

NANOTECHNOLOGY ACCEPTANCE: A CASE STUDY OF UNIVERSITY STUDENTS IN MALAYSIA

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Abstract-The concepts of nanotechnology were initiated and first discussed in 1959 by renowned physicist Richard Feynman. Nanotechnology has then become a new wave of technology which is speculated to replace most of current technology. It is due to nanotechnology new products for future lifestyle with high efficiency, high speed and environmental friendly services. Market researchers are predicting the world market volume of nano-optimised products to be up to 3 trillion US Dollars in 2020. This would correspond to about 15 percent of the entire global production of goods. Even though nanotechnology offers many benefits to the future technology, it may lead to few social issues which are still under debate especially about the safety, environment, health and misuse. In order to establish nanotechnology awareness and acceptance, the assessment from the society is an important factor to be discussed. In this paper, a feedback on nanotechnology from a group of undergraduate business students in Universiti Teknologi MARA is presented. The level of awareness has been divided into five categories which are no feeling, alarmed, concerned, hopeful and exited. The highest percentage of frequency of awareness is in the concerned level, by which possible side effects and usage safety are the critical issues raised. In addition, the analyses capture the characteristics which potential consumers of nanotechnology products based feel very important. Based on the awareness and perceived usefulness score, Model of Nanotechnology Acceptance for nanotechnology research and initiatives is proposed. The model would serve as a foundation for determining the best approach of creating better awareness and offering nanotechnology products without violating the sustainability requirements of the environment, society and economy.

Keyword - nanotechnology, awareness, assessment, nanotechnology acceptance model, Malaysia

I. INTRODUCTION

Advance knowledge, either the knowledge on technology or new innovation has always been facing awareness and acceptance challenges, especially from the society of developing countries including Malaysia. Advance technology is considered as a new technology and it is very crucial to the developing country because new technology is believed to be able to solve organizational problems and able to increase economic growth. One of the new technologies constantly being discussed is nanotechnology. According to [1] nanotechnology is the ability to measure, see, predict, and make things on the extremely small scale of atoms and molecules. Materials created at the nanoscale are called nonmaterial's, and they often can be made to exhibit very different physical, chemical, and biological properties than their normal-sized counterparts. [2] has conducted a nationwide survey among 1,003 adults about awareness of and attitudes towards nanotechnology. He has discussed the potential of benefits and risks of nanotechnology as the potential benefits of nanotechnology which include the use of nanomaterials in products to make them stronger, lighter, and more effective. Some examples are food containers that are able to kill bacteria, stain-resistant clothing, high-performance sporting goods, faster, smaller computers, and

more effective skin care products and sunscreens. Nanotechnology also has the potential to provide new and better ways to treat disease, clean up the environment, enhance national security, and provide cheaper energy. While there has not been conclusive research on the potential risks of nanotechnology, there are concerns that some of the same properties that make nanomaterials useful might make them harmful. It is thought that some nanomaterials may be harmful to humans if they are breathed in and might cause harm to the environment. There are also concerns that invisible, nanotechnology-based monitoring devices could pose a threat to national security and personal privacy.

According to [3], nanotechnology has become popular currently, especially in developed country such as in the USA, European Community, Japan, Taiwan as well as South Korea. Much scientific research was carried out and many products have been commercialized. Malaysia launched its nanotechnology initiatives in 2010 which include R&D and education as well as socio-economic nanotechnology plans. However, Malaysia is lacking behind in this aspect because the technology is still new to the Malaysian experts [4]. Despite its laggard application in Malaysia, the government has taken serious actions over the development of nanotechnology in the country. Some of the initiatives include developing strategies to promote and adapt

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nanotechnology in a bigger scale such as identifying researchers with nanotechnology expertise, upgrading and equipping nanotechnology laboratories to ease researchers and also encouraging the Human Development Program in producing nanotechnologist [4]. In addition, to show the seriousness of the country in promoting and increasing the acceptance of nanotechnology, the Ministry of Science and Technology has also embarked on the responsibility of working on the National Nanotechnology Initiative (NNI).

