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Original Article

Awareness and Perceptions on Bioethical Issues among Pre-Service Science Teachers

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Abstract: This study aims to investigate the awareness and perception level of bioethical issues among pre-service science teachers at one of the Malaysian Education Institutions. A total of 67 respondents studying science major and science elective were involved. A questionnaire based survey with an alpha Cronbach of approximately 0.93 was used. Data were analysed using SPSS version 22. The results showed that the average awareness and perception level were $\bar{x}$=4.218±0.758 (very high level) and $\bar{x}$=3.991±0.923 (high level), respectively. There was a statistically significant difference according to religion and course. Cloning showed the highest awareness level followed by organ donation, genetic modification, stem cells, abortion, gene therapy, gene screening and euthanasia. Overall, the findings indicated that pre-service science teachers were aware of the existence of bioethical issues. However, the authorities may implement bioethical issues more firmly in the future to increase pre-service science teachers' awareness and perception level.

Key words: Bioethical issues, pre-service science teachers, awareness, perception

Introduction: Bioethics is now becoming increasingly important around the world due to rapid advancement in Science and Technology (S&T), apart from the drastic changes in macroeconomic planning and globalization[1]. New discoveries and innovations in S&T, on the other hand have raised a number of bioethical issues[2]. This relationship makes the teaching and learning of bioethics in science curriculum more

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important than ever before[2,3]. In this regard, pre-service science teachers should be prepared to face bioethical issues because the Malaysian National Philosophy of Education (NPE) emphasizes that not only science teachers should be able to foster understanding of science content, science process skills, positive attitude towards science and nurture unity among students but also instil ethical and moral values in students[4]. Malaysia's preparations to address the emergence of bioethical issues are strengthened by promoting bioethics awareness on students of higher education institutions since 2005[5] and establishing the National Bioethics Council of Malaysia in 2012[6]. Understanding the importance of fostering ethics to students by teachers is important because it is part of science education[7].In the Malaysian science teacher education programme, bioethical issues are taught to pre-service science teachers or to science teacher trainees through integration into other subjects. Some subjects that contain the topic of bioethical issues include Biological Diversity[8], Ethics and Safety[9], Emerging Issues in Biology and Environment, Principles in in biotechnology[10] and Fundamental Genetics[11]. Bioethics in science has been promoted and taught, but bioethical issues still raise questions and create different views in the society. Confusion among the community is exacerbated by the emergence of some groups that reject the advancement of S&T, although scientists continue to claim its benefits. The refusal and scepticism of anti-vaccine groups to accept child vaccination[12] based on precise scientific facts is an example of how people reject S&T innovation.

Cloning, organ donation, euthanasia, stem cells, genetic modification, abortion, gene therapy and gene screening are some of the popular or most important bioethical issues[13,14]. Usually, debates of these bioethical issues are related to potential risks or harmful effects of the application of S&T to human health, the environment and even contrary to traditional beliefs and religions. Whether S&T brings a good or bad effect, bioethical issues still affect human life and environment and touch on almost every area of human endeavour[15]. The emergence of bioethical issues with differences of opinion in society has raised some questions in the preparation of pre- service science teachers. This issue may be traceable based on their lack of awareness of ethics and their ethical perceptions. However, the level of awareness and perception of bioethical issues among pre- service science teachers in Malaysia is unclear due to the lack of literature on bioethics education in the science teacher programme. Low, Lexman and Mohamed Saat[16] also stated that the ethical perceptions of Malaysian undergraduate students are largely unknown. Rodzalan and Mohamed Saat[17] found that the level of ethics of undergraduate students is high but this study is not specific to bioethical issues among pre-service science teachers.

Pre-service science teachers will lead the next generation through their major role in enabling students to make decisions that are more reasonable on ethical issues. Teachers play a role in shaping society[18,19]. In this regard, teachers can influence society by changing students' awareness and perception of bioethical issues. However, it is very important for teachers to have a lot of information and knowledge on bioethical issues before they can teach bioethics in their teaching and learning process. According to Özkan and Umdu Topsaka[20], to improve bioethics education among science teachers, it needs to be implemented while they are still in pre- service teacher training. Kohlberg[21] supported the notion where ethical awareness should be taught in early age by providing continuous education, especially to students in higher education. Pre-service science teachers are in the early stages of developing a conscience and establishing their identities and values, they may show maturity in both physical and mental form, but in reality, their values are still immature. Teaching bioethics including making a good ethical decision to pre-service science teachers at this age are more

effective and essential than at any other time in their lives[22,23,24]. Moreover, bioethical issues are an excellent tool to generate interest and establish the relevance of science content as well as pre-service science teachers are youth who are closely related to ethical issues such as suicide, abortion and organ donation[2,25,26]. According to Ozkan and Umdu Topsaka[20], if pre-service science teachers provide the awareness in bioethics, they will enable effective education.

