Measuring Public Knowledge of Science and Technology In Indonesia

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ABSTRACT

In the era of knowledge economy, nowadays the community does not only serve as a user of science and technology but also play a role in monitoring and evaluating the science and technology policies. In order to play its role, the community needs to have a good knowledge of science and technology. Therefore, this paper measures the Indonesian people's knowledge of science and technology. Measurements were performed by applying a classical test theory that comes with the classification level of knowledge. Measurements were made using the data of the Public Perception of Science and Technology Survey (Indonesia) - 2014. Classical test theory is applied to obtain the proportion of people knowing the issues of science and technology. Furthermore, based on the proportion, the level of public knowledge is classified. The final step is measuring knowledge to identify which society that understands science and technology issues properly. The measurement results show that communitie's knowledge of the science and technology in Indonesia is still relatively lacking. When viewed by the issue of science and technology, the Indonesian people have a high knowledge on the issue of terrorism, e-commerce, and formalin. Meanwhile, the Indonesian people have a low knowledge on the issue of currency redenomination and depreciation. Findings of this study can be used as a guide for increasing public knowledge of science and technology in Indonesia.

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1.   Introduction

In the era knowledge economy, it is believed that science and technology (S&T) to be one of key factors of economy growth. Scientific advances and technological change are important drivers of recent economic performance. In recent years, multi factor productivity (MFP) has increased in several OECD countries reflecting greating efficiency in the use of labour and capital (OECD (2000)). MFP growth is generally due to improved managerial practices, organisational change and, most important, to smarter and more innovative ways of producing goods and services. Remarkable improvement in the industrial and economy growth of South Korea was also evident driven by innovation resulting from increasing in S&T (Chung and Shungcul (2009)). China's economic success in the past three decades was also driven by S&T. Due to resource constraints as well as raising costs, Chinas policy makers are steering the economy towards an alternative growth model in which knowledge and technology play key role (Wu and Yarui (2010)).

In addition to the role of economic growth, S&T was recognized as basic development of modern society. S&T provide people with knowledge and tools to understand and address many of the challenges. It affects all aspect of life that can make it better. S&T can be implemented both at practice level as well as intelectual level (MOSTI (2012)). On practical basis, our knowledge of science and technology enables us to use the complex gadgets and things around us more effectively, for example is the use of computer, phones, televisions, radios, electricity, vehicles, robots and more. At intellectual level, a good understanding of S&T enables to understand complex issues that society faces and so enables us to fully participate in making better decisions for themselves as well as for the country.

In America, people implement S&T in all aspect of their life, including work, leisure, family, and civic activities (NSF (2012)). In the workforce, Americans use technology to improve productivity in ways that could not have been imagined a generation ago, applying recently invented tools and applications. In their leisure time, they entertain themselves with high technology electronic products and make friends, communicate, and stay informed about the world through the Internet and social media. As citizens, they may engage in discussions on climate change, stem cell research, and nuclear power-issues about which atmospheric scientists, microbiologists, and nuclear engineers have for-

mal training and expertise-or benefit from advances in new technologies. Nowadays, in the development of S&T in a country, society became one of the parties beside government and the legislature. Society as a user of S&T, now also started to play a role in monitoring and evaluating the S&T policy. In order to carry out both roles, the community needs to have knowledge and a good understanding of S&T. It becomes important in encouraging the development of S&T in order to accelerate the growth of the national economy. Therefore, it is necessary to overview the public perception of S&T, including public knowledge of S&T.

In Indonesia, Survey on Public Perception of Science and Technology has also been carried out by Center for Science and Technology Development Studies (PAPPIPTEK) LIPI in 2008 (Nani et al. (2008)). In 2014, a survey was conducted again to update the data in the previous survey. After six years it is believed that there has been a shift in the public perception of science and technology. Based on the data from Survey on Public Perception of Science and Technology in 2014, this study could measure the Indonesian knowledge of S&T.

