

Development of Biology E-Modules Based on Islamic, Science, Environment, Technology, and Society Using eXeLearning on Bacterial Material

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Abstract:

Online learning during the COVID-19 pandemic is a choice so that learning can continue. However, in its implementation, various obstacles were found. These obstacles are caused by poor internet networks, limited internet quotas, and the availability of teaching materials that do not support the online learning process. Therefore the objectives of this study are to describe: 1) The validity of the biology e-module, 2) The practicality of the biology e-module, and 3) Students' responses to the biology e-module based on I-SETS using *eXeLearning* on bacterial material. The method used in this study is the research and development method with the ADDIE model. The result shows that: 1) The average validity results of biology e-modules, include the material validity of 94,5% (very valid) and the media validity of 95% (very valid), 2) The practicality of the biology e-module was obtained at 94% (very practical), and 3) The average student's responses to the biology e-module was obtained at 85% (very good). So, it can be concluded that the biology e-module that has been successfully developed can be used in online biology learning.

Keywords: Biology E-Module, *eXeLearning*, I-SETS, Online Learning

Abstrak:

Pembelajaran daring selama pandemi COVID-19 menjadi alternatif pilihan agar pembelajaran tetap dapat berlangsung. Akan tetapi dalam pelaksanaannya ditemukan berbagai kendala. Kendala-kendala tersebut disebabkan oleh jaringan internet yang buruk, kuota internet yang terbatas, dan ketersediaan bahan ajar yang kurang mendukung proses pembelajaran daring. Oleh karena itu, tujuan penelitian ini untuk mendeskripsikan: 1) Validitas e-modul biologi, 2) Praktikalitas e-modul biologi, dan 3) Respons siswa terhadap e-modul biologi berbasis I-SETS menggunakan eXeLearning pada materi bakteri. Metode yang digunakan dalam studi ini adalah metode penelitian dan pengembangan dengan model ADDIE. Hasil studi menunjukkan bahwa: 1) Rata-rata validitas e-modul biologi, meliputi validitas materi sebesar 94,5% (sangat valid) dan validitas media sebesar 95% (sangat valid), 2) Praktikalitas e-modul biologi sebesar 94% (sangat praktis), dan 3) Rata-rata respons siswa terhadap e-modul biologi sebesar 85% (sangat baik). Maka dapat disimpulkan e-modul biologi yang berhasil dikembangkan dapat digunakan dalam pembelajaran biologi secara daring.

Kata Kunci: E-Modul Biologi, *eXeLearning*, I-SETS, Pembelajaran Daring

Introduction

The COVID-19 pandemic that occurred in Indonesia caused a tremendous impact on various aspects of life, including education. It is recorded that since March 2020, education in Indonesia began to experience a revolution. To prevent the transmission of COVID-19,



conventional learning at all levels of education began to shift to online learning.¹ Despite the advantages and disadvantages, online learning is a solution that can be done so that learning can continue and avoid the transmission of COVID-19.² However, the consequence is that teachers and students must have mastery of technology. In addition, there are various obstacles, such as unstable internet networks, insufficient internet quota, and limited teaching material and learning media.³

Based on the results of the analysis of the needs of class X MIPA students at MAN Bondowoso, East Java, Indonesia, it shows that during the online learning process, students experience various obstacles that cause a decrease in learning outcomes. The obstacles faced by students include poor internet networks, limited internet quotas, and the availability of printed teaching materials that do not support online learning in terms of use, content, and presentation. One of the materials that show that the average student learning outcome is below the minimum completion criteria is bacterial material. As some studies state that bacterial material is one of the materials that are very difficult for students to understand because the material is complex, complicated, abstract, microscopic, and contains many scientific names.⁴

So to overcome these problems, an innovation is needed that makes it easier for students to understand bacterial material during the online learning process. One of the alternatives offered is an I-SETS-based biology e-module. I-SETS-based e-modules will make learning more meaningful because it integrates the material with Islam, the environment, awareness of phenomena that occur in society, scientific thinking attitudes, and understanding of technological developments.⁵ Najib and Alhefni report that meaningful learning can improve student learning outcomes.⁶ According to Imadudin I-SETS carries the message that knowledge comes from the same source, namely Allah Swt, which is manifested in the Qauliyah verses (Qur'an and Sunah) and the Kauniyah verses (the universe and its contents). Meanwhile, science can be utilized in

¹ Jeffry Handhika et al., *Pembelajaran sains di era akselerasi digital* (Magetan: CV. AE MEDIA GRAFIKA, 2020).

