

Research Article

Developing bacterial set box media containing *fiqh al biah* for Islamic senior high school



Uswatul Wadhichatis Saniyyah^{a,1*}, Nur Hayati^{a,2}, Saifullah Hidayat^{a,3}

^a Department of Biology Education, Faculty of Science and Technology, UIN Walisongo Semarang, Jl. Prof. Dr. Hamka, Tambakaji, Ngaliyan, Semarang, Central Java, 50185, Indonesia,

¹ uswahdichah@gmail.com; ² nurhayati@walisongo.ac.id; ³ hidayatsaifullah@walisongo.ac.id

* Corresponding author

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ABSTRACT

The limitations of bacterial visualization media make bacteria consider as abstract and difficult material to study. Furthermore, the implementation of bacteria material and the integration of Islamic values are difficult to teach. This research aimed at developing and validating the BSB (Bacterial Set Box) media containing *fiqh al biah*. The method used in this research was R&D (Research and Development) with 4D model (Define, Design, Develop, and Disseminate) by Thiagarajan et al. The media developed was three dimensions (3D), which was packed up in a box which contained three packages. The first box was bacterial visualization; the second box was bacterial classification; the third box was 3D box containing *fiqh al biah*. The field test was carried out in Al Azhar Islamic Public School 16 and MA Nurussalam Semarang. The results showed that the validation percentages were 94% (material expert), 79% (media expert), 96% (integration expert), 92% (biology teacher of Al Azhar Islamic Public School 16), and 86% (biology teacher of MA Nurussalam). A pilot scale test and a large scale test showed very feasible. It can be concluded that BSB media containing *fiqh al biah* is very feasible to use.



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INTRODUCTION

The bacteria material learning process faces so many obstacles in the application of cognitive and psychomotor aspects. Bacteria material was seen as complex material by students because it was microscopic and abstract (Novianti et al., 2019). The observation results on October 2019 in Al Azhar 16 Islamic Public High School Semarang and MA Nurussalam Semarang showed the same case. The impediments to building the bacteria concept for students are their assumption that bacteria material was abstract and difficult to learn. Based on questionnaire and interview results to all of the tenth graders' students in Al Azhar 16 Islamic Public High School Semarang and MA Nurussalam Semarang. Students thought that bacteria were abstract because they cannot touch the bacteria directly. They only know the description of bacteria by a bit of picture and translate it to their brains. Besides, bacteria are microscopic objects and do not know how to study bacteria for their lives. The other reason is that the instructional media used cannot

visualize the actual details of the bacteria content being studied and other problems that are difficult to avoid, which was about the time consuming to this material. In contrast, the bacteria materials are quite a lot. Because of all the troubles, the student does not interest in learning about the bacteria material. The study illustrates that the low learning interest will impact the low student understanding and impact the little student learning outcomes on the material (Turnip & Hasruddin, 2018).

This study results in as same as the research study that biology is a subject that faces so many obstacles to learn (Çimer, 2012; Weng et al., 2020). Material about bacteria is abstract matter and interdisciplinary (Çimer, 2012), only concrete in the textbook, and no substantial experience for the students to facilitate more effective learning become significant sources of misconception in biological concepts (Chavan & Patankar, 2018; Nofitasari et al., 2021). Biology is a subject required for admission into many professional courses. Besides, biology helps the students understand the environment and expects students to develop awareness, scientific temper, positive temper, skills, and values (Chavan & Patankar, 2018). British biologists published a call to arms warning that the decline in field biology skills in the United Kingdom has reached a crisis point (Surahman et al., 2017). One reason why the quality of biology learning declined is the disconnection between the recognized importance of field experiences and the increasingly limited opportunities for gaining relevant field-based training (Barrows et al., 2016). Increasing the correlation of teaching aspects in the real-life becomes one solution to break down this gap (Fleischner et al., 2017).

