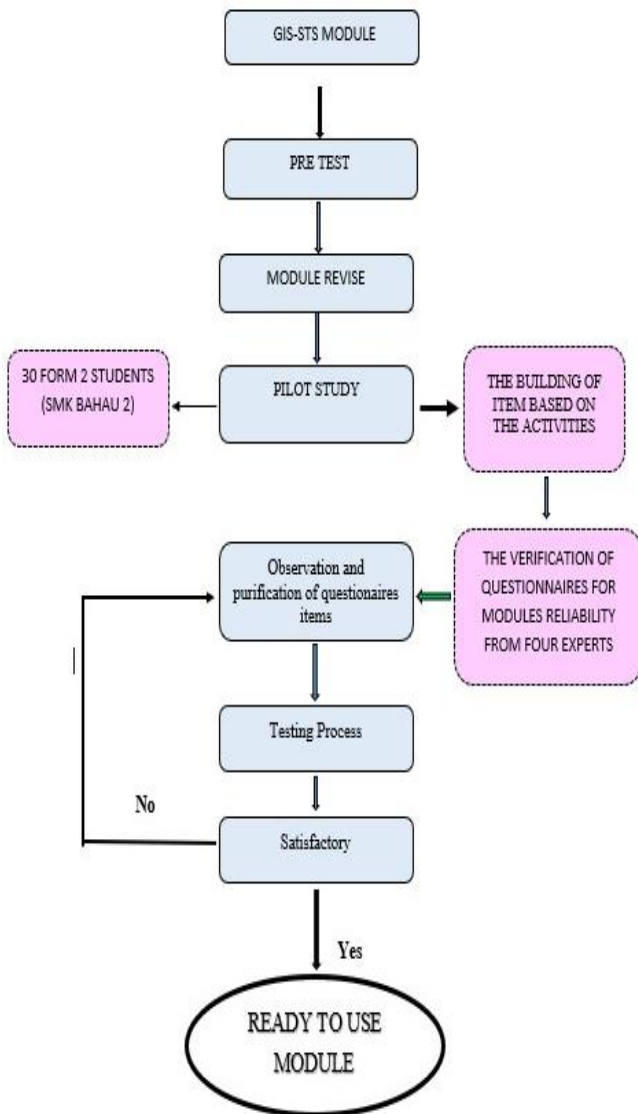


Fig. 1: Process of Assessing Reliability Coefficients in GIS-STs Module

IV. RESULTS AND DISCUSSION

A. Total Validity and Accuracy of Items in Questionnaire Form for the GIS-STs Module

All experts assigned have assessed the validity and accuracy of each item built by the consultants based on the module activities as suggested by previous researchers like [10], [11], [26], [27].

Table 4 displays the consensus and assessment of field experts on modules created by researchers. The results demonstrate that the minimum percentage attained is 83% for the Human Geography sub-module while the maximum percentage obtained is 92% for the Geography Skill sub-module which proves that the items in the questionnaire that have been created and are reliable and valid to be adopted for research purposes. Field experts also agree that all the items in the questionnaire form have acceptable accuracy after referring at the high validity value of more than 80%. Additionally, the general score obtained for all items is 87.1% above the 80% level hence resulting in the validity of the whole set of questionnaires is at an exceptional standard as proposed by [18]-[29].

Table 4: The validity of the GIS-STs module reliability questionnaire

No.	Sub Module	Percentage	Coefficient of Accuracy Validity of Module Questionnaires
1	Geography Skills	92%	.920
2	Physical Geography	84%	.840
3	Human Geography	83%	.830
4	Geography Area	89.1%	.894
	Total	87.1%	.871

C. Analysis of Validity and Accuracy of Items in Questionnaire Based on Module Activities

This questionnaire is composed of 40 items based on 13 activities in the study module. These items have been created by the researcher to secure the validity and accuracy of using the module to be submitted. All experts chosen made the right and accuracy of all these items based on the activities available in the proposed modules, too. Table 5 reflects the validity and accuracy of the items in the questionnaire based on the activities contained in the module. The findings prove that the coefficient of validity and accuracy of the items in the questionnaire is .92 which is beyond the minimum value of .60 based on [21] and exceeding .80 based on [18]. The findings proved that the curve distance measuring activity obtained the highest accuracy value of .95, too. Additionally, the lowest achievement value is the activity of recognizing climate diversity and its impact on human activity in Asia is .89. Then, based on the consensus of field experts it is also thought that the validity and accuracy of the modules are great and good.

Table 5: Reliability coefficients value for GIS-STs module by activity

No.	Activities	Percentage	Coefficient of Accuracy Validity for Module Questionnaires
1.	Measuring straight distance	90%	.900
2.	Measuring curved distance	95%	.950
3.	Measuring width	92%	.920
4.	Identifying East line and North line	93%	.930
5.	Identifying PGV and CLV	90%	.900

6.	Identifying Effects of Earth Rotation	93%	.930
7.	Identifying Occurrences of Four Seasons	93%	.930
8.	Identifying High Annual Rain Concentration	93%	.930
9.	Identifying Low Annual Rain Concentration	93%	.930
10.	Identifying Land Transport in Malaysia	93%	.930
11.	Identifying Air Transport in Malaysia	92%	.920
12.	Identifying Water Transport in Malaysia	91%	.910
13.	Identifying Climate Variation and Its Influence on Human Activities in Asia	89%	.890
	Total	92%	.920

*PGV (Physical Ground View)

*CLV (Culture Land View)

C. Findings of reliability coefficients of the GIS-STS module as a whole

The researchers have examined the reliability of this module in Form Two Geography L&F through a pilot study conducted. Assessment of module reliability based on all GIS-STS module learning activities completed on students using Cronbach alpha analysis (reliability coefficients). A total of 30 students have answered the module reliability questionnaire certified by those four experts. Table 6 demonstrates the holistic reliability coefficients of the sub-modules after the pilot study.