² Rizki Ananda, Fadhilaturrehmi Fadhilaturrehmi, and Imam Hanafi, "Dampak pandemi Covid-19 terhadap pembelajaran tematik di Sekolah Dasar," *Jurnal Basicedu* 5, no. 3 (July 10, 2021): 1689–94, <https://doi.org/10.31004/basicedu.v5i3.1190>.

³ Zuraida Nisaul Alfiah et al., "Analisis kesulitan belajar matematika secara daring bagi siswa Sekolah Dasar," *Jurnal Basicedu* 5, no. 5 (August 16, 2021): 3158–66, <https://doi.org/10.31004/basicedu.v5i5.1297>; Amran Amran et al., "Hambatan siswa dalam pembelajaran daring pada mata pelajaran matematika pada masa pandemik Covid-19 Di Sekolah Dasar," *Jurnal Basicedu* 5, no. 6 (October 18, 2021): 5179–87, <https://doi.org/10.31004/basicedu.v5i6.1538>; Alwan Fauzy and Puji Nurfauziah, "Kesulitan pembelajaran daring matematika pada masa pandemi COVID-19 di SMP Muslimin Cililin," *Jurnal Cendekia: Jurnal Pendidikan Matematika* 5, no. 1 (March 17, 2021): 551–61, <https://doi.org/10.31004/cendekia.v5i1.514>; Pipip Zulfa Huzaimah and Risma Amelia, "Hambatan yang dialami siswa dalam pembelajaran daring matematika pada masa pandemi COVID-19," *Jurnal Cendekia* 5, no. 1 (2021): 533–41; Rinrin Nur Tasdik and Risma Amelia, "Kendala siswa SMK dalam pembelajaran daring matematika di situasi pandemi COVID-19," *Jurnal Cendekia: Jurnal Pendidikan Matematika* 5, no. 1 (March 17, 2021): 510–21, <https://doi.org/10.31004/cendekia.v5i1.536>.

⁴ Syarifah Fadillah and Yadi Ardiawan, "Pengaruh *Model Problem Solving* dan *Problem Posing* terhadap kemampuan pemecahan masalah ditinjau dari Self Confidence," *AKSIOMA: Jurnal Program Studi Pendidikan Matematika* 10, no. 3 (October 1, 2021): 1373–81, <https://doi.org/10.24127/ajpm.v10i3.3664>; Salwa Rezeqi et al., "Analisis kebutuhan bahan ajar taksonomi organisme tingkat rendah terhadap capaian pembelajaran berbasis KKNI," *Jurnal Pelita Pendidikan* 8, no. 2 (July 2, 2020), <https://doi.org/10.24114/jpp.v8i2.17697>.

⁵ Rita Rahmaniati and Supramono Supramono, "Pembelajaran I-SETS (Islamic, Science, Environment, Technology and Society) terhadap hasil belajar siswa," *Anterior Jurnal* 14, no. 2 (June 1, 2015): 194–200, <https://doi.org/10.33084/anterior.v14i2.185>.

⁶ Donas Ahmad Najib and Elhefni Elhefni, "Pengaruh penerapan Pembelajaran Bermakna (*Meaningfull Learning*) pada Pembelajaran Tematik IPS Terpadu terhadap hasil belajar siswa kelas III di MI Ahliyah IV Palembang," *JIP Jurnal Ilmiah PGMI* 2, no. 1 (January 23, 2016): 19–28, <https://doi.org/10.19109/jip.v2i1.1063>.

technology, and technology can be used to meet the needs of society while still paying attention to its implications for the environment.⁷

The application used to develop biology e-modules is *eXeLearning*. *eXeLearning* was chosen because it has various advantages including an open source application, can be used for free, can be used to compile teaching materials in a web form, can be exported to various content (IMS, SCROM1, and websites), can be used independently, can be integrated into LMS (Learning Management System), easy to navigate, and allows creating teaching materials that contain text, images, interactive activities, and multimedia clips.⁸ *eXeLearning* is also suitable for use in the digital era, can improve learning outcomes, and is effectively used during online learning at home.⁹