Similar to other disciplines, nanotechnology is taken seriously in the academia. According to [5], the emergence of nanotechnology as a potential subject of social research also corresponds with more general discussions within academia and the government. However, nanotechnology is not isolated from fundamental issues. Nanotechnology is still under high scrutiny for its insufficient regulations and low public awareness [6], [3] and [7]. In addition, awareness and acceptance is a one of the key factors to make sure the nanotechnology initiatives will be successful [5]. Therefore, it is important to assess the awareness on the nanotechnology knowledge to ensure the acceptance to the nanotechnology products. Industries engaged with nanotechnology products have to look for the strategies to ensure sustainability of their nanotechnology products in the market. Therefore, it is important for researchers to develop a model which serves as a guide in sustaining nanotechnology product in the market. [8] in their study have investigated the acceptance towards new technology where the results of their study indicated respondents placed a great emphasize on nanotechnology benefits and risks effects before deciding on the new technology acceptance when buying the products. Misunderstanding must be avoided. People must trust the technology and understand the affect then only they will accept and willing to have the product. Therefore, for anything which is new, people need to be educated about the benefits and usefulness of nanotechnology, and awareness need to be created.

II. METHODOLOGY

Descriptive statistics are used for this study because it only assesses and describes the opinions and perspectives of a given population on nanotechnology acceptance. The instrument used for this study was adapted from past research which was conducted by [9]. However, the questionnaires required some modifications to render its appropriateness to the context of this study. The questionnaire consisted of two sections, which Section A obtained information regarding the demographic profiles, Section B was on attitude and awareness on nanotechnology which consisted of 71 items. The population for this study was the social science students in Universiti Teknologi MARA, Malaysia. Questionnaires were self-administrated by researchers. The total numbers of questionnaires successfully collected and analyzed was 223 from 400 sets of questionnaires distributed. The data was analyzed using SPSS 20.0. Exploratory Data Analysis (EDA) was conducted on the data and the results met the basic assumptions of normality and linearity. Cronbach alpha coefficients were calculated to test the reliability and validity of the instruments respectively and the results indicated acceptable value which alpha value is .85 shows the instrument was reliable for the study.

III. MODEL OF NANOTECHNOLOGY ACCEPTANCE

Resistance to technology is common in nature. It is due to the unfamiliarity of the context, lack of adequate information and concern on its impact especially the negative consequences. A study done by [8] concludes with model of willingness to buy nanotechnology product. This model assesses the acceptance based on benefits and risk effects evaluation prior to willingness to buy the idea of new technology when buying the product based on new technology. People are only willing to buy a new product once they have a sufficient product knowledge and believe the benefits are superior than the risks. However [8] does not address the importance of government role. Government supports and activities are very crucial for every country to influence people to accept new ideas. Therefore, in fulfilling the gap, the current study undertakes the respondents' views on the government and administrative functions. Based on the results, a model that captures the importance of government roles and intervention programs, together with other factors of perceived risks and perceived usefulness are found to be highly correlated with nanotechnology acceptance. Analyses of validity and reliability, exploratory factor analysis, confirmatory factor analysis and structural equation modeling were conducted and the results were all above the acceptance level. The model of Nanotechnology Acceptance has been established as shown in Figure (1).

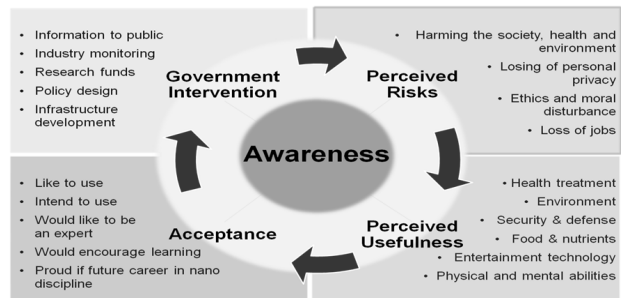


Fig. 1 Model of Nanotechnology Acceptance

This model is to guide the industries in capturing the preferred nanotechnology based products. It also serves as a guideline for government agencies in educating and promoting knowledge on nanotechnology for sustainable usage. This model will be the reference for industries and policy makers to develop guidelines for society to be protected from harmful technology and also assisting the consumers to evaluate product quality and safeness. The consumers are able to access the information on genuine nanotechnology based product should the government design appropriate intervention programs. As shown in Figure 1 above, the government has to play an important role. A number of activities need to be developed such as to disseminate information to the public. The government has to think also of a strategy on how to educate people and confirm adequate information being disseminated throughout the country. Others activities that the government should be able to carry out such as industry monitoring, research funding, policy design especially policy on the safety of products and infrastructures development. The public or the societies need to have information on nanotechnology then