There is not much research of bioethical issues in science education in the literature[20]. In Malaysia, several studies related to ethics among science teachers or science students have been conducted. Nair, Mohamed and Marimuthu[27] conducted the research of morals, and ethics among pre- service science teachers at the tertiary level, Rodzalan and Mohamed Saat[17] conducted a study on morals and ethics among undergraduate students majoring in science and Jasimin[28] has studied ethics in science among in-service science teachers. However, most studies in Malaysia focus on moral or ethical practices as a science teacher rather than specializing in bioethical issues in science. Therefore, it is highly desirable to investigate the awareness and perception of pre-service science teachers in Malaysia on bioethical issues in science.

Research questions and hypotheses

The following main research questions have been used to guide this study:

What is the awareness and perceptions of bioethical issues among pre-service science teachers?

Are there significant differences in the awareness and perceptions of pre-service science teachers on bioethical issues towards gender, religion and courses?

This study tests the following null hypotheses :

1.There is no significant difference between male and female pre-service science teachers towards their awareness and perceptions of bioethical issues

2.There is no significant difference between Muslim and non-Muslim pre-service science teachers towards the awareness and perceptions of bioethical issues

3.There is no significant difference between science major course and science elective course pre-service science teachers towards the awareness and perceptions of bioethical issues

Methodology: In a present study, a total of 67 respondents of pre-service science teachers at one of educational institutions were involved.

The respondents divided into two groups of gender; 28.4% (19 respondents) were male and 71.6% (48 respondents) were female. The largest number of respondents at 58.2% (39 respondents) was contributed by science major, while science elective only contributed 41.8% (28 respondents). Science major refers to respondents who compulsory studied science subjects, while science elective refers to respondents who studied optional science subjects. Muslims were 71.6% (48 respondents) representing the largest share, while non-Muslim (Buddhists, Christianity and Hindus) consisted 28.4% (19 respondents).

This study was conducted at one of the Educational Institutes in Malaysia. A survey based on a questionnaire to measure awareness and perception of bioethical issues with a five degree Likert scale; (5) Strongly agree ($\bar{x}$=4.20-5.00), (4) Agree ($\bar{x}$=3.40-4.19), (3) Moderate ($\bar{x}$=2.60-3.39), (2) Disagree ($\bar{x}$=1.80-2.59) and (1) Strongly disagree ($\bar{x}$=1.00-1.79) was used. The five-level interpretation was (5) Very high, (4) High, (3) Moderate, (2) Low and (1) Very low.

Alpha Cronbach of questionnaire was approximately 0.93. This study only focuses on eight bioethical issues namely; cloning, organ donation, genetic modifications (GMO), stems cells, abortion, gene therapy, gene

screening and euthanasia. These eight issues were the main and popular bioethical issues over the past few years. The data analyses were made by t-test using SPSS 22.0 package programme. Significance level was taken to be 0.05.

Results:

Awareness of bioethical issues: The result of awareness level among respondents is shown in Table 1. The overall average awareness level of the respondents regarding bioethical issues was $\bar{x}$=4.218±0.758. Among bioethical issues, cloning indicated the highest awareness level at 4.373 followed by organ donation at 4.358, genetic modification at 4.299, stem cells at 4.269, abortion at 4.239, gene therapy at 4.194, gene screening at 4.060 and euthanasia at 3.955. An analysis of the difference in awareness level according to respondent's background profiles showed a statistically significant difference according to religion (t=5.650, p< 0.05). Muslim displayed higher awareness levels of bioethical issues than non-Muslim, and science major course showed higher levels than science elective course. Male showed higher awareness levels than female, however there was no significance difference according to gender. Table 2 shows the t-test result on the awareness level of bioethical issues towards the background profiles respondents.

Perception of bioethical issues: The result of respondents' perception of bioethical issues is shown in Table 3. These perceptions containing 21 statements where statements 1 to 9 were related to general information of S&T, bioethics, religion, law and policy, while statements 10 to 21 were specifically related to bioethical issues. The average perception of 21 statements was at a high level ($\bar{x}$=3.991±0.923).

