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The Development of Android and Web-based Logical Thinking Measurement Tools as an Alternative Solution for Research Instruments

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Abstract. This type of research is a development research or it is known by the term of Research and Development (R & D). The focus of this research is to develop a logical reasoning ability measurement tool based on qualified Web and Android as a research instrument alternative solution. The implementation of this research is conducted on Statistics Department in the Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar. The subject of the study in question is the students of Statistics Department of Universitas Negeri Makassar. Measurement tool that will be developed is a Test of Logical Thinking (TOLT). The development of this information system using PHP programming language based on CodeIgniter Framework with MySQL database.

1. Introduction

The development of science and technology affects the teenagers' perspective to use internet as the main goal. This development also changes the paradigm of learning in education world. UNESCO (2016) in its website said that the Information and Communication Technology (ICT) can contribute to the freedom of access to education, equality in education, the delivery of quality learning and teaching, professional development of teachers and more efficient education management, governance and administration. Sirozi [1] says that according to UNESCO, the educational institutions are not only required to encourage students to learn, but also required to encourage students learning to acquire knowledge, to promote learning activities act, learning to live together, and learning for life, with the lifelong learning paradigm [2].

Mathematics is one of the knowledge which has a basic abstract object, which based on consistency truth and arranged in a hierarchical manner and in accordance with the rules of logical reasoning. Mathematics as a science with deductive reasoning that relies on logic in convincing the truth of an argument [3]. In mathematics learning, the ability to think logically has an important role in understanding to solve math problems. Understanding the concept which is not supported by logical thinking ability will result in students have a good intuition about a concept but are unable to complete a problem [4]. Thinking logically is a process of thinking consistently as an effort to obtain a conclusion. In some discussion about the term logical thinking [5] are often interchangeable with the term logical reasoning, because both contain some common activities [6][7]. Actually, the term logical



thinking [8] has a broader scope than logical reasoning. Logical thinking includes logical reasoning and other mathematical activities: understanding, connection, communication, and logical problem solving [9].

The regulation of the Minister of National Education Republic of Indonesia Number 23 in 2006, said that one of standard competences of graduates for primary and secondary education unit is to demonstrate the ability to think logically, critically, and creatively. Logical thinking ability is the ability to be expected as one of the capabilities that need to be owned and developed by graduates of elementary and secondary education units. Logical thinking ability is also a very important ability to support the development of science and math learning. This is supported by studies that connect the ability to think logically with other variables. Sumarmo [9], states that there is no association between logical thinking ability and creative thinking ability, and between the logical thinking ability and creative thinking ability, as well as between the three abilities and the disposition of mathematical thinking, however there is an association between the logical thinking ability and the critical thinking ability. Swestyani [10] stated that the implementation of the discovery learning can improve the logical thinking ability. Fitriana research [11] shows that ability to think logically in mathematics is in medium category and mathematics learning outcomes is in medium category, so the ability to think logically has insignificant direct effect to learning outcomes with a 52% confidence level. From the above discussion, it encourages the researcher to develop a web-based and android measurement tool to measure the logical thinking ability.

2. Research Method

The model used in this research is the Research and Development (R & D) approach model [12]. The research instrument used in this research is an instrument of Test of Logical Thinking (TOLT). The research was carried out on Statistics Department in Faculty of Mathematics and Natural Sciences, State University of Makassar. The research subjects in question are students of Statistics Department batch III. The purpose of this research is to develop a qualified web-based and android logical thinking ability measurement tool and it is hoped with this measurement tool, the researchers will examine the logical thinking ability by using this tool as their instrument of the research.

3. Result and Discussion

3.1. Needs Analysis

From the observations that have been made, the needs of the Logical Thinking Ability research instrument (TOLT) is important. The difficulty in obtaining this instrument becomes one of the reasons that make the needs for this instrument becomes important. In addition, with this instrument, so the cost of research implementation related to TOLT no longer requires printing costs of TOLT test instrument.

3.2. Design

3.2.1. Database. Corresponding with the analysis that has been done, so the database implementations are as follows:

a. Login Table

This table contains the application users. Table login is an early stage in the manufacturing process of an information system. Making the log table is important for keeping the system more secure. Making the log table is also one of the ways that data abused people who are not responsible. This login table is used as a system user authentication.