only they can assess the benefits and risks on nanotechnology. It is common to say there is a risk in new technology. In this case, many researchers [10], [4] and [8] also have discussed on nanotechnology risks. Risk issues that have evolved in nanotechnology are such as harming the society in terms of health and environment, losing of personal privacy, ethics and moral disturbance and loss of jobs. These issues are of concerned towards the public because if the public perceived benefits more, than nanotechnology idea will be a success. Therefore, the government needs to ensure public understanding that the benefits of nanotechnology is giving more useful impacts and solving many problems compared to the risks. Some of the examples of benefits that nanotechnology can offer could be found in the health treatment, environment, security and defense and food nutritious, entertainment technology, physical and mental abilities. Therefore, the model of nanotechnology acceptance will be able to create awareness to the public and serves as a strategy to create awareness on new technology.

IV.AWARENESS TOWARDS NANOTECHNOLOGY

The researchers from the USA and Europe have examined public perceptions of nanotechnology among the society. Results of their studies show that public awareness about nanotechnology is very low [11] and [12]. In contrast, this study shows different results. The researchers believed the main reason is because of the different respondents and culture. Previous researches had the public as their participants but this study has chosen students as the participants. Based on the survey, students were asked on their familiarity on the term of nanotechnology. Figure (2) shows results that 74% of university students have heard of the term nanotechnology and 24% otherwise. This result shows good indication towards Malaysian scenario, as majority of the students are familiar with the term nanotechnology. It also shows their awareness on new technology is very high. Moreover, students are more alert on new technology evolution and aware that this technology was discussed extensively nowadays. However, the main concern is whether they are able to explain further about nanotechnology. Next section will discuss more on the student’s knowledge especially the risks and benefits of nanotechnology.

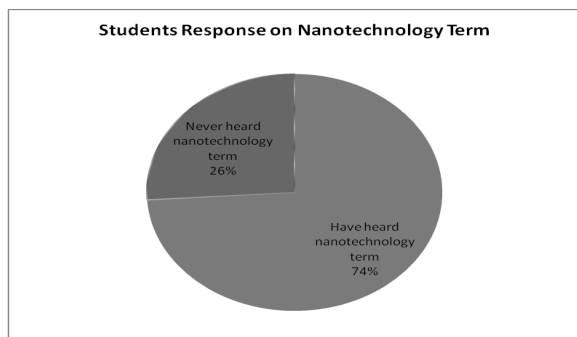


Fig. 2 Percentage of students’ have heard nanotechnology term

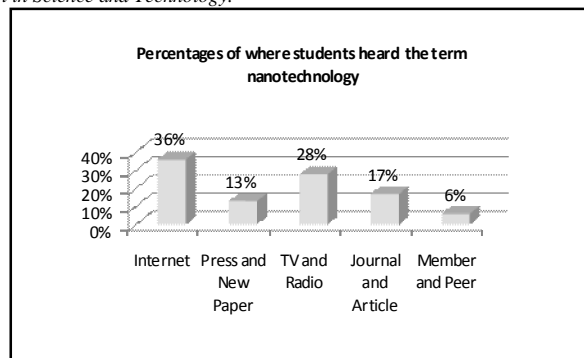


Fig. 3 Percentage of where students heard the term nanotechnology

Referring to figure (3) above, result also shows majority of students said they discover the nanotechnology term from the internet (36%), followed by television and radio (28%), journal and article (17%), press and newspaper (13%) and lastly from the general public or peers (6%). Therefore it could be assumed that that in order to educate students with new idea or technology, the government must focus more inputs through the internet. It is believed that majority of student have access information or knowledge from the internet easily through university’s facilities. That is why majority of them discovered nanotechnology through internet.

Next discussion is about nanotechnology awareness and student knowledge on risks and benefits. From this study, unfortunately the result shows even though majority of the students know the term nanotechnology, but when asked further about nanotechnology, the risks and benefits, majority of them said they have no idea what is the risks and benefits of nanotechnology. Percentages of nanotechnology knowledge by students are as shown in figure (4).