Another problem has been shown from the implementation of psychomotor aspects. The interview results illustrate that both of Al Azhar 16 Islamic Public High School Semarang and MA Nurussalam Semarang faced some difficulties with carrying out the essential competencies on point 4.5, which presents characteristics and the role of bacteria data in daily life. Because those are due to lack of support for school and infrastructure in the form of laboratories, tools, and materials needed. The media previously used by teachers at MA Nurussalam Semarang was in the form of pictures in the textbooks only. Meanwhile, for Al Azhar 16 Islamic Public High School Semarang, the teacher used images and video media displayed through a PowerPoint (PPT). Based on the students' needs as much 85% of students in both of the schools responded it was necessary to have instructional media that was able to visualize bacteria material in 3-dimensional form. This result is the same as the study result from (Çimer, 2012) that concludes for enhancing the quality of biology teaching, using visualization techniques such as 3D materials, real-life objects, videos, or technology students understand abstract or invisible biological concepts material. Besides, the fact that found based on the questionnaire results and interview showed the equal condition. Argues that the more senses involved in learning something, the more concrete experiences students will get and the stronger their long-term memory of the material being studied (Wardani & Sumarmin, 2020). Due to the lack of media that can provide an authentic experience for students, they will feel bored and do not care about the material's values. Research that results from applying Dale's cone of experience to increase learning and retention and apply strategies at the bottom of the pyramid by simulating reality and representing reality was the most effective way to learn (Fleischner et al., 2017).

In this research, researchers also asked how the correlation and implementation of material based on Islamic value and the results contradicted with content that should teach especially about the connectivity between Islam and science. Even both schools are Islamic schools, but the integration of Islamic positively and science did not exist. The integration of Islamic values in science will provide strength in the cognitive, psychomotor and affective domains and provide holistic learning outcomes without dichotomous. Therefore, this integration is necessary to improve the quality of Islamic education (Hidayat et al., 2020). The integration between science and Islamic value has aims to understand the complexity of life phenomena by approaching the integrative-interconnection and has a purpose for man to study nature to discover God and use the character to benefit humanity (Mufid, 2014). Besides, these benefit values are for preventive all activities that can cause harm to humanity and destroy, and humanity balance is forbidden (Faruqi, 2007). The interview results gave the researchers a challenge to researchers challenge media that give the connectivity with Islamic vibes Stated that the integration of science. E-learning (biology, physics, and chemistry) in schools is very important to be implemented. Science plays an essential role for humans in playing their lives in living their lives but has destructive impacts such as environmental crises. This environmental crisis is caused by spiritual emptiness, and humans keep themselves away from God moral guidelines (Sunhaji, 2018). The researchers are trying to assess the negative impact of bacteria that can cause environmental problems and cause diseases in humans, such as bacteria that can cause diseases and others because river water has been contaminated by waste and garbage for daily needs. This knowledge is then linked to the discussion of *fiqh al biah*, or known as environmental *fiqh* as a preventive measure, to understand how important environmental damage is based on religious knowledge (Sulistyo, 2018). States that environmental education becomes a preventive forum to educate students so that they can understand the phenomenon of the

environmental crisis and foster environmental care based on the internationalization of religious values in the environmental-science discourse (Hidayat, 2015) Research states that *fiqh al biah* or environmental *fiqh* seeks to make people aware that environmental problems are a common problem that is dealing with them will be of worship is valuable because they are by the demands of *shari'ah*. The Qur'an as a guideline for the Islamic person has mentioned 485 times the word '*ardh* (earth) in various contexts, and it has also been mentioned that humans are *Khalifah* (QS. Al Baqarah [2]: 30) and as prosperous of the earth (QS. Hud [11]: 6). Therefore, education on the environment or environmental *fiqh* is important to be taught (Jayawardana & Trianggono, 2018).

In this case, the articles and journal that explain the 3-dimensional media of bacteria which contain the integration of Islamic and science side was so limited. Researchers are mention five articles that explain this topic. First, an article from Garcia-Bonete et al., (2018) textbooks and 3-dimensional media for learning are two different types of media to help the students learning. On this topic, we have some similarities within the case of material but differences in the content. The second one, an article from Clark, (2008) tried to develop an integrated textbook within bacteria material by engaging students to mock research identification without using a laboratory. The following article is the anti-bacterial power test from *manila sapodilla* to *e.coli* and their implementation in learning bacteria from Jeronen et al., (2017) the result of the power test study becomes a report to the student using 2-dimensional learning Media for students. The last article is an article from Lufri et al., (2020) with the title the development of colloid textbooks containing *fiqh al biah* for eleventh graders of Islamic Senior High School. The article topic was so different, but we have some similarity in integrating between science and Islam by the form of *fiqh al biah* by exposing the value of learning. Based on this, this research's novelty is that the integration of bacterial material packaged in 3-dimensional media has been carried out. Still, the integration between the media box set of bacteria containing Islamic values of *fiqh al biah* has never been done. The benefit of this research is that later we can find out the feasibility of the bacterial set box media in teaching bacterial material. The most important benefit is that in addition to studying bacterial material, we also get material on managing the environment or behaving well towards the environment (*fiqh al biah*).