Table 1: Awareness of bioethical issues among respondents

Bioethical issues	Awareness		Interpretation
	Average (X^2)	S.D.	
Cloning	4.373	0.671	Very high
Organ donation	4.358	0.667	Very high
Genetic modifications (GMO)	4.299	0.759	Very high
Stem cells	4.269	0.709	Very high
Abortion	4.239	0.653	Very high
Gene therapy	4.194	0.802	High
Gene screening	4.060	0.795	High
Euthanasia	3.955	0.878	High
Overall awareness of bioethical issues	4.218	0.753	Very high

Table 2: t–test on awareness of bioethical issues towards respondents' background profiles.

Profile	Categories	Average	S.D.	t	p
Gender	Male Female	4.290 4.190	0.568 0.632	0.596	0.553
Religious	Muslim Non-Muslim	4.438 3.665	0.436 0.651	5.650	0.000**
Course	Science major Science elective	4.484 3.848	0.418 0.652	4.862	0.000**

Respondents perceived S&T makes an important contribution to the quality of human life as the highest level (4.388), followed by interest in S&T as the second highest level (4.343) and bioethical issues need to be studied in the Science and Biology curriculum as the third highest level (4.343). The second and third highest levels had the same average value but differ in standard deviation. These three perceptions were at a very high level. For statements familiar with the term "Bioethics", awareness of the emergence of bioethical issues in line with

the development of Science and Biology and discussing bioethical issues in the classroom, respondents perceived at a high level of 3.522, 4.075, and 3.478, respectively.

Further result found that for religious, law and policy statements, respondents perceived high level (4.030) for the authorities have a clear policy on bioethical issues. Vice versa, religion has the ideal framework for dealing with any bioethical issues and the law needs to have an ideal framework for bioethical issues perceived at very high levels with an average of 4.209 and 4.239, respectively.

Statements specifically related to bioethical issues, respondents perceived at a very high level (4.3) only for the statement of performing gene treatment first before symptoms appeared if gene examination tests showed genetic defects. Other statements of bioethical issues, respondents perceived only at a high level stating with

Table 3: Perceptions of respondents on items related to bioethical issues

Items		Score		Interpretation
		Average	S.D.	
1	Science and Technology makes an important contribution to the quality of human life	4.388	0.627	Very high
2	I'm interested in Science and Technology	4.343	0.750	Very high
3	I'm familiar with the term "Bioethics"	3.522	0.975	High
4	I'm aware of the emergence of bioethical issues in line with the development of Science and Biology	4.075	0.876	High
5	Bioethical issues needs to be studied in the Science and Biology curriculum	4.343	0.789	Very high
6	I often discuss bioethical issues in class	3.478	0.943	High
7	Religion has the ideal framework for dealing with any bioethical issues	4.209	0.826	Very high
8	The law needs to have an ideal framework for bioethical issues	4.239	0.799	Very high
9	The authorities have a clear policy on bioethical issues	4.030	0.758	High
10	Genetic modification foods have been introduced in my country	3.866	0.886	High
11	The authorities allow organ donation in my country	4.075	0.841	High
12	If my family need a kidney, I will donate one to him	4.149	0.942	High
13	If my family need a kidney, I will not buy one from the black market	3.567	1.587	High
14	The authorities not freely allow abortion in my country	3.821	0.999	High
15	I'm aware of the implications of Stem Cell Technology	4.075	0.703	High
16	Stem Cell Technology should be introduced to all	4.030	0.816	High
17	The authorities allow cloning by law	3.642	1.111	High
18	If a gene screening test shows I have a genetic defect, I will have to do the gene treatment first, before the symptoms appear	4.300	0.738	Very high
19	Besides me, my family members can also be informed about my health screening findings	4.000	0.816	High
20	I will take my family members for genetic therapy, if they have a genetic defect	4.044	0.706	High
1	I aware that euthanasia is only allowed by the authorities, for reasons that justify it.	3.881	0.826	High
Overall perceptions on related item of bioethical issues		3.991	0.923	High

statements about respondents donating kidneys (4.149), followed by authorities allowing organ donation (4.075), aware the implications of stem cell technology (4.075), taking family members for genetic therapy if they have a genetic defect (4.044), introduce stem cell technology to all (4.030), family members can inform about health screening findings (4.000), euthanasia is only allowed by the authorities for certain reasons (3.881), introducing genetic modification to the country (3.866), abortion is not freely allowed by authorities (3.821), authorities allow cloning (3.642) and finally, donating kidneys without buying from the black market (3.567).