2. Methodology

This study uses secondary data sources derived from the 2014 Indonesian Public Perception of Science and Technology Survey conducted by Center for Science and Technology Development Studies - Indonesian Institute of Sciences (PAPPIPTEK-LIPI). Public Perception Survey of Science and Technology in 2014 was conducted in ten regions in Indonesia including Jakarta, Surabaya, Bandung, Medan, Makassar, Denpasar, Balikpapan, Yogyakarta, Ambon and Batam. This study was conducted from January - December 2014.

The population in this study are residents aged over 15 years and have minimum education of the high school level. The sample in this study are residents aged over 15 years, minimum education was the school at the high school level and residing in the selected region. Sampling design used in this research is the proportionate stratified random sampling. Strata used in this sampling is the classification town (population and function of the city). Total respondents were successfully collected in this survey as many as 2,012 respondents. However, only 1,829 respondents were declared valid and may be used in the analysis process.

2.1 Method to Measure Public Knowledge

The Indonesian people's knowledge of science and technology were identified in two ways. First, knowledge assessed based on objective public knowledge of science and technology issues. Secondly, the public knowledge of science and technology are identified based on their understanding of science and technology issues.

2.2 Knowledge assessed based on objective public knowledge of science and technology issues

An objective knowledge measurement can be done through a questionnaire (for example: test) using a series of true/false questions, multiple choice or other types of questions. In this study, objective public knowledge of science and technology issues is measured using true/false questions. Public was requested to provide an true/false answer to the statements on 18 issues related to science and technology. A list of statements that are used to measure objective public knowledge on the issue of science and technology can be seen in Table 1.

The first stage is conducted to measure public knowledge that is to calculate the number and proportion/percentage of correct answers given statements. Classical test theory approach was used to calculate the percentage (%) of the correct answer. The measurement of knowledge via standardized tests is a well-developed sub-discipline of education and psychology, dating back to the early part of the last century (Ekstrom, 1973; Hambleton & Zaal, 1991; Spearman, 1904). The basic paradigm can be viewed as a translation of an objective body of knowledge into a set of propositions whose truth or falsity are known. A representative sample of these propositions is presented to persons ("subjects ") in the form of a questionnaire (i.e., a test) consisting of a series of true/false, multiple choice or other questions.

The results of administering such a test to a set of subjects can be represented as a response matrix X whose rows correspond to subjects (respondents) and whose columns correspond to test items, and where the cell xij gives the response of subject i to question j. In addition, there is a row vector Y representing the answer key, with cell yj indicating the correct answer for item j. To evaluate a subject's performance, we need only to measure the similarity between their row of X and the answer key Y. The natural measure of similarity is the simple matching coefficient, mi, which, for any given subject i, counts the proportion of times that $x_{ij} = y_{ij}$ for all questions j.

Table 1: List of statements used to measure objective public understanding of science and technology

Science & Technology Area	Statements
Information & Technology	Facebook is a social network where users can communicate with friends and other users through private or public messages and features of chat
Information & Technology	Plowing the web site is one of the cases of cyber crimes that happened in Indonesia
Environment	The use of gas fuel can reduce air pollution
Health	Immunization against of a disease will provide immunity or resistance to all kinds of diseases
Health	Antibiotics can kill the virus
Defense and Security	Special Detachment 88 (Densus 88) is a special unit of the National Police for the prevention terrorism in Indonesia
Environment	Increasing global temperature will cause a drop in sea level
Transportation	Fuel electric cars is BBG
Defense and Security	Currently, often happens border conflict between Indonesia and Thailand
Food	Formalin easily obtained in the free market with cheap prices, but not allowed to be added into food stuffs or used as a food preservative
Food	Use yeast to develop bread an event in the development of biotechnology
Transportation	MRT is a mode of transport that is able to carrying passengers in large quantities (bulk) with frequency and very high speed (rapid)
Economics and Business	Online shopping allows both buyers and sellers to not directly face to face
Economics and Business	Currency redenomination is a nominal cutting is done on a currency by reducing the amount of value
Education	E-learning is a new way of teaching and learning using electronic media, especially the Internet as a learning system
Social and Humanitarian	Early warning system (EWS) is an early warning system against disasters
Education	Thematic curriculum applied using an interdisciplinary curriculum approach
Economics and Business	Depreciation occurs when there is an increase in the value of the rupiah against foreign currencies