Integrating science and Islamic values becomes a subject point of this article. Besides, the researchers reverse to an article that concerns developing 3-dimensional media but for genetic material. In their study, the genetic box's instructional media has the advantages of making the student more attractive to learn, explaining the abstract object, and is easy to use and assembled (Mahfudhillah et al., 2007). This topic was so interesting, and the researchers tried to analyze this part. The researchers are trying to design a medium that can visualize bacteria in their shape, types of bacteria based on the number of the flagellum, oxygen request, and gram staining of bacteria. Besides, the researchers refer to the negative role of bacteria with the aim that the media can reflect reality by showing cause-and-effect reactions to improve students' psychomotor abilities. These are poured out in learning media and provide learning experiences to students to enhance up student motivation and make it easier for students to understand the material bacteria and impart Islamic values contained in the jurisprudence of the environment. This study aims to produce learning media innovations that are used to understand the material and combine it with *fiqh al biah* or environmental *fiqh* and measures the validity of the media. This media is called BSB (Bacterial Set Box) containing *fiqh al biah* media. This study's results can be used as a source of the latest references in the use of media that can be integrated with Islamic values.

METHOD

This research and development are carried out by referring to the 4-D development model (Thiagarajan et al., 1974), which consists of 4 stages: defining, designing, developing, and disseminating (Irawan et al., 2018). However, this research and development are only carried out until the development stage. The research was conducted at Al Azhar 16 Islamic Public High School Semarang and MA Nurussalam Semarang with X MIPA class population. Research in the field test stage was more broadly carried out using saturated sampling because the population in class X in each school was not more than 20 students. Using this technique refers to the nonprobability sampling technique by taking all population members as a sample. This research has effectuated in the school before pandemic covid-19. So, all of the stages in this field have been done offline. The defined step is carried out by the front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objects. Analysis was performed with questionnaires validated before and concluded that the most complex material was bacteria. For the interview, the researchers asked about the learning resource, media used, the most challenging material and the reason, the student academic value, and what students need for the better quality of learning process. In the interview and questionnaire stage, it can be

seen that the schools of Al Azhar 16 Islamic Public High School Semarang and MA Nurussalam Semarang have the same troubles in bacterial material with no correlation teaching between Islamic value, science value and need a media that can visualize bacterial material. Researchers also study the core concept of bacteria about aim, the cumulative achievements indicator, and the basic competence of bacterial material. These various things are used as a reference for designing products.

The *define* stage was carried out by compiling the reference criteria test, media selection and format, and initial design. The initial prototype research of instructional media devices in BSB media designs containing *fiqh al biah*. The expert assessment stage carries out the development stage to ask for validation by material experts, media experts, integration experts, and biology teachers to see their responses and suggestions to the media. Then revisions are made after they are appropriate then, a development test is carried out. The development test was carried out in a limited field consisting of 5 students with random sampling from both schools. The results of the feasibility test on the limited field test show that the media is very feasible. After that, the media tested into a wider field test scale to see product validation. Data of this research is consists of quantitative and qualitative data. The qualitative data is about command, suggestion, and some opinion from material experts, media experts, integration experts, and field practitioners towards learning media. Quantitative data were obtained from validity scores obtained from each expert through a validity questionnaire. The researcher validates the questionnaire to the supervisor who is an expert in their respective fields before validating the product. Aspects of indicator in the questioner for material experts are content eligibility aspects, presentation feasibility aspects, and aspects of language eligibility used in media guidebooks. Besides, aspects of indicator in the questioner for media expert are the display aspect of media, the relevance of media and materials, aspects of visual media communication, and benefit aspect of media. The integration expert's aspect indicator is the integration content of science and Islam in the media, aspects of the spirituality of science in the media, and linguistic aspects (Al Quran, Al-Hadith, and Fiqh) text and context in media.

The validity questionnaire was used using a Likert scale. Guidelines for using the Likert scale can be seen through the [Table 1](#).