Further analysis of the difference perception of bioethical issues according to respondents' background profiles found that there was statistically significant difference in religion ($t=3.862$, $p<0.001$) and course ($t=4.379$, $p<0.001$), but gender showed insignificant difference. Male, Muslim and science major course showed high average perception compared to other background profiles. Table 4 shows t-test on the perception of bioethical issues towards the background profiles of the respondents.

Table 4: t- test on perception of bioethical issues towards respondents' background profiles

Profile	Categories	Mean	S.D.	t	p
Gender	Male Female	3.992 3.935	0.472 0.529	0.405	0.687
Religion	Muslim Non-Muslim	4.125 3.652	0.397 0.571	3.862	0.000**
Course	Science major Science elective	4.191 3.713	0.332 0.558	4.379	0.000**

**P<0.05

Discussion: The overall level of awareness of bioethical issues among pre-service science teacher was very high ($\bar{x}$=4.218±0.758). This finding was consistent with other studies such as research by Ilyas et al.[13] and Aggarwal, Sandhu and Kukreja[26] who found that awareness of bioethical issues is quite high among respondents of Hazara University and Sri Guru Ram Das University of Science and Medical Research. According to Ilyas et al.[13] and Aggarwal, Sandhu and Kukreja[26], high awareness of these bioethical issues is due to its curriculum content. Postgraduate respondents from Molecular Medicine and Medical Biotechnology Department, where bioethics had been included in their curriculum, also exhibited relatively high level of awareness on bioethical issues[29]. Therefore, the very high level of awareness in this study may be due to exposure to bioethical issues through the content of their curriculum as the findings of other researchers.

Besides well exposed of bioethical issues as above discussion, the high level of bioethical issues awareness in this study can provide an initial overview of the level of scientific literacy among pre-service science teachers. This is because the awareness and understanding of the impact of S&T on society is one of the dimensions of scientific literacy[30]. According to Kolarova and Denev[3], the topic of ethics is increasingly important as a tool to improve students' scientific literacy, therefore, the ethical topics applied in the curriculum indirectly affect the high awareness of bioethical issues. These findings may reflect awareness about bioethical issues at the societal level since literacy rate among the population aged 15 years and older in Malaysia is high around 94.64%[31]. Scientific literacy is an important element to enable people to think and critically evaluate an issue and make wise decisions, especially S&T surrounded by various ethical, social, political and economic issues[32].

The study also found that cloning was perceived as the highest awareness level of bioethical issues, followed by organ donation, genetic modification, stem cells, abortion, gene therapy, gene screening and euthanasia (Table 1). This finding might indicate that cloning was very popular issues compared to others, while less popular issues caused euthanasia to be in the lowest awareness. The finding was in line with the ranking of the most important bioethical issues by Iliyas et al.[13] and Alam et al.[14]. Awareness level of each bioethical issues in this study namely cloning, organ donation, genetic modification (GMO), stem cells and abortion were found to be very high level more than 4.2, while gene therapy, gene screening and euthanasia were perceived high level between 3.4 and4.19. These findings indicated that pre-service science teachers had at least high level of awareness of each bioethical issue. The awareness of some bioethical issues in this study also showed higher awareness than in other fields and countries. For example, Jeon and Kim[23] who studied undergraduate students of Biomedical Science in Korea found only moderate levels for organ donation and euthanasia. This difference in high level of awareness may also be due to differences ability among students. In Malaysia, the latest trend in the selection of pre-service science teachers is through strict selection, besides they must have a good academic qualification before being accepted for teacher training programme. The characteristics possessed by pre-service science teachers may influence the outcome of this study, but further research should be done in the future to confirm the relationship between respondents' ability and level of awareness on bioethical issues.