Name	Type	Collation	Attributes	Null	Default	Extra
id	int(10)			No	None	AUTO_INCREMENT
username	varchar(15)	latin1_swedish_ci		Yes	NULL	
password	varchar(15)	latin1_swedish_ci		Yes	NULL	
nama	varchar(40)	latin1_swedish_ci		Yes	NULL	
status	int(1)			Yes	NULL	

Figure 1. Login Table

b. TOLT Table

TOLT table is a table that manages logical thinking ability test results obtained from the application. The data result of this TOLT table is used to calculate the recap questions' score on TOLT. From this recap score is then obtained the results about the level of logical thinking ability of the user.

Name	Type	Collation	Attributes	Null	Default	Extra
id	int(10)			No	None	AUTO_INCREMENT
nim	varchar(20)	latin1_swedish_ci		Yes	NULL	
nomor1	int(1)			Yes	NULL	
nomor1a	int(1)			Yes	NULL	
nomor2	int(1)			Yes	NULL	
nomor2a	int(1)			Yes	NULL	
nomor3	int(1)			Yes	NULL	
nomor3a	int(1)			Yes	NULL	
nomor4	int(1)			Yes	NULL	
nomor4a	int(1)			Yes	NULL	
nomor5	int(1)			Yes	NULL	
nomor5a	int(1)			Yes	NULL	
nomor6	int(1)			Yes	NULL	
nomor6a	int(1)			Yes	NULL	
nomor7	int(1)			Yes	NULL	
nomor7a	int(1)			Yes	NULL	
nomor8	int(1)			Yes	NULL	
nomor8a	int(1)			Yes	NULL	
nomor9	tinytext	latin1_swedish_ci		Yes	NULL	
nomor10	tinytext	latin1_swedish_ci		Yes	NULL	
status	int(1)			Yes	0	

Figure 2. TOLT Table

c. Log Table

Log table is a table that contains the user logs e.g., user access, access time, and IP information that is used to access. The logging process is the process of recording all user activities in the information system. The process of irregularities in the system can be checked through the system log, for example there are users who make changes to data on information systems.

Name	Type	Collation	Attributes	Null	Default	Extra
id	int(10)			No	None	AUTO_INCREMENT
tanggal	varchar(20)	latin1_swedish_ci		Yes	NULL	
nim	varchar(20)	latin1_swedish_ci		Yes	NULL	
ip	varchar(20)	latin1_swedish_ci		Yes	NULL	

Figure 3. Log Table

3.2.2. User Interface

a. Main page

This section contains the initial information regarding TOLT test, e.g. what is TOLT.

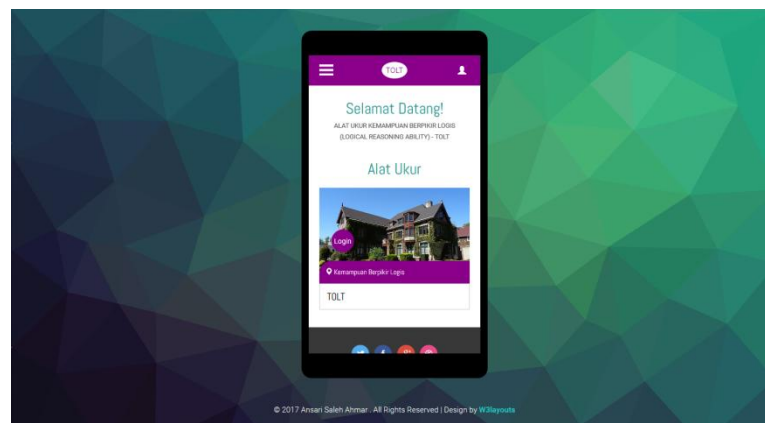


Figure 4. The Picture of Mobile Version Main Page

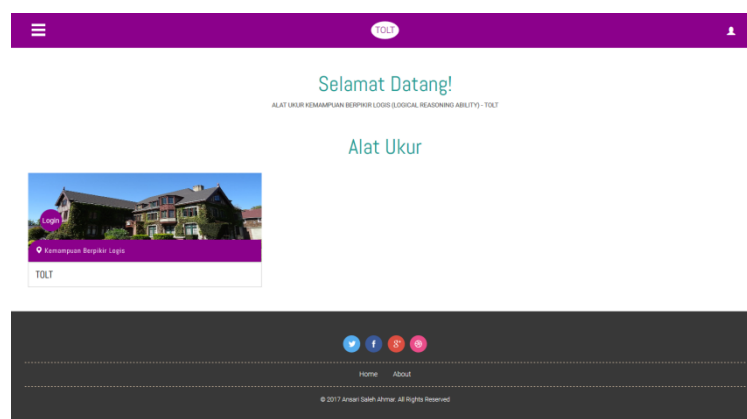


Figure 5. The Picture of Web Version Main Page

b. Login page

This section is login section for the participants so that they can access the TOLT test. The implementation of this login page is to privatize data existing in the system so that it cannot be accessed by unauthorized person.