Table 1. Direction for valuation in Likert Scale

Statement	Score
Very Good	5
Good	4
Enough	3
Poorly	2
Very Less	1

(Source: [Riduwan & Sunarto, 2014](#))

The data obtained is then analyzed using the following percentage validity [Formula 1](#). P = Percentage of validity, x = score rating of respondents in one item, xi= ideal rating score in one item, 100% = a constant.

$$P = \frac{x}{xi} \times 100\% \quad (1)$$

The data obtained is then interpreted and concluded based on the qualification assessment criteria according to [Table 2](#).

Table 2. Assessment of media validity qualifications

Presentage of Assesment	Interpretation
81%-100%	Very worthy
61%-80%	Worthy
41%-60%	Worthy enough
21%-40%	Unworthy
0%-20%	Very unworthy

(Source: [Riduwan & Sunarto, 2014](#))

RESULTS AND DISCUSSION

This media has specially designed by researchers to answer challenges for the problems by making 3-dimensional media that can visualize bacteria and add Islamic content in their correlation with jurisprudence *al biah* or *fiqh* of environment. The resulting 3-dimensional media is divided into three sets, visualization of bacteria (namely set 1), and classification of bacteria (namely set 2). This set consists of the classification of bacteria based on their shape, the number of the flagellum, the need for oxygen, and a mini practicum media to determine bacteria's classification based on gram staining. Set 3 contains *fiqh al biah* media. This media is

in the form of a 3-dimensional diorama equipped with a story presentation. Then, students are asked to carry out instructions according to the instructions and answer some of the analysis questions asked. Before the media was tested on students, this media went through a revision stage based on media, material, and integration experts. Revisions from media experts are fixing the typo in the media guide book, but there were no revision suggestions in the context of media. According to material experts, revision suggests to media Set 1 an incorrect position between flagellum and pili organelles. Integration experts have no suggestion for revision. After the researcher's purpose, all of the revision and the next media will be tested on the students.

Set of bacterial visualizations (Set 1), the model of bacterial visualization produced was bacterial bacilli. Bacilli are used as model bacteria because they are found in many reading sources and are the most accessible bacteria to be identified and visualized. Media set 1 is designed so that it can be used to observe the morphology and anatomy of bacilli bacteria whose entire illustrative components refer to (Aripin & Suryaningsih, 2020). This set is also equipped with a mini box containing an organelle card affixed to several parts of the bacteria using adhesive (Figure 1).



Figure 1. Set 1: (1) visualization of bacterial morphology and (2) bacterial anatomy

Bacterial classification set (Set 2), the bacterial classification set consists of bacterial categorization based on the flagellum location, shape, oxygen requirements, and gram staining. Classification of bacteria based on the flagellum location, this form of bacterial visualization uses a bacterial model of bacilli. The right and left sides are adhesive to attach the flagellum modification (Figure 2). This media is designed to be disassembled and modified by students into monotric, lophotric, amphitric and peritric bacteria (Aryulina & Riyanto, 2016).



Figure 2. Set 2: (1) Classification of bacteria based on the location of the flagellum, (2) modification results in the form of monotric bacteria, (3) lophotric bacteria, (4) amphitric bacteria, and (5) peritric bacteria

Classification of bacteria based on their shape, visualization of the classification of bacteria based on their shape consists of coccus and bacilli. Coccus form bacteria are made from "pom-pom" (wool decoration) modified by sticking to the right side. The left side and the bacillus form of the bacillus are made of modified fur fabric formed into bacterial bacilli. This media is designed to be converted into coccus, diplococci,

staphylococci, and streptococci. Likewise, with the form of bacilli into monobacilli, diplobacillus, and streptobacillus (Figure 3).



Figure 3. Set 2: (1) Modification of coccus become monococcus, (2) diplococcus, (3) streptococcus, (4) staphylococcus, (5) modification of bacilli become monobacilli, (6) diplobacilli, and (7) streptobacilli

Bacterial classification based on oxygen requirements, media visualization is made of flannel fabric patchwork, which is analogous to bacterial colonies and resins as a medium so that both are inserted into a test tube. The media is equipped with adhesive in the cell's mouth and a bacterial card in the mini box 2. This media is designed so that students can distinguish aerobic, anaerobic, facultative anaerobic, and aerotolerant bacteria (Figure 4).