Related to this study, several studies have reported on the development of I-SETS-based e-modules and e-modules using *eXeLearning*, including the results of the study by Puspita et al who succeeded in developing I-SETS-based biology student worksheets with very feasible criteria for use.¹⁰ In addition, Rafik et al have also reported that the development of *Augmented Reality* teaching materials on the I-SETS-based circulatory system material is suitable for use and can improve the understanding of the material in the circulatory system.¹¹ Furthermore, Agusti et al stated that the development of chemical e-modules using *eXeLearning* was tested to be feasible to use with a material validity of 93.33% and the media validity of 92%.¹² However, there have been no reports of studies on the development of I-SETS-based biology e-modules on bacterial material using *eXeLearning* software simultaneously.

Therefore, based on this phenomenon, researchers are interested in developing this biology e-module intending to describe: 1) The validity of the biology e-module, 2) The practicality of the biology e-module, and 3) Students' responses to the biology e-module based on I-SETS using *eXeLearning* on bacterial material. It is hoped that this biology e-module can be used in online learning and can help students in understanding bacterial material comprehensively.

Method

This study was conducted at MAN Bondowoso, East Java, Indonesia, in the 2020/2021 school year. The method used in this study is the research and development method with the

⁷ Muhamad Imaduddin, "A New way to promote Islamization of Science: I-SETS Design for pre-service science teachers," *Journal of Natural Science and Integration* 3, no. 1 (April 30, 2020): 1–12, <https://doi.org/10.24014/jnsi.v3i1.8774>.

⁸ *eXeLearning*, *eXeLearning Features: New in EXe 2.7*, n.d., <https://exelearning.net/en/features/>; Mastiur Verawaty Silalahi et al., "Pelatihan penggunaan *eXeLearning* sebagai Media Pembelajaran Online yang interaktif," *Jurnal Abdidas* 2, no. 4 (August 25, 2021): 954–63, <https://doi.org/10.31004/abdidas.v2i4.404>; Purnama Sofyan, *Panduan EXeLearning Sebagai Aplikasi Pembuat Modul E-Learning* (Pusdiklat Kehutanan, 2015), https://purnamasofyan.id/wp-content/uploads/2019/03/PANDUAN-EXELEARNING-purnamasofyan.id_.pdf.

⁹ Mukhlis Rohmadi, "Pemanfaatan *eXeLearning* sebagai media belajar dari rumah selama Pandemi Covid-19," *Educatio: Jurnal Ilmu Kependidikan* 16, no. 1 (July 11, 2021): 37–49, <https://doi.org/10.29408/edc.v16i1.3343>; Mastiur Verawaty Silalahi, "Pengembangan Media EXeLearning Pada Kimia Dasar Terhadap Hasil Belajar Mahasiswa," *Jurnal Pedagogi Dan Pembelajaran* 3, no. 3 (2020): 516–24, <https://doi.org/10.23887/jp2.v3i3.29293>.

¹⁰ Laila Puspita et al., "The development of worksheets students based I-SETS (Islamic, Science, Enviroment, Technology, Society) skills to train students think critically," *Jurnal Pendidikan Biologi* 11, no. 02 (2022): 21–29, <https://doi.org/10.24114/jpb.v11i2.28058>.

¹¹ Ainur Rafik, Bayu Sandika, and Ira Nurmawati, "Development of *Augmented Reality* teaching materials based on I-SETS towards understanding the concept of learners," in *Integrated Models of Knowledge and Religion in Contemporary Muslim World*, vol. 1 (The 1st Annual Conference on Islam, Education, and Humanities (ACIEH), LP2M, UIN Kiai Haji Achmad Siddiq Jember, 2022), 167–82, <https://proceedings.uinkhas.ac.id/index.php/proceedings/article/view/24>.