Table 6: Reliability value of the GIS-STS module based on sub-module

No.	Sub Modules	Percentage	Coefficient of Accuracy of the Reliability Questionnaire
1.	Geography Skill	89.3%	.893
2.	Physical Geography	85.3%	.853
3.	Human Geography	87.8%	.878
4.	Area Geography	85.6%	.856
	Total	87.3%	.873

Based on Table 4, all reliability coefficients score exceeds .80. This signifies that overall the reliability of the modules is good and satisfactory. The highest reliability coefficient value is .893 which is the Geography Skill sub-module. Furthermore, the lowest reliability coefficient value is .853, the Physical Geography sub-module. Then, the findings for

the overall reliability of the module are .873 which in turn shows that the GIS-STS Module is acceptable and reliable for the use of pupils of Form Two Geography.

D. Findings of reliability coefficients of GIS-STS module by activity

The GIS-STS module which has been used by 30 Form Two students in this pilot study exhibits high reliability coefficients. All students have answered 40 items in the questionnaire based on activity. Table 7 shows the value of reliability coefficient by activity.

Table 7 shows the value of reliability coefficient according to the activity obtained. All items obtained a coefficient value of more than .80, which means that the reliability of the module by activity is great. The highest value of reliability coefficient is .907 for curving distance measuring activity. While the lowest reliability coefficient value is .830, which is for the identification of the east and north lines and to identify the high average annual rainfall area. Additionally, the findings of the overall coefficient of reliability of the module based on the activity are .856 which thus shows that the activities contained in the GIS-STS Module are acceptable and reliable to be applied to Form Two Geography students.

Table 7: Reliability coefficients of GIS-STS module based on activities

No.	Activities	Percentage	Coefficient of Accuracy Validity for Module Questionnaires
1.	Measuring straight distance	90%	.900
2.	Measuring curved distance	90.7%	.907
3.	Measuring width	88%	.880
4.	Identifying East line and North line	83%	.830
5.	Identifying PGV dan CLV	93%	.930
6.	Identifying Effects of Earth Rotation	87%	.870
7.	Identifying Occurrences of Four Seasons	87%	.870
8.	Identifying High Annual Rain Concentration	83%	.830
9.	Identifying Low Annual Rain Concentration	84%	.840
10.	Identifying Land Transport in Malaysia	88.3%	.883



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11.	Identifying Air Transport in Malaysia	88.6%	.886
12.	Identifying Water Transport in Malaysia	86.6%	.866
13.	Identifying Climate Variation and Its Influence on Human Activities in Asia	85%	.850
	Total	85.6%	.856

E. Discussion

Based on the findings of this study, the GIS-STSS module obtained a high reliability coefficient value and all 13 activities that were assimilated into four sub-modules were accepted based on the acquisition of the group using this module in the pilot study. Reliability of each activity also scores above .80 and above (.83 to .90). According to [18], the score exceeds .80 value of coefficient of reliability is high. Reliability of this module is decided when the student can pursue the objectives of L&F and be able to follow all planned activities successfully. If students follow the activities in this module smoothly, it proves that the module is efficient and affects L&F [30]. As the results of the study all over the .80 value, it can be derived that the GIS-STSS module created has a high reliability coefficient value.

Besides, if comparisons were made on all GIS-STSS sub-modules, the results show that the Geography Skill sub-modules shows the highest value of module reliability coefficients of .893, followed by the Human Geography sub-modules; .878. The lowest reliability coefficient value is the Physics Geography sub-module of .853. Furthermore, these values have also go beyond the scores raised by researchers [25], [27], [41], [29].

Based on the value of the reliability coefficient obtained from this pilot study of .873 it can be explained that the GIS-STSS module is acceptable and reliable as it can be adopted in actual experimental studies to be completed later. Processes in obtaining this reliability value are also implemented in line with what previous researchers have conducted on their review modules such as [15], [16], [43], [11].

Further, the GIS-STSS Module can also be regarded as a complete module as it has undergone pilot studies to decide validity and reliability. According to [42], a quality and complete module can be identified after the validity of the content from experts and module reliability through pilot studies are being assessed. Through this study, it can be comprehended too, that reliability evaluation of the module is a process that required to be done in building a module in education. While the evaluation process is complex and takes a long time, the results of the suggestions, feedback and improvements from experts and respondents can enhance the quality of a module to be created and thus contribute to the effectiveness of a developed module.

V. CONCLUSION

Generally, this study has all the steps taken into consideration in order to determine the reliability of the

GIS-STSS module implemented. In this study, the researcher sought for advice from four field experts to test and validate the accuracy of each item developed by the researcher before the questionnaire was apportioned to respondents. The assessment results from four field experts, the value of the validity and reliability coefficients of the developed items are 0.92. Likewise, the findings from the pilot study completed by the reliability coefficient of the module are 0.873. The findings prove that the reliability coefficients of the modules are at a high level and hopefully this module can be adopted for actual experiments to be carried out later. The module is likely to be used as an effective L&F material specially to boost the thinking skills in space thus gauging more students to Geography subjects.

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