Based on the background profile of pre-service science teachers, the results of this study found that male, Muslim and science major course showed higher level of awareness on bioethical issues than female, non-Muslim and science elective course (Table 2). Some researchers such as Rodzalan and Mohamed Saat[17] revealed that the level of ethics are different in terms of academic discipline among higher education students, Jasimin[28] found that Muslim science teachers have different perceptions than non-Muslim science teachers on ethical issues and Rodzalan and Mohamed Saat[17] found that female have higher ethical awareness compared to male in the study of undergraduate programme majoring in science. Jeon and Kim[23] also found that awareness of biomedical ethics according to general characteristics showed a statistically significant difference towards gender, religion and major course. However, t-test of this study only found religion and course were statistically significant differences (Table 2). No significant differences in bioethical issues awareness of gender may be due to the both sexes received almost identical exposure of it curriculum. Religion and course had significant differences in awareness of bioethical issues, possibly due to the mastery of different disciplines and different principles in religion as a way of their life. These results showed that several background factors such as religion and education level would influence people's thinking[33].

Further study on pre-service science teachers' perception related to statement of bioethical issues was found "agree", indicating a high level perception. The difference perception of bioethical issues according to respondents' background profile showed a statistically significant difference only for religion and course (Table 4). Meanwhile, male, Muslim and science major course showed high average perception compared to other background profiles. The high perception in this study is in line with the revelation of very high awareness of each bioethical issue. This may show the relation between perception and awareness because the perception is the process of becoming aware of situations, of adding meaningful associations to sensations[34].

The result for S&T makes an important

contribution to the quality of human life and interest in S&T, respondents perceived very high level indicated that they were strongly agreed. This means that S&T will benefit pre-service science teachers live and influence their interest in S&T. This is in line with Alam et al.[14] who stated that most of the respondents (76.4%) in their study not only believed that S&T would benefit their lives but also expressed interest in S&T.

Respondents perceived high level for familiar with the term "Bioethics", aware of the emergence of bioethical issues in line with the development of Science and Biology and often discuss bioethical issues in class. These findings indicated that pre- service science teachers aware and know about bioethics education and bioethical issues in their Science and Biology curriculum. These results in line with the statement of bioethical issues need to be studied in the Science and Biology curriculum, to which respondents had strongly agreed. This result is also in accordance with Rasool et al.[35] which 78% teachers and students agree that ethical issues should be included in the biology syllabus, while Iancu[36] suggested that bioethical education be implemented using the modern context of biological teaching. The findings of this study were in line with the implementation of bioethics education in Japan, Australia and New Zealand, where almost all of the teachers thought bioethics were needed in education and bioethical issues were generally covered more in biology classes than in social science classes[37].

Respondents perceived high level for class discussion on bioethical issues as mention above, but the statement showed the lowest perception. This result may be due to the factor of student busyness or the lack of curriculum content which leads to less discussion. According to Mahmud et al.[4], the curriculum structure of degree programs containing more general science content commonly lacks content knowledge that may affect student understanding and development of inquiry-based science teaching. The findings in the statement Bioethical issues needs to be studied in the Science and Biology curriculum which perceived very high level, and often discuss bioethical issues in class which perceived low high level may need to be considered when designing a new Science and Biology curriculum by incorporating bioethical issues into the current curriculum structure.

Based on statement religion has the ideal framework for dealing with any bioethical issues, it can be said that pre-service science teachers agree in a religious approach in dealing with bioethical issues (Table 3). This is in line with the findings of Özkan and Umdu Topsakal[20] where the respondents prefer a theological approach to bioethical issues or in other words their decisions deal with religious rules. Statements of the law needs to have an ideal framework for bioethical issues, and the authorities have a clear policy on bioethical issues are closely related to the seriousness of the authorities on bioethical issues. Pre-service science teachers perceived high and very high for both items indicating that the authorities should pay attention to bioethical issues. In fact, the Malaysian authorities had already set up the National Bioethics Council in 2012 to help address bioethical issues especially those related to policy and law.

Based on the result from statement specifically related to bioethical issues, the finding showed that respondents agree to all statements, except statement if a gene screening test shows a genetic defect, respondents will have to do the gene treatment first, before the symptoms appear, where they strongly agree. Very high perception on this statement indicated that pre-service science teachers were very aware about gene screening and willing to avoid getting sick. Respondents perceived high level for other statements specifically related to bioethical issues. This means that pre-service science teachers were also aware on bioethical issues mention namely genetic modification foods, organ donation,

abortion, stem cell technology, cloning, gene screening, genetic therapy and euthanasia. Pre-service science teachers perceived high to introduce both genetic modification food and stem cell technology to all, which might be due to the development of both technologies around the world and their advantages. Side effects from two technologies that have not been proven, do not have a significant effect on respondents. This was supported by statement of pre-service science teachers, where they were aware of the implications of stem cell technology.