¹² Mely Agusti, Sura Menda Ginting, and Febrian Solikhin, "Pengembangan E-Modul Kimia menggunakan *eXe-Learning* berbasis *Learning Cycle 5e* pada materi larutan penyangga," *ALOTROP: Jurnal Pendidikan Dan Ilmu Kimia* 5, no. 2 (2021): 198–205, <https://doi.org/10.33369/atp.v5i2.17240>.

ADDIE model. The procedures used are analyzing, designing, developing, implementing, and evaluating.¹³ At the stage of the analyzing is carried out the identification of problems and the analysis of needs are. Aspects of analysis include problem analysis, curriculum analysis, student characteristics analysis, teaching material characteristics analysis, material analysis, media analysis, analysis, assignments, and student learning style analysis. The stage of designing is a process of designing materials, media, questions, assignments, skills, and instruments used in the development stage, selecting types of teaching materials, formulating learning objectives, and designing and compiling e-module designs. At the stage of development, there is a validation process and e-module trials. E-modules are validated by experts i.e. material experts, media experts, and practicality experts. Then, to see the students' responses to the biology e-module, a small-scale trial was carried out. The grid of expert validation instruments to e-modules based on BNSP and Anisah is shown in Tables 1, 2, and 3.¹⁴ Meanwhile, the grid of limited scale e-module test instruments is adapted from Andila et al., and Herawati and Muhtadi in Table 4.¹⁵

Table 1. The Grids of E-Module Validation Instruments by Material Experts

No.	Aspect	Number of Statement Items
1.	Content feasibility	7
2.	Language feasibility	7
3.	Presentation feasibility	6
Total		20

Table 2. The Grid of E-Module Validation Instruments by Media Expert

No.	Aspect	Number of Statement Items
1.	Cover design	3
2.	Content design	4
3.	The Ease of use	2
4.	Implementation	1
Total		10

Table 3. Practicality Instrument Grids

No.	Aspect	Number of Statement Items
1.	Content feasibility	7
2.	Language feasibility	7
3.	Presentation feasibility	6
4.	Cover design	3

¹³ Risa Nur Sa'adah and Wahyu, *Metode penelitian R & D (Research and Development): Kajian teoritis dan aplikatif* (Malang: CV Literasi Nusantara Abadi, 2021).

¹⁴ BSNP, *Standar buku ajar dan modul ajar* (Kementerian Riset, Teknologi dan Pendidikan Tinggi Direktorat Jenderal Pembelajaran dan Kemahasiswaan Direktorat Pembelajaran, 2017), [http://bpm.umg.ac.id/aset/images/download/M3-Standar-BA\(1-8-2017\).pdf](http://bpm.umg.ac.id/aset/images/download/M3-Standar-BA(1-8-2017).pdf); Silvia Anisah, "Desain dan uji coba coba modul dengan Pendekatan SETS (*Science, Environment, Technology, and Society*) pada materi larutan penyangga" (Thesis, Riau, Universitas Islam Negeri Sultan Syarif Kasim Riau, 2020), <http://repository.uin-suska.ac.id/29536/>.

¹⁵ Kiki Andila, Hadma Yuliani, and Nur Inayah Syar, "Pengembangan bahan ajar fisika berbentuk *E-Modul* berbasis Kontekstual menggunakan aplikasi *eXe-Learning* pada materi usaha dan energi," *Kappa Journal* 5, no. 1 (June 30, 2021): 68–79, <https://doi.org/10.29408/kpj.v5i1.2757>; Nita Sunarya Herawati and Ali Muhtadi, "Pengembangan Modul Elektronik (*e-Modul*) interaktif pada mata pelajaran kimia kelas XI SMA," *Jurnal Inovasi Teknologi Pendidikan* 5, no. 2 (October 30, 2018): 180–91, <https://doi.org/10.21831/jitp.v5i2.15424>.

5.	Content design	4
6.	The Ease of use	2
7.	Implementation	1
	Total	30

Table 4. Grids of Small Scale Trial Instruments (Limited)

No.	Aspect	Number of Statement Items
1.	Material	3
2.	Appearance	2
3.	Attractiveness	2
4.	Advantage	3
	Total	10

Furthermore, at the implementation stage, there was a process of applying the biology e-module which had been tested for validity and practicality to students in a limited number of 10 students of class X MIPA 3 MAN Bondowoso. Then, questionnaires were distributed to find out student responses to the biology e-module. At the evaluation stage, there are two types of evaluation (formative and summative). However, this study only conducted a formative evaluation. As the purpose of this research is to develop products and to know the validity, practicality, and student responses. At this final stage, a product revision is carried out based on the results of the assessment of teaching materials at the previous stage.