Figure 4. Display of bacterial calculation media based on oxygen requirements

Bacterial classification media based on gram staining consists of two petri dishes, a box of bacterial colonies, two dropper pipettes, one tweezer, and two test liquid bottles. This media is used as a mini-laboratory for gram staining lab (Figure 5).



Figure 5. Display of bacterial classification media based on gram staining


Containing *fiqh al biah* sides (Set 3), this media is a three-dimensional picture in the form of a miniature diorama, a picture of the river environment. The researchers use dioramas in this media because it has the relation of objects to each other. These described items are perfectly handled in dioramas as a depiction of reality (Mahlail et al., 2018). The instruction of using media is designed to analyze the correlation picture of the state of the situation with the slogan of the hadith contained in the media to determine the attitude/action that they must take if they find such river conditions (Figure 6).



Figure 6. Display of *fiqh al biah* media

BC (bacterial card) is a bacterial card containing a picture of bacteria, its classification, characteristics (shape, size, gram type, locomotion, oxygen need type), other information for students relating to several bacteria species, and the source of that information (Figure 7).

BACTERIAL CARD (BC)



Salmonella typhi

Sumber: typhid image/CDC.com

Klasifikasi:

Kingdom	Sub Kingdom	Filum	Kelas
Bacteria	Negibacteria	Proteobacteria	Gammagroteobacteria
Ordo	Famili	Genus	Spesies
Enterobacteriales	Enterobacteriaceae	Salmonella	Salmonella typhi

Karakteristik:

Bentuk	Ukuran	Jenis Gram	Alat Gerak	Kebutuhan Oksigen
Basil	0,3-2 x 1,5-20 mikron	Gram positif	Flagel tipe peritrik	Anaerob

Keterangan:
Salmonella typhi merupakan bakteri yang dapat menyebabkan demam tifoid. Bakteri ini bersifat patogen. *S.typhi* mampu bertahan hidup selama beberapa bulan sampai setahun jika melekat pada tinja, mentega, susu, keju dan air beku.

Sumber:
www.itis.gov.id
Cita YP.2011. Bakteri salmonella typhi dan demam tifoid. Jurnal kesehatan masyarakat Andalas. Jurnal.fkm.unand.ac.id (diakses pada 1 November 2019)

Figure 7. Display of BC (bacterial card)

The guiding book for using BSB (Bacterial Set Box) containing *fiqh al biah* media. This guiding book contains introductory material and instructions for using media. This guide book contains what bacteria is their classification, the content of what *fiqh al biah* is, and its implementation to our life (Figure 8). Besides, in this book, there were some correlations and descriptions between studying bacteria and the implementation of our daily life based on Al Quran, Al-Hadith, and *fiqh al biah* perspective. The following is the display of the front and back cover. For the whole of BSB guide book, it can download at this link; https://drive.google.com/file/d/1HxrpYKVMZYK_jjBDHe1_djeO0TYDF-7/view?usp=sharing



Figure 8. Display the front cover back of the media guide book

The validation results by mastery expert (ME), media expert (MeE), integration expert (IE), biologists' expert for Al Azhar 16 Islamic Public High School Semarang and MA Nurussalam Semarang. The validation result's feasibility showed 94% from mastery expert who is concluding that the media is valid to use. The feasibility of validation result from media expert was 79%, from integration expert was 96%, from the biology expert for Al Azhar 16 Islamic Public High School Semarang was 92% and from the biology expert for MA Nurussalam Semarang was 86%. Based on this result of the feasibility test, we can conclude that this media is very suitable for learning media. The following chart was about the percentage of the feasibility of validation results from all of the experts (Figure 9).