Respondents perceived agree the authorities allowed organ donation. Statements of if my family need a kidney, I will donate one to him indicated that pre-service science teachers will be willing to donate organs for the needs of their families, but statement of if my family need a kidney, I will not buy one from the black market, most of them were opposed to getting organs from the black market. This showed that respondents aware about organ donation especially kidney donation even though the organ donation rate in Malaysia is among the lowest in the World[38]. Statement of if my family need a kidney, I will not buy one from the black market showed high perception but it has the lowest average perception compared to other statements specifically related to bioethical issues (Table 3). This showed that pre-service science teachers were very difficult to decide on bioethical issues whether to buy kidney or not from the black market especially for the needs of their families.

For abortion issue, the authorities not freely allow abortion in the country. Respondents have agreed this. However, it was not perceived very high probably due to many cases that occur among adolescents in Malaysia. The Federation of Reproductive Health Associations Malaysia has estimated that there are about 90,000 abortions performed annually in Malaysia and The Reproductive Rights Advocacy Alliance Malaysia has estimated that there are about 240 clinics nationwide offering abortion services[39]. Abortion in Malaysia is mostly illegal except in certain cases when a medical practitioner deems that continuing the pregnancy poses a danger to the mother's life, physical health, and mental well-being. The findings of this study may support Alam et al.[14] who found abortion as the second most important bioethical issue due to the social unacceptability of premarital pregnancy rather than as a strictly bioethical issue.

The highest awareness level was found for cloning as mentioned in research question I, but it was not perceived very high in statement of the authorities allow cloning by law (Table 3). This may be due to not clear about the law of the cloning and other modern technologies based on low in technical knowledge and their implications. According to Ilyias et al.[13], a correct picture on cloning issue only could emerge when all the pros and cons are explained to the people.

For euthanasia issue, which statement about aware of euthanasia is only allowed by the authorities, for reasons that justify it was found high awareness (Table 1) and high perception (Table 3). This means that pre-service science teachers were aware on euthanasia issue and only allowed by the authorities for certain reasons. Euthanasia may be less prone to pre-service science teachers causing their perceptions and awareness not to acquire very high. Ilyias et al.[13] can support this, where euthanasia found the second lowest ranking according to the most important bioethical issues. Jeon and Kim[23] also found euthanasia in second place out of 7 biomedical issues awareness.

Statements if a gene screening test shows I have a genetic defect, I will have to do the gene treatment first, before the symptoms appear, besides me, my family members can also be informed about my health screening findings and I will take my family members for genetic therapy, if they have a genetic defect were related to gene testing

and health. Pre-service science teachers' perceptions of the three statements were high with an average of more than 4. As mentioned above on statement if a gene screening test shows I have a genetic defect, I will have to do the gene treatment first, before the symptoms appear, these findings indicated that pre-service science teachers were concerned about their respective health levels. This may have caused the respondents to also give a high perception for statements family members can also be informed about my health screening findings and I will take my family members for genetic therapy, if they have a genetic defect.

Apart from the findings discussed earlier, this study also found that three statements approached a moderate level (3.4). The statements were i) I often discuss bioethical issues in class (3.478), ii) I am familiar with the term Bioethics (3.522) and iii) if my family need a kidney, I will not buy one from the black market (3.567). This low level of perception may be due to curriculum weaknesses, student busyness, lack of bioethical exposure in the teaching and learning process and difficulty making decisions accurately according to the bioethical issues encountered, as previously discussed. Therefore, these three statements should be given attention in improving the implementation of bioethics education among pre-service science teachers in the future.

Conclusions and recommendations: It can be concluded from the results that awareness of bioethical issues among pre-service science teachers were very high, while their perceptions level were high. Cloning showed the highest awareness level, followed by organ donation, genetic modification, stem cells, abortion, gene therapy, gene screening and euthanasia. Statistically significant differences were found between religion and course of pre- service teachers regarding bioethical issues. However, there were no significant differences between genders towards bioethical issues. It is hoped that this study will provide useful findings, particularly to assist the best implementation of bioethical issues in science curriculum among pre-service science teachers.