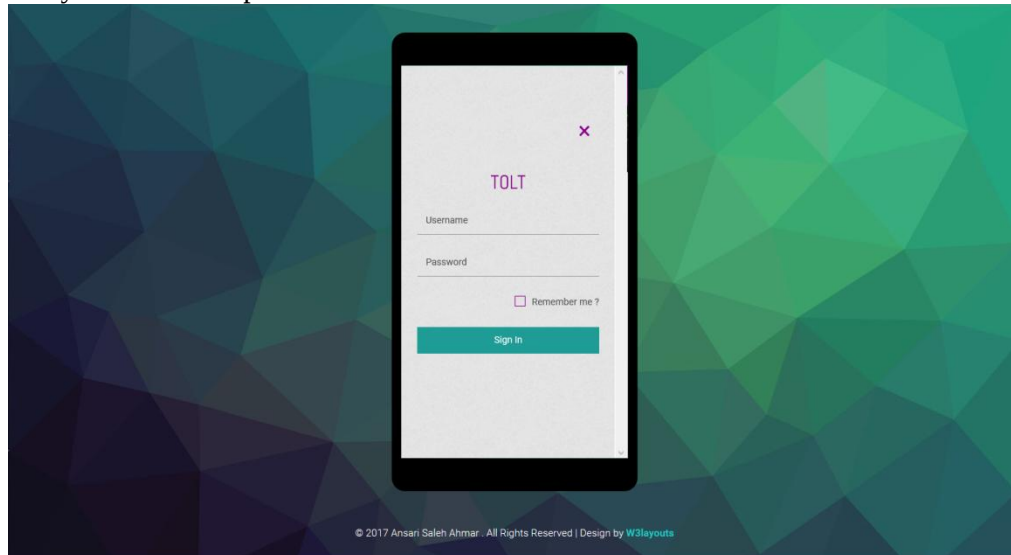


Figure 6. Mobile Version Login page image

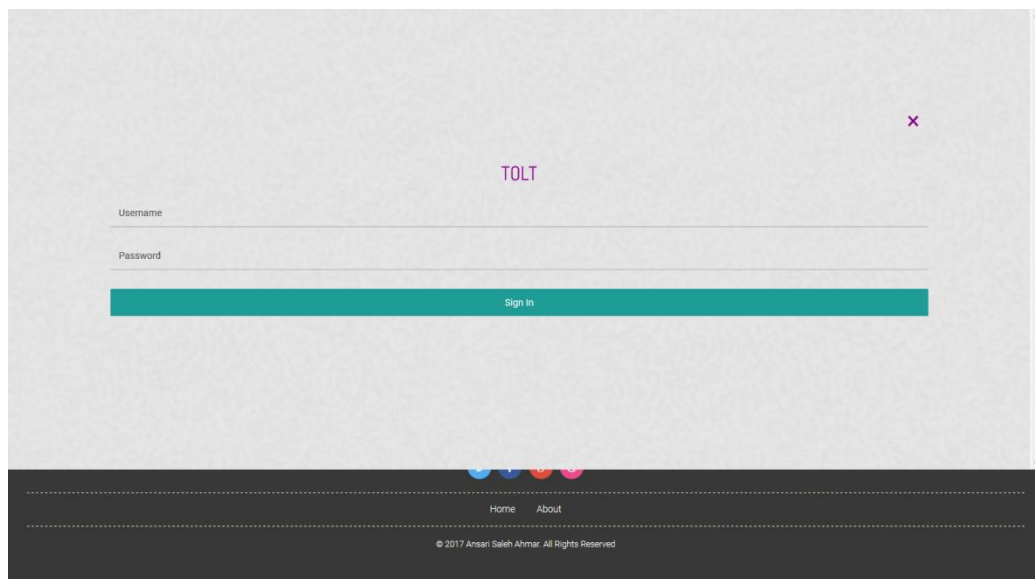


Figure 7. Web Version Login page image

c. Test page

This section is related to the TOLT test page. In this section, examinees will be presented with questions related to TOLT. This page can be accessed if the participant has a username and password to login.