After knowing the percentage of correct answers of an individual public, the next step to do is to categorize the level of public knowledge based on the percentage of correct answers. The stages that are used to obtain the level of knowledge on the science and technology can be seen in Figure 1.
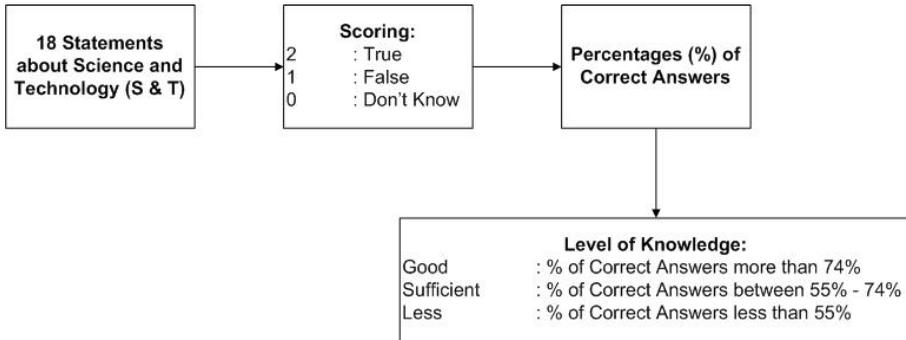

Figure 1: Stages to obtain the level of knowledge on the science and technology

2.3 Public knowledge of the science and technology are identified based on their understanding of science and technology issues
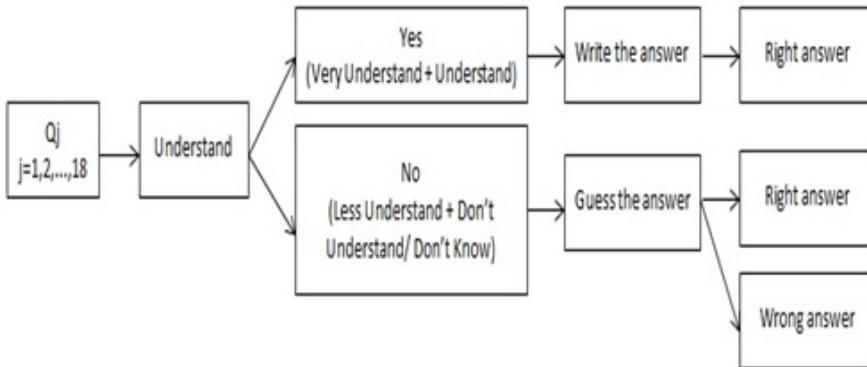
Figure 2: Stages to obtain respondents who understand and answer correctly on science and technology issues

Test theory usually distinguishes between the performance of a subject, m_i (defined as the proportion correct), and the knowledge of a subject, di (defined

as the proportion of the material that the person knows). The assumption is that a person's score on a test is not exactly the same as their knowledge for two reasons. First, the questions asked on the test are a sample of the set of all propositions possible, and by chance alone the sample chosen could include a preponderance of questions to which the subject happens to know the answers. Second, in a true/false or multiple-choice test, the respondent may guess the right answer without knowing it.