Based on this study, some recommendations can be given as follows; First; pre-service science teachers should be given more opportunities to discuss bioethical issues. This may require a review of the curriculum related to bioethical education. This suggestion based on the result of bioethical issues often discuss in class. Second, bioethics must be a subject studied in science and science education. In addition, science curricula at all levels of education should incorporate ethical issues of science. This will make bioethics more familiar among the community or students. This suggestion based on the result of familiar with the term “Bioethics”. Third, it is important to prepare students with ethical knowledge, skills and values in order to respond to ethical dilemmas and be able to make ethical decision after entering the real world of work. Bioethical issues should be discussed openly through seminars, conferences and workshops to encourage interaction between experts, academicians, researchers, students, policy makers etc. This suggestion based on the result of family need a kidney, without buying one from the black market. Fourth, awareness of bioethical issues needs to be created at all levels so that people can train their own opinions instead of following others blindly. Discussions on ethical issues in science education should also help students understand scientists as some students can become future scientists, while increasing their interest in science. However, the background profile of students should be scrutinized as their respective religions and disciplines of knowledge can influence their thinking on ethical education. This suggestion based on the findings of significant differences in average awareness and perception in bioethical issues towards the religion and course of the respondents. Lastly, fifth; this study has limitations in terms of generalization because it only investigates

pre-service science teachers in one of the Institutes of Education in Malaysia. Therefore, it needs future replication studies to cover the whole country while qualitative research may also be needed to strengthen the findings of the study.

References:

1. Lasker SP, Rahman MM. Bioethics for peace and sustainable development of Bangladesh. Bangladesh Journal of Bioethics 2019; 9 (2): 38-40.
2.Csongradi C. Why teach bioethics? 2019. www.actionbioscience.org/education/csongradi.html . (9 March 2020).
3.Kolarova TA, Denev ID. Integrating a bioethics course into undergraduate biology education. Biotechnology & Biotechnological Equipment 2012: 26(1), 2801-2810.
4. Mahmud SND, Mohamad Nasri N, Samsudin MA, Halim L. Science teacher education in Malaysia: challenges and way forward. Asia-Pacific Science Education 2018; 4, 8.
5. Phipps M. Bioethics education in tertiary settings: The University of Malaya experience. In Calderbank D, Macer DRJ., (eds.). Asia-Pacific Perspectives on Bioethics Education. Bangkok, UNESCO Asia and Pacific Regional Bureau for Education, 2008.
6.Kementerian Sains, Teknologi dan Inovasi (MOSTI). Pelancaran Majlis Bioetika Negara. 2012. https://www.mosti.gov.my/web/berita/pelanca ran-majlis-bioetika-negara/ . (20 April 2020).
7. Jegede OJ. School science and the development of scientific culture: A review of contemporary science education in Africa. International Journal of Science Education 1997; 19(1), 1-20.
Institut Pendidikan Guru Malaysia (IPGM). Buku
8. Panduan Akademik Sesi. Program Ijazah Sarjana Muda Perguruan Dengan Kepujian (PISMP). Pusat Pembangunan Akademik, Institut Pendidikan Guru Malaysia, Cyberjaya, 2017.
9. Universiti Malaya (UM). Buku Panduan Ijazah Dasar Sesi 2018/2019. Fakulti Pendidikan. UM: Kuala Lumpur, 2018.
10. Universiti Pendidikan Sultan Idris (UPSI). Panduan Akademik Sesi 2019/20 Program Sarjana Muda. Fakulti Sains dan Matematik. UPSI: Tanjung Malim, 2019.
11.Universiti Sains Malaysia (USM). Sarjana Muda Sains dengan Pendidikan Sidang Akademik 2014/2015. USM: Pulau Pinang, 2014.
12.Ahmed A, Kah SL, Bukhsh A, Al-Worafi YM, Sarker MMR, Long CM, et al. Outbreak of vaccine-preventable diseases in Muslim majority countries, Journal of Infection and Public Health 2018; 11, 153–155.
13. Ilyas M, Alam M, Ahmad H, Tariq M, Bibi S, Ali A, et al. Awareness regarding bioethical issues among the students and Faculty of Hazara University Mansehra, Pakistan. Pakistan Journal of Medical Science 2009; 25(1), 97-102.