Data collection instruments used in this study were interviews, questionnaires, and documentation. Interviews were conducted with biology teachers and students to find out the problems and needs of students. Questionnaires in this study were material validation questionnaires, media validation, practicality questionnaires, and student responses. The questionnaire contains quantitative assessments and qualitative responses. Quantitatively, respondents filled out scores using a *Likert Scale* with a choice of scales 1 to 4 shown in Table 5.¹⁶ While qualitatively, respondents provide comments and suggestions openly on the biology e-module. In this study, documentation consisted of student teaching materials, student worksheets, biology textbooks, student learning outcomes, and student lists.

Table 5. Questionnaire Rating Scale

No.	Criteria	Score
1.	Very good	4
2.	Good	3
3.	Not Good	2
4.	Very Not Good	1

The product trial subjects in this study were 2 material experts, 2 media experts, 1 biology teacher, and 10 students of class X MIPA 3 MAN Bondowoso. The material expert validators are Mohammad Wildan Habibi, M.Pd., and Rosita Fitrah Dewi, S.Pd., M.Si. The two validators have qualifications as specialists in microbiology material, a master's degree, and lecturers in the Biology Education Study Program at UIN Kiai Haji Achmad Siddiq Jember. The first media expert validator was Dinar Maftukh Fajar, S.Pd., M.Pfis. who has the qualifications of a media expert, a

¹⁶ Sugiyono, *Metode Penelitian & Pengembangan (Research and Development)*. (Bandung: Alfabeta, 2015).

master's degree, and a lecturer in Science Education at the UIN Kiai Haji Achmad Siddiq Jember. While the second media expert validator is Ira Nurmawati, S.Pd. M.Pd. who has the qualifications of a media expert, master's degree, and lecturer in Biology Education Program Study at UIN Kiai Haji Achmad Siddiq Jember. The practicality test was carried out by Yustisia Walida, S.Pd. who has a bachelor's education qualification and is a biology teacher at MAN Bondowoso. While the limited test was carried out by 10 students of class X MIPA 3 MAN Bondowoso.

The data analysis technique used is descriptive qualitative and quantitative descriptive analysis techniques. The data analyzed is the result of validation sheets, practicality, and student responses with predetermined assessment criteria using the formula as in equation (1). The criteria for validity, practicality, and student responses adapted from Zunaidah and Amin are shown in Table 6.¹⁷

$$Percentage = \frac{\text{Score obtained}}{\text{Maximum Score}} \times 100\% \quad (1)$$

Table 6. Criteria for Interpreting Results of Validity, Practicality, and Student Responses

No.	Interval	Criteria		
		Validity	Practicality	Student Response
1.	81%-100%	Very Valid	Very Practical	Very Good
2.	61%- 80%	Valid	Practical	Good
3.	41%-60%	Quite Valid	Quite Practical	Quite Good
4.	21%-40%	Less Valid	Less Practical	Less Good
5.	0%-20%	Very Less Valid	Very Less Practical	Very Less Good

Results and Discussion

The biology e-module which was developed based on I-SETS uses the *eXeLearning* application. Users can access it with the help of the *Reasily* application. The development procedure is according to the ADDIE model used.

1. Analyzing Stage

Based on the results of the analysis, it was found that during the COVID-19 pandemic, students conducted distance learning from home using *Android*. However, students experience various obstacles during the online learning process. The results of interviews with students showed that the obstacles faced by students were: 1) The internet network is not supportive, 2) The internet quota is not enough to access learning videos, and 3) The use of printed teaching materials is considered less effective during online learning. Students state that the pictures on student worksheets are colorless, the explanation of the material on student worksheets is limited and less detailed, and the presentation of student worksheets is less attractive. While in the biology package book, the number is limited, so the package book must be used interchangeably, and 4) Especially in bacterial material, never do the practicum.