3.   Result and Discussion

3.1   Characteristics of people in Indonesia

The result Survey on Public Perception of Science and Technology in 2014 show that the people who succeeded in surveys in Indonesia, the percentage of people who are female and males tend to be balanced among females (51%) and men (49%).
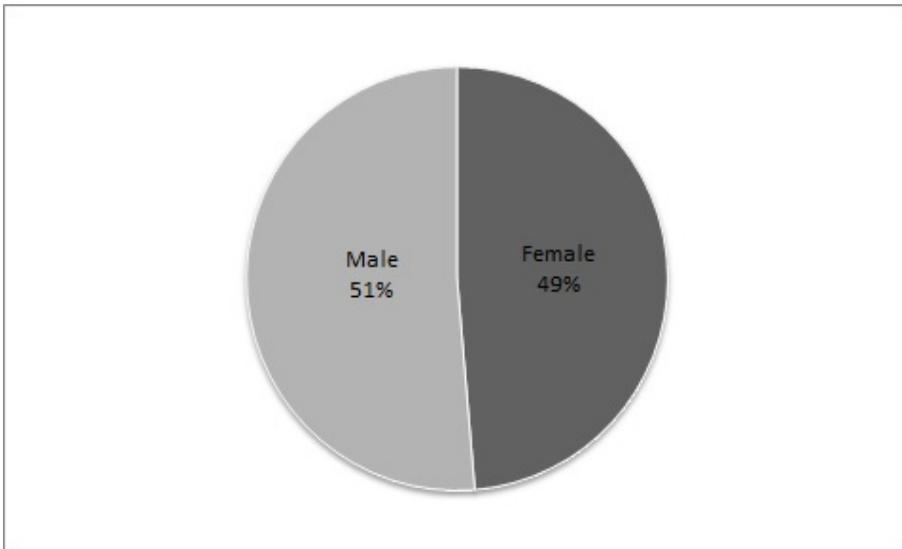

Figure 3: Indonesian people distribution based on gender

The education level of respondents in this research were grouped into four categories, which is senior high school, diploma, Bachelor, Master and PhD. When people are classified by level of education, the majority of people have a high school education level (59%). Only 2% of the people educated Master
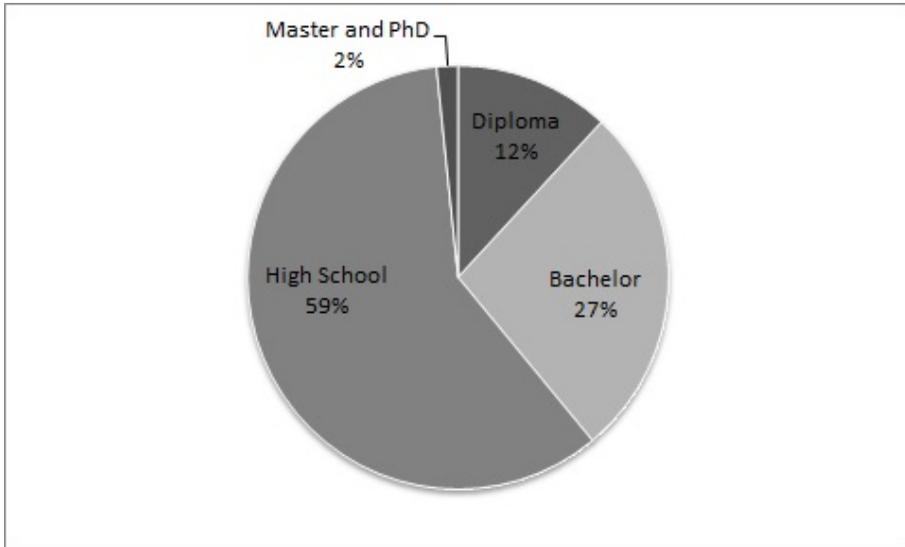
and PhD (Figure 4).

Figure 4: Indonesian people distribution based on education level

In this research respondents profession were divided into four categories. The first category is a student or college student. The second category is employee. Residents are included in this category is the population status as civil servants, police / ABRI / TNI, private employees, and entrepreneurs. The third category is student or college student. The fourth category is the other. This type of work is included in the other categories are retirees, people who do not work, and have other jobs outside of the first category. The result Survey on Public Perception of science and technology in 2014 show that the majority of people in the survey are the workers (64%). The lowest number of respondents came from other job categories 9% (Figure 5).