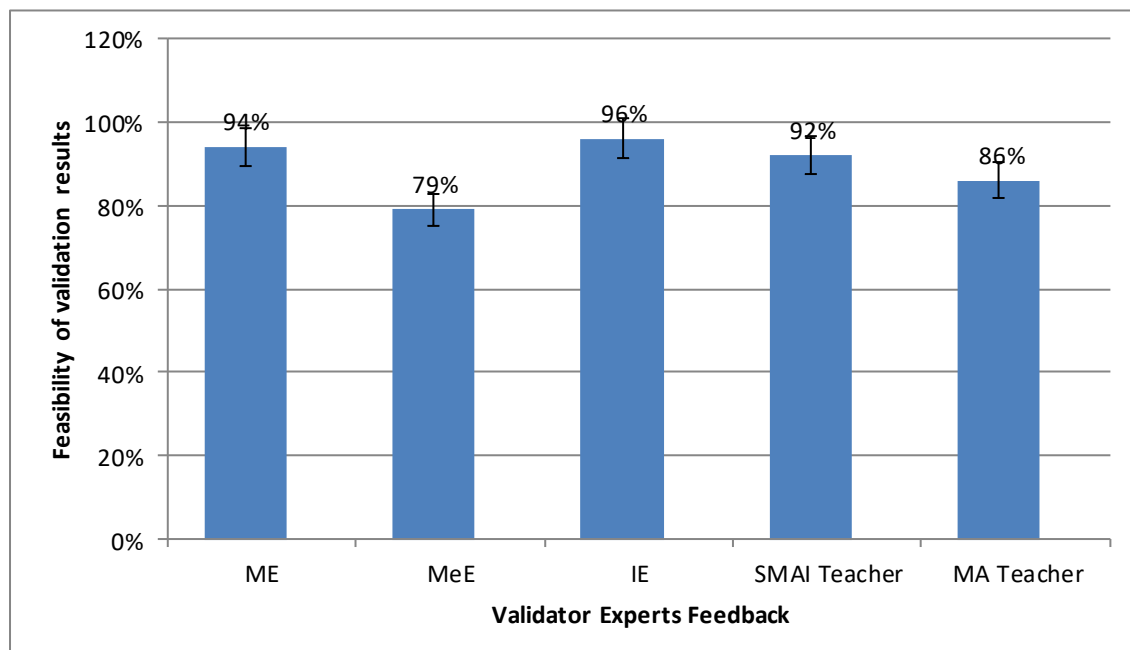


Figure 9. The graphic of feasibility validation result from the experts

The limited field test is carried out to obtain responses from a portion of the population as a reference for conducting a broader field test. Based on Table 3, it can be seen that this media is eligible to be tested on a more extensive scale of field.

Table 3. Limited field test results

No	Students	Aspects			Recapitulations of Categories
		Media	Theory	Benefits	
1.	PD-1	94,67%	100%	100%	Very Worthy
2.	PD-2	93%	92,3%	100%	Very Worthy
3.	PD-3	98,67%	84,6%	100%	Very Worthy
4.	PD-4	100%	100%	100%	Very Worthy
5.	PD-5	85,3%	87,69%	90%	Very Worthy

The result of the wider field test showed by this graphic in Figure 10. The average recapitulation of student responses from AI Azhar 16 Public high school Semarang and MA Nurussalam Semarang is 89.3%, with a very decent category. This percentage has shown that the BSB (Bacteria Set Box) media containing *fiqh al biah* was valid and decent for helping students study bacteria and integrate bacteria material and *fiqh al biah* by a reverse to validity and decent test category from (Riduwan & Sunarto, 2014). The percentage also showed that the media approved to use.

BSB (Bacterial Set Box) media containing *fiqh al biah* is a media specifically designed for group use. One group consists of 5-6 students. In using this media, teachers can use discovery learning models. Researchers present *fiqh al biah* in bacterial material as a novelty. In this media set 3, students are given media in the form of mini dioramas of the river environment, mini slogan boards containing the prohibition of disposing of trash, and hadith boards that say "At Thahuuru Syathrul Iman". As well as for instructions for using the media. Students are asked to carry out instructions according to the instructions in the form of a story like the one in the Figure 11.

Based on the researchers' analysis, by using this media, the students have gained knowledge of environmental *fiqh* that what the main character in the story is doing is wrong and violates religious norms, and is against the Qur'an and hadith. The feedback answer from students states that they do not know about *fiqh al biah* first after they studied with this media, they understand what environment *fiqh* is and how the implementation in their daily lives. Thus, students will think the actions that can destroy the balance of the environment are *haram* to do. In this media context, students will learn by themselves that small actions such as throwing garbage in the river have many negative impacts on nature and humans themselves. Therefore, it will indirectly form a moral responsibility based on scientific and religious knowledge that damaging the environment is bad. And this is where the role of environmental *fiqh* is applied.