Furthermore, the results of interviews with biology teachers showed that the curriculum used was the revised 2013 curriculum. In addition, teachers have never used I-SETS-based biology teaching materials in biology subjects. MAN Bondowoso is an Islamic-based school. However, there are no biology teaching materials that are integrated with Islamic values, verses of the Qur'an,

¹⁷ Farida Nurlaila Zunaidah and Mohamad Amin, "Developing the learning materials of biotechnology subject based on students' need and character of Nusantara PGRI University of Kediri," *Jurnal Pendidikan Biologi Indonesia* 2, no. 1 (2016): 19–30.

and hadith. Teachers also find it difficult to provide material in video form because students do not have sufficient quota to access material on *Youtube*.

2. Designing Stage

At this stage, the researcher succeeded in compiling material and evaluation questions on the biology e-module according to core competencies, basic competencies, competency achievement indicators, and learning objectives. The material is compiled based on up-to-date references from microbiology books, microbiological studies from an Islamic perspective, and scientific journal articles. In addition, there is an integration between bacterial material and Islamic, science, environment, technology, and society (I-SETS).

One example of I-SETS integrations in bacterial material can be seen in the harmful bacterial (pathogenic bacteria) sub-material, namely in the phenomenon of *Syphilis*. Scientifically, this disease is caused by the bacterium *Treponema pallidum* and transmitted by direct contact with a syphilis sore during anal, vaginal, or oral sex.¹⁸ Some researchers have reported that one of the main routes of transmission of *Syphilis* is through free sex.¹⁹ Free sex behavior is strictly prohibited in Islam and free sex in Islam is part of the act of adultery.²⁰ Syarbini, Mukri, and Jalaludin revealed that both adultery (zina) and free sex are “haram” in Islam.²¹ In Islam, it has been regulated regarding the prohibition of committing adultery which is stated in the Qur'an Surah Al-Isra'verse 32.²² Thamrin explained that one of the pearls of wisdom of prohibiting adultery is preventing various diseases caused by adultery.²³

Not only harmful bacterial material but Islamic integration can also be linked to the other bacterial sub-material. The material includes the history of the discovery of bacteria, bacterial reproduction, and beneficial bacteria. For example, the history of the discovery of bacteria cannot be separated from the contributions of Islamic scientists, namely Ibn Sina and Ibn Haytham.²⁴ In addition to integrating material with Islam, bacterial material is also integrated with aspects of science. Its implementation can be done by building concepts from the symptoms of nature, developing scientific thinking and attitudes, and relating theoretical concepts of science to

¹⁸ Serena Braccio, Mike Sharland, and Shamez N. Ladhani, “Prevention and treatment of mother-to-child transmission of *Syphilis*,” *Current Opinion in Infectious Diseases* 29, no. 3 (June 2016): 268–74, <https://doi.org/10.1097/QCO.0000000000000270>.

¹⁹ Alexandre Cândido da Silvia et al., “Importance of the dentist and the auxiliary oral health team in the diagnosis of Syphilis,” *Revista Cubana de Estomatología* 57, no. 1 (2020): 1–11; Braccio, Sharland, and Ladhani, “Prevention and Treatment of Mother-to-Child Transmission of Syphilis.”

²⁰ Dewi Lestari, “Hubungan persepsi siswa dengan layanan informasi terhadap tingkat pemahaman pergaulan bebas di SMA Negeri 4 Tebing Tinggi,” *Al-Mursyid: Jurnal Ikatan Alumni Bimbingan dan Konseling Islam (IKABKI)* 2, no. 2 (2020): 250–64.

²¹ H. Amirulloh Syarbini and H Hasbiyallah, *Anda bertanya ustadz menjawab* (Bandung: Kawan Pustaka, 2013), https://www.google.co.id/books/edition/Anda_Bertanya_Ustadz_Menjawab/s_RqMlM78LIC?hl=en&gbpv=0; Syarifah Gustiawati Mukri, “Pendidikan seks usia dini dalam perspektif hukum Islam,” *Mizan: Jurnal Ilmu Syariah, FAI Universitas Ibn Khaldun (UIKA) BOGOR* 3, no. 1 (2015): 1–20, <https://doi.org/10.32507/mizan.v3i1.153>; Moh. Jalaludin and Abdul Azis, “Pergaulan bebas generasi muda dalam Perspektif Hukum Islam (Al-Qur'an),” *Al Irsyad: Jurnal Studi Islam* 1, no. 1 (March 5, 2022): 41–56, <https://doi.org/10.54150/alirsyad.v1i1.86>.