3.2 Knowledge assessed based on objective public knowledge of science and technology issues

Objective understanding of science and technology issues become one indication of the public′s knowledge of science and technology. Objective understanding identified through community accuracy in answering any statements related to science and technology issues. Science and technology issues are asked to identify the objective knowledge of the science and technology com-
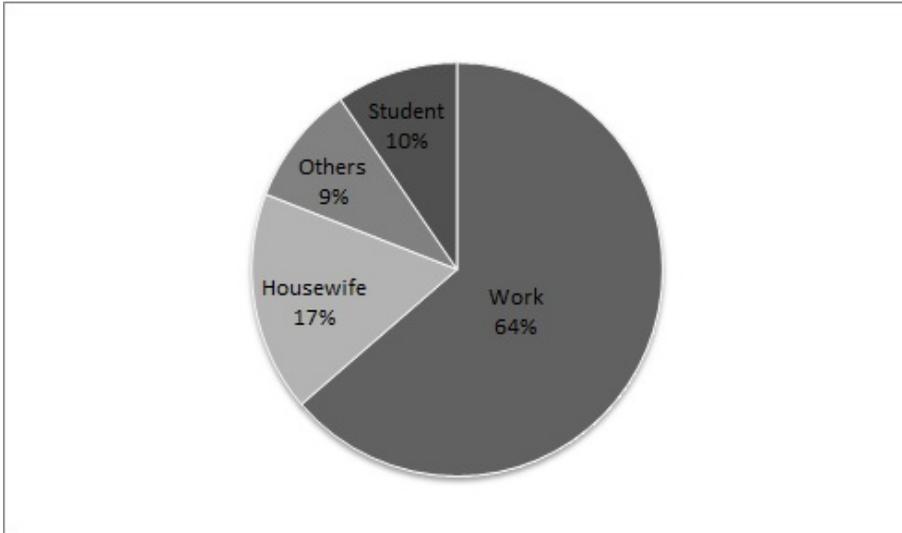
Figure 5: Indonesian People Distribution based on Profession

munity covers several areas such as ICT, economics and business, defense and security, food, energy, education, transportation, and environment.

In general the objective understanding of science and technology issues are shown in Figure 6. The figure shows that people really understand the issues of science and technology related to social media Facebook, Detachment 88 and the terrorists, and formalin. Almost all of the public (95%) answered correctly the statement related with social media (Facebook). Meanwhile, the people who answered correctly the statement related with terorism and formalin are 88%.

Many people who know social media associated with the currently booming use social media as a means of communication and dissemination via the Internet worldwide. In early 2015, the market research firm eMarketer presented a report about the Facebook users who access through mobile phones worldwide. According to the report, the number of users who access Facebook through a mobile phone will reach nearly one billion in 2015. This figure has increased significantly from last year to reach 860 million users worldwide.