14.Alam M, Rahman Z, Shah M, Zar MS, Shams S, Ali F, et al. Bioethics: awareness, attitudes and opinions among University students and Faculty/Researchers. Pakistan Journal of Medical Science 2012; 28(4), 680-685.
15.Mohamed Z. National Bioethics Council's: Role in promoting ethics in research excellence. 2015. https://uitmethics.uitm.edu.my/v1/images/stories/re sources/NationalSymposium2015/1.roles.pdf .(10 April 2020).
16.Low HH, Laxman L, Mohamed Saat M. A study of the ethical perception amongst Malaysian public university students. International Conference of the Asian Academy of Applied Business (AAAB), UM, 2003.
17.Rodzalan SA, Mohamed Saat M. Ethics of undergraduate students: A Study in Malaysian Public Universities. International Journal of Information and Education Technology 2016; 6 (9), 672-675.
18. Deering TE. The ethical perspective of British and American preservice teachers and American preservice teachers. Educational Research 1998; 4(3), 353-358.
19. Patel J. Role of teachers in nation building. International Journal of Trend in Scientific Research and Development 2018; 2 (5), 2086-2089.
20. Özkan G, Umdu Topsaka U. Preservice classroom teachers' bioethical perceptions. The Eurasia Proceedings of Educational & Social Sciences (EPESS) 2016; 4, 573-578.
21. Kohlberg L. Essays on Moral Development. The Philosophy of Moral Development. Moral Stages and the Idea of Justice. Harper & Row, New York: 1981.
22.So BU, Park HS. A research on undergraduate students' bio-ethics concept. The Catholic Thought 2004; 30, 139–78.
23.Jeon MS, Kim HJ. Awareness levels of biomedical ethics in undergraduates. Indian Journal of Science and Technology 2015; 8(S8), 149-153.
24.Hudha AM, Amin M, Bambang Sumitro S, Akbar S. The Effectiveness of OIDDE learning model in the improvement of bioethics knowledge, ethical decision and ethical attitude of biology preservice teachers. Journal of Baltic Science Education 2018; 17 (6), 960-971.
25.Choo JW. A basic study on the educational contents for teenagers' bioethics. Biomedical Law and
26. Ethics 2008; 2(3), 257–73.
Aggarwal K, Sandhu S, Kukreja S. Bioethical awareness in Indian Medical Scenario. Intentional Journal of Current Research in Medical Science 2018; 4(10), 10-14.
27.Nair SM, Mohamed AR, Marimuthu N. Malaysian teacher trainees' practices on science and the relevance of science education for sustainability. International Journal of Sustainability in Higher Education 2013; 14 (1), 71 – 89.
28.Jasimin MAH. Kefahaman dan persepsi guru terhadap etika dalam sains. Tesis Sarjana Pendidikan. UTM. 2014.
29. Soluti SS, Ebrahimi M, Karimi Moonaghi H. Jamialahmadi K. Perceptions on bioethical issues among postgraduate basic medical sciences students of Mashhad University of Medical Sciences, Iran. Journal of Medical Education Development 2016; 9 (22), 112-115.
30. Miller JD. Scientific literacy: a conceptual and empirical review. Daedalus 1983; 112, 29-48.
31. UNESCO. Malaysia: Education and Literacy. 2020. http://uis.unesco.org/en/country/my.(10 April 2020).
32. France B. Location, location, location: Positioning biotechnology education for the 21st century. Studies in Science Education 2003; 43(35), 88-122.
33. Ajzen I, Fishbein M. Attitudes and the attitude-behaviour relation: Reasoned and automatic processes. European Review of Social Psychology 2000; 11(1), 1-33.
34. Giliner B, Halter V. Psychology. Harper & Row,

New York: 1970, 170.
35. Rasool S, Javed S, Nadeem SG, Hakim ST. Bioethics education, awareness of ethics and dissemination of knowledge among teachers and students. RADS Journal of Biological Research and Applied Science 2013; 4 (2), 20 – 32.
36. Iancu M. Bioethical education in teaching biology. Procedia-Social and Behavioural Sciences 2014; 127, 73-77.
37. Macer DRJ, Asada Y, Akiyama S, Tsuzuki M. Bioethics in High Schools in Australia, Japan and New Zealand. In Macer DRJ. Bioethics for the people by the people. Eubios Ethics Institute, Christchurch: 1994, 177-185.
38.James WF, Ong JS, Oo WL, Hossain MM, Nirmala DB, Haron H, et al. Demographics of healthcare professionals' knowledge and attitude toward deceased organ donation: Survey of critical care areas in a tertiary hospital. Medical Journal of Malaysia 2019; 74 (2), 109-115.
39.Acher N. Feature: The law, trials and imprisonment for abortion in Malaysia. International Campaign for Womans Right to Safe Abortion. Berer M. (ed.). 2018. https:// www.safeabortion womensright.org/10209-2/. (10 April 2020).

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