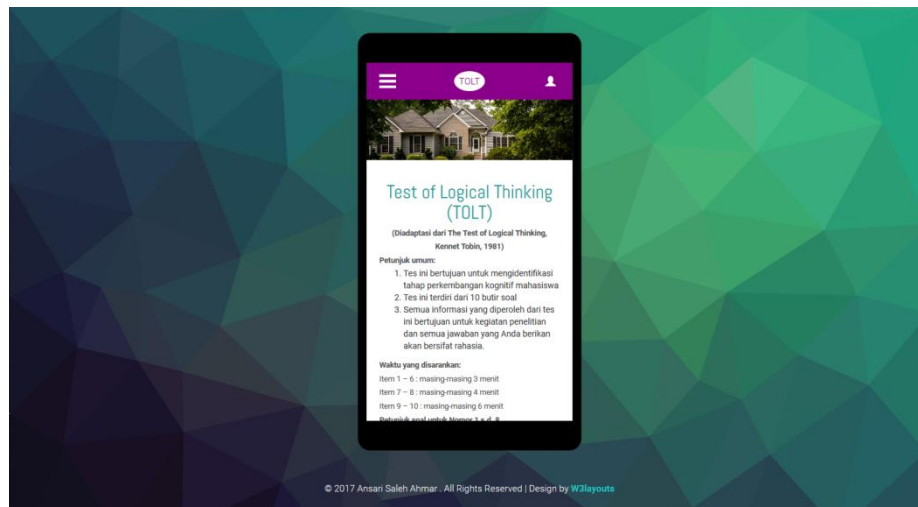


Figure 8. Mobile Version Test Page Image

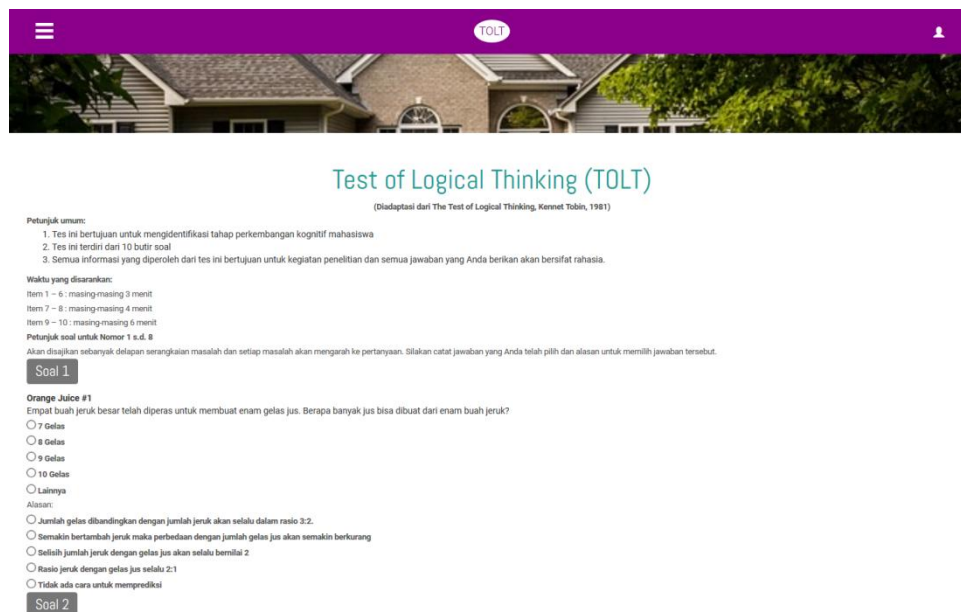


Figure 9. Web Version Test Page Image

3.2.3. *Testing Function.* Here are the function test results to know the system has already run as planned.

Table 1. Function Testing

No	Function	Yes	No
1	Login		
	Login in accordance with Username, Password, and status	v	
2	Test		
	The questions are readable	v	
	User Friendly System	v	

3.3. Discussion

The design and development of a web and android-based logical thinking ability measuring tool (logical reasoning ability) which has been done in the previous stage of the requirement analysis phase and design data phase provide results that can be said good because testing the functions of the website features have been done and everything works well.

4. Conclusion

Based on the results of data analysis research in the previous chapter, the conclusion of the results of this study is that the web and android-based logical thinking ability measurement tool (logical reasoning ability) is user friendly and reduce printing costs.

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