Interestingly, of the many countries that increased penetration of users accessing Facebook through a mobile phone, Indonesia became the most highlighted. Based on the existing data in the eMarketer report on January 2015,
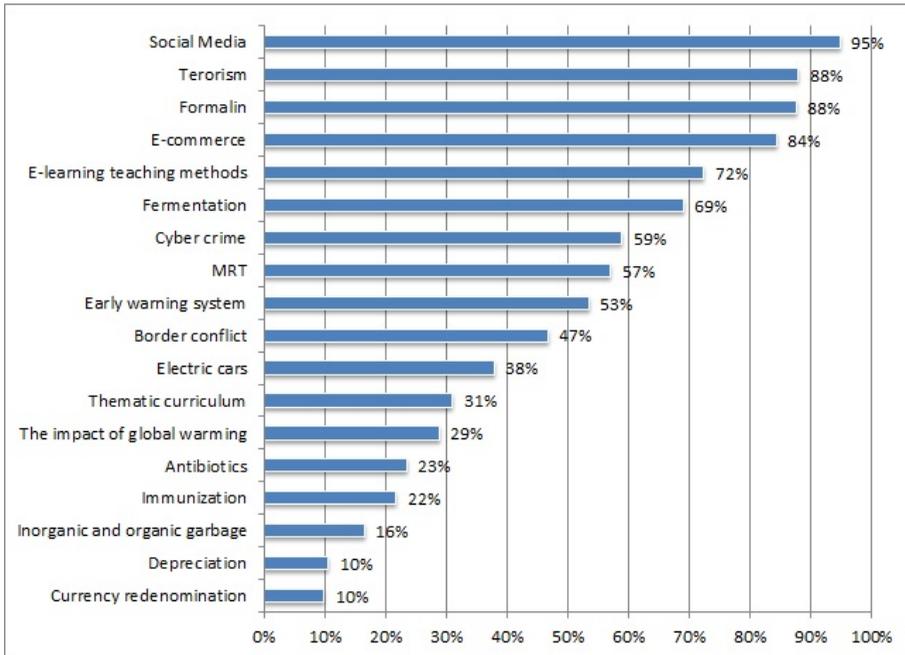
Figure 6: Objective understanding of science and technology issues

Indonesia is still ranked third in the world with the highest number of Facebook users in the world, behind the United States and India. However, this island nation has a penetration of Facebook users via mobile phone in the world's highest, reaching 88.1 percent in 2014 and will rise to 92.4 percent, equivalent to 62.6 million people this year.

Meanwhile, the Indonesian people's knowledge related to terrorism and formalin encouraged the proliferation of media in Indonesia to discuss the two topics. The number of cases of terrorism and abuse of formalin and the high commitment of Indonesian law enforcement to combat cause the media very often picked it up as news. Figure 6 also shows that there are still many people who do not really understand the issues of science and technology. In addition, these images show that most people do not really understand (not the right answer and do not know) about the organic and inorganic waste; depreciation; and currency redenomination. Most people also do not really understand about the effects of global warming; immunization; antibiotics. It is shown that most people give the wrong answers on all three issues related statements.

A possible reason to explain why many people in Jakarta did not answer this statement as true because certain issues are more specific and requires a deeper understanding of the issue of science and technology in a specific field. Meanwhile, the people who answered correctly to the issues of science and technology is probably the people who have the knowledge, attention, and interest in science and technology are high, especially for people who have a high level of education.

In this study, respondents were asked to answer true / false statements on 18 issues related to science and technology. Based on the respondents answers, the number and percentage of correct answers of the given statements were calculated. Furthermore, based on the percentage of the correct answers, calculations was done to determine the level of public knowledge on science and technology. The level of public knowledge on science and technology are grouped into three categories: less, quite and good. The category is based on the percentage of correct answers to all the statements. Public understanding was categorized as less if the answer was not more than 55%, sufficient if the correct answer category between 55% - 74%, and considered good if the correct answer is more than 74%.

In general, the people of Indonesia have an average percentage that is 50% of correct answers related to the issue of science and technology (Table 2).

Table 2: Percentage of correct answers in Indonesian society related to the issue of science and technology

Minimum	Maximum	Average	St. Deviation
0%	89%	50%	17%

Indonesia people have an average of less knowledge towards science and technology. This is indicated by a score of knowledge of the Indonesian people as 50%.

The fact that the percentage of correct answers to specific statements relating to issues of science and technology is still low indicating that the level of public knowledge are also still lacking. This suggests that there′s a need to improve people′s knowledge and understanding of science and technology. Good beginnings to stimulate interest in science and technology can be carried out among children at an early age, for example through interactive programs related to science and technology, national and international competitions in the field of science and technology, as well as providing amusement park or family entertainment center that combines with learning about science and technology. It is hoped that in this way, the public, especially the children will gain

knowledge and understanding of science and technology from an early age.