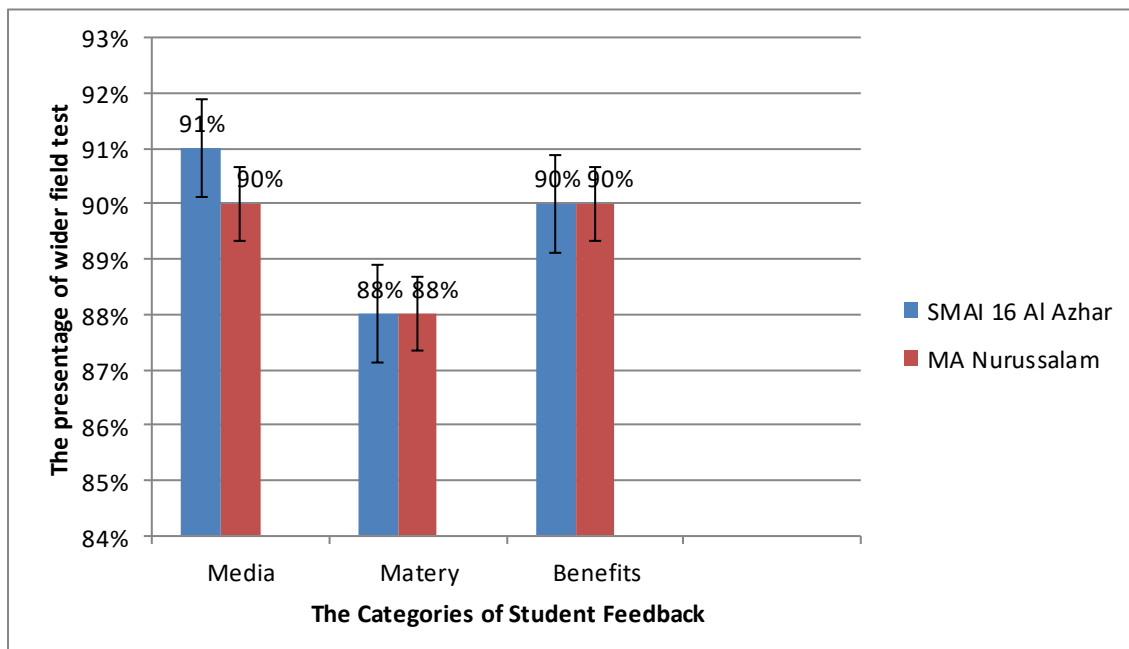


Figure 10. The graphic of the wider field test results



Figure 11. The sample of guidance book in *fiqh al biah* material

This study research analysis has an equal characteristic study that 3-Dimensional media can help the students study invisible objects and raise their understanding of the material. Students can see what is learned and explained by the teacher clearly (Arifin & Lestari, 2020; Yuniarti et al., 2017). Developing BSB (Bacterial Set Box) media based on *fiqh al biah* give positive impacts students. BSB media is a model that fuses a few speculations identified with instructional structure and learning forms. Students hold more data by what they do rather than what seems to be heard, perused, or watched (Davis & Summers, 2015). Using diorama to collaborate between science and Islamic value has successfully increased students' interest. This result is the same as the research study from (Efe, 2017) that students taught by diorama were better in science learning skills than those taught with the traditional learning method. *Fiqh al biah* is a paradigm in Islamic religion (Mufid, 2014) that suggests protecting and curing the environment as an asset from God (Hidayat, 2015). By adding *fiqh al biah* content, BSB (Bacterial Set Box) media become a complex media that helps students study the correlation between Islam and science. This integration is a novelty of this research. This media also becomes attractive media for students; it shows that when the media implement to the student, they are very interested because they learn something with the new media and make them understand.

CONCLUSION

The characteristics of BSB (Bacterial Set Box) media containing *fiqh al biah* are as follows bacterial visualization set (set 1), bacterial classification set (set 2), and *fiqh al biah* set (set 3). This media is also equipped with BC (Bacterial Card) and media usage manual. The results showed that the validation percentages were 94% (material expert), 79% (media expert), 96% (integration expert), 92% (biology teacher of Al Azhar Islamic Public School 16), and 86% (biology teacher of MA Nurussalam). So, this media can cover all the problems and fix them by combining Islamic and science vibes. The researchers also hope that this media can be useful media for all of the students in the large field who want to learn about bacteria and its implementation. All of the researchers on the science education side have to give more attention to this complexity of the integration between Islamic and science vibes by creating another media that combines the other material issues.

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