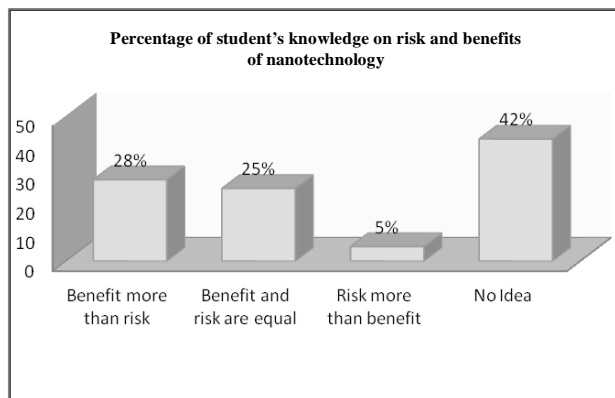


Fig. 4 Percentages of students’ knowledge on risk and benefit of nanotechnology

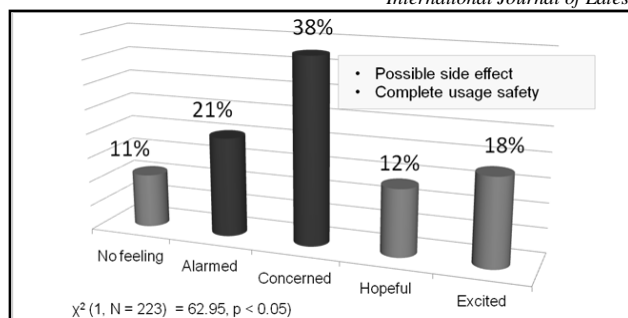


Fig. 5 Percentages of students feel on nanotechnology

Figure (5) shows majority of the students (38%) feel concerned on nanotechnology followed by alarmed (21%), excited (18%), hopeful (12%) and no feeling (11%). This result shows that majority of students feel that nanotechnology has issues on their risks which are the side effect and safety. Therefore, the government needs to encounter these issues in order to create acceptance towards nanotechnology. Overall, the awareness on nanotechnology has increased from 51% in 2005 to 66% awareness in 2008 [13] and it shows the trend of awareness is increase very well. Progress in awareness and acceptance of nanotechnology is critical for national security, prosperity of the economy, and the enhancement of the quality of life. It is anticipated that nanotechnology will be a major transitional force that possesses the potential to change the society. Rapid and continued advancement in the field of nanotechnology is accelerating the demand for specific professional knowledge and skill. Contemporary approaches and practices to further engage learners and enhance their abilities to apply nanoscale-related content knowledge must be continually developed in order for the Malaysians to solidify itself as the primary builder of nanotechnology research and development. Steadfast development of new technologies leading to continual transformation of society serves as a strong indicator that current educational practices should be altered in order to prepare knowledgeable and engaged citizens.

V. CONCLUSION

The study recommended that in Malaysia, it is needed to disseminate the information about nanotechnology since the understanding of what is nanotechnology is still limited. In order to ensure the successfulness of nanotechnology idea, the government has to play a pivotal role. Referring to the model of nanotechnology acceptance, it is proven that the government needs to equip the society with the knowledge of the benefits and risks before nanotechnology idea could be accepted. This model serves as a guideline for stakeholders such industries, government even policy maker to anticipate future direction, address issues related with nanotechnology and improve Malaysian economic competitiveness to face global challenges. Furthermore, the research findings are very important to provide data of reference on awareness of Malaysian society and the model of nanotechnology can be used to initiate nanotechnology policy and acceptance on various sectors such as education, economic, local-based industry, as well as environmental.

In the coming decade, it is predicted nanotechnology will have an enormous impact in the society. Future advances could change approaches to education, manufacturing, electronics, IT and communications technology making previous technology redundant and leading to applications which could not have been developed or even thought about, without this new approach. How far the acceptance and understanding of nanotechnology among consumers are still undefined by [14]. Thus, this research has addressed the issues related with nanotechnology acceptance and understanding among students. This is the pioneer model that has been developed to guide the industries, policy maker and customer in resolving issues of nanotechnology products especially for developing countries.

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