In this study, respondents' knowledge is also classified by the type of city. Classification of the city based on the number of inhabitants. In this case there are five types of cities, small cities, medium cities, big cities, metropolitan and mega cities. Results of classification of types of cities is based on population that show Indonesia consists of three types of cities namely big cities, metropolitan and mega. In the Public Perception Survey on Science and Technology in 2014, the city of Denpasar, Balikpapan, Yogyakarta, Ambon, and Batam chosen as the area that represents the large cities in Indonesia. Meanwhile, the city which represents the metropolitan cities of Surabaya, Bandung, Medan, and Makassar. Jakarta representing the mega cities in Indonesia.

When classified by the type of city, community knowledge on the calculation based on the type of cities shows that people in the mega city, metropolitan and large cities have an average value of knowledge that is not much different to each other. As shown, there is 51% in large cities, 50% in mega cities, and 49% in metropolitan cities Figure 7. That is, people in the three cities that belong to the group of people who have less ($< 55\%$) knowledge of the science and technology.
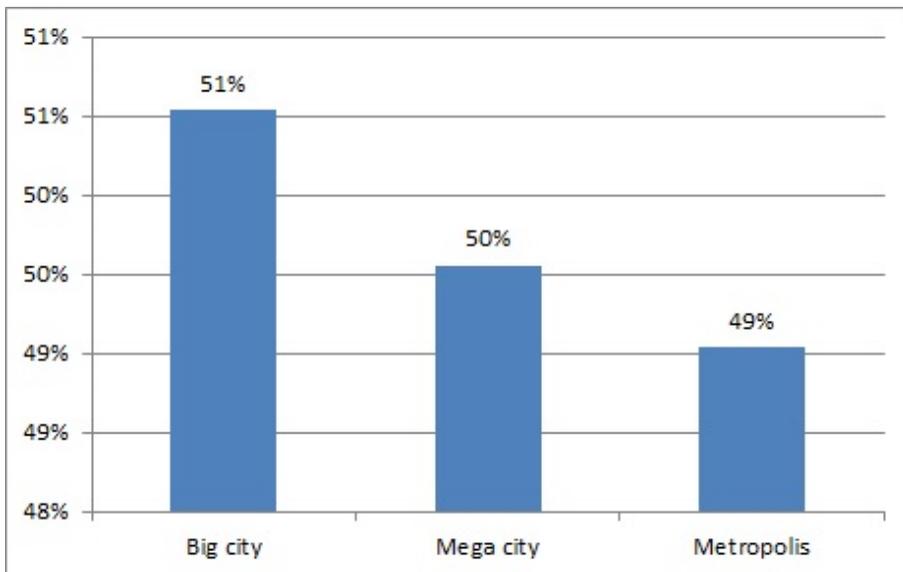

Figure 7: Level of public knowledge of science and technology based on the type of cities

3.3 Public knowledge of the science and technology are identified based on their understanding of science and technology issues

Subjective public understanding of science and technology issues are shown Figure 8. The figure shows that the issue of science and technology that most widely understood by the public is a social media; organic and inorganic garbage; and immunization. More than 70% of people understand the science and technology of the three issues. While science and technology issues of the least understood public is thematic curriculum. Not more than 20% were aware of the thematic curriculum.
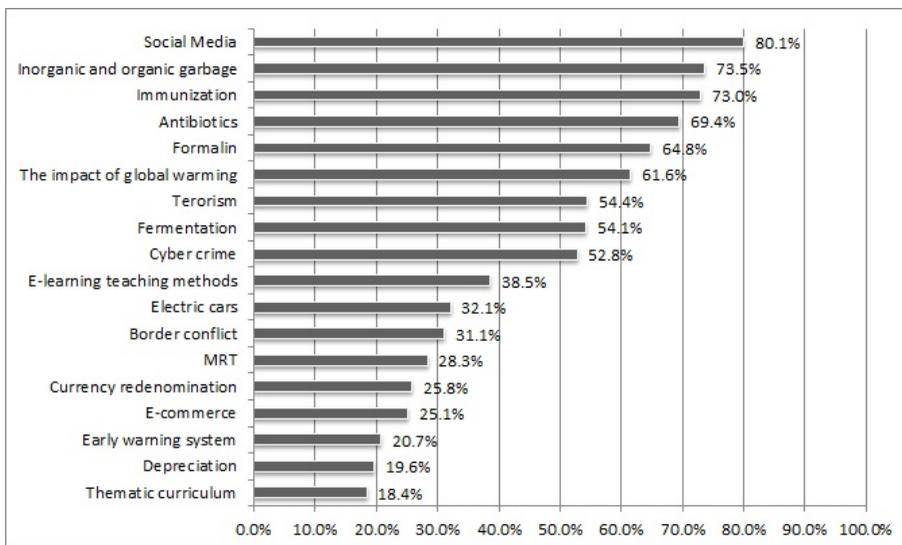

Figure 8: Level of public knowledge of science and technology based on the type of cities

The next steps to be carried out after finding out people's understanding of science and technology issues are measuring whether people who have understood and understood very well on these issues can answer correctly the statements related to issues of science and technology. People who understand and can answer the statements related to science and technology issues correctly can be seen in Figure 9.

Figure 9 also shows that there are still many people who do not really understand the issues of science and technology. It is shown from the many people who claim to understand the issues of science and technology, but can
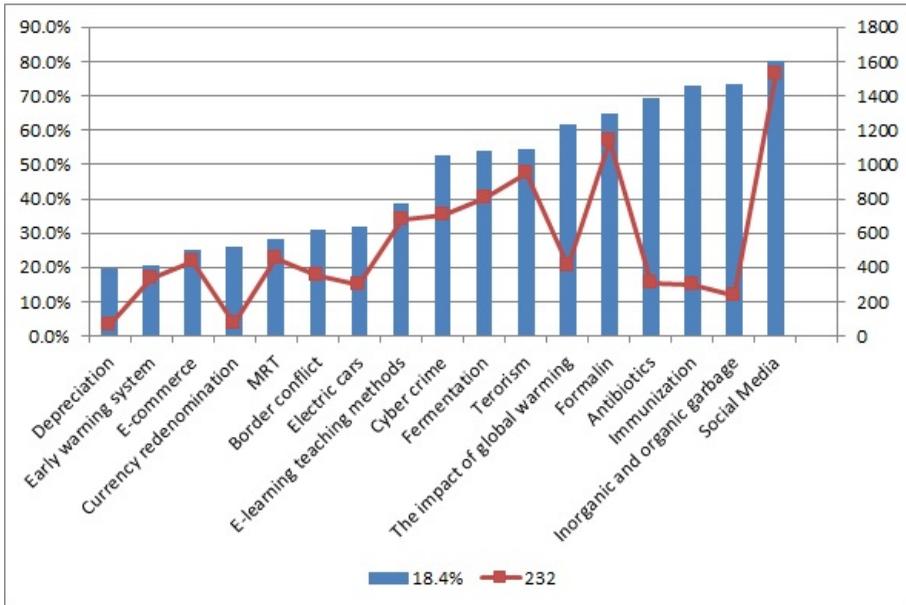
Figure 9: People who understand and can answer the statements related to science and technology issues correctly

not answer correctly when given a statement relating to these issues.

4. Conclusion

Based on the research done, it can be concluded that the majority of Indonesian people still have limited knowledge of science and technology, particularly in the specific issues related to science and technology. Indonesian society has a real understanding on science and technology issues related to social media Facebook, Detachment 88 and terorism, and formalin. Most of the Indonesian people do not really understand about organic and inorganic waste; depreciation; and currency redenomination. In addition, objective public understanding towards the issue of science and technology shows that there are still many people who do not really understand the issues of science and technology. It is shown from the many people who claim to understand the issues of science and technology, but cannot answer correctly when given a statement relating to these issues.

5.   Acknowledgment

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