²² Ali Mohtarom, “Hukum menikahi wanita hamil karena zina dan kedudukan anaknya,” *Jurnal Mu'allim* 2, no. 1 (July 10, 2020): 1–14, <https://doi.org/10.35891/muallim.v2i1.2158>; Anita Alawiah, “Risk factors for the incidence of sexually transmitted infections in The Makassar City skin and genital health center in 2019” (Makassar, Universitas Muhammadiyah Makassar, 2020), https://digilibadmin.unismuh.ac.id/upload/25460-Full_Text.pdf.

²³ Tamrin, “Zina dalam perspektif tafsir Al-Qur'an,” *MUSAWA* 11, no. 1 (2019): 1–13, <https://doi.org/10.24239/msw.v11i1.439>.

²⁴ Hotmasari Harahap et al., “Filsafat Islam pada masa *Golden Age* dan kontribusinya dalam dunia pendidikan,” *Scaffolding: Jurnal Pendidikan Islam dan Multikulturalisme* 4, no. 3 (2022): 250–66, <https://doi.org/10.37680/scaffolding.v4i3.2024>; H.M. Subandi, *Mikrobiologi: Kajian dalam perspektif Islam*, Edisi Revisi (Bandung: PT Remaja Rosdakarya, 2014).

everyday life. In this biology e-module, one form of integration is found in simple practicum activities to make organic fertilizers.

The integration of bacterial material with environmental aspects can be seen in the use of bacteria to overcome environmental pollution. An example of a bacterium that has the potential to degrade plastic is *Pseudomonas sp.* In addition, there are bacteria *Alcanivorax nanbaiticus* and *Halomonas meridiana* that function in degraded diesel oil spills in the waters.²⁵ The integration of bacterial material with technology in this biology e-module is carried out by studying beneficial bacteria in various technological fields. For example, the use of *Methanobacterium* in biodigester technology.²⁶ Meanwhile, society integration is in the use of bacteria for the welfare of society. Although there are harmful bacteria, certain types of bacteria also have many benefits for human well-being. Bacteria can be used in various fields, such as environment, technology, health, food, and, industry.²⁷

At this stage, the formulation of learning objectives is also carried out. Learning objectives are arranged based on core competencies and basic competencies 3.5 and 4.5.²⁸ The preparation of biology e-modules is based on the guidelines for the preparation of e-modules by Kemendikbud. The components contained in the e-module are cover, preface, table of contents, glossary, introduction (sub-components: basic competencies; competency achievement indicators; description; time; prerequisites; and instructions for use), learning (sub-components: learning objectives; descriptions; summaries; assignments; skill worksheets; and self-assessments), evaluations (sub-components: individual project assignments and daily tests), and appendices (sub-components: tables and bibliography).²⁹ The biology e-module is designed using the *eXeLearning* application. Especially for the cover before being included in *eXeLearning* was first designed using *Microsoft Word* shown in Figure 1. After the e-module is successfully created, users can access it via *Android* with the help of *the Reasily* as shown in Figure 2.

²⁵ Jiaojie Li et al., "Rapid biodegradation of Polyphenylene Sulfide Plastic Beads by *Pseudomonas Sp.*," *Science of The Total Environment* 720 (June 2020): 137616, <https://doi.org/10.1016/j.scitotenv.2020.137616>; Atik Sriningsih and Maya Shovitri, "Potensi isolat bakteri *Pseudomonas* sebagai pendegradasi plastik," *Jurnal Sains dan Seni ITS* 4, no. 2 (2015): 2337–3520, <https://doi.org/10.12962/j23373520.v4i2.13495>; R.A. Wilkes and L. Aristilde, "Degradation and metabolism of synthetic plastics and associated products by *Pseudomonas Sp.*: Capabilities and Challenges," *Journal of Applied Microbiology* 123, no. 3 (September 2017): 582–93, <https://doi.org/10.1111/jam.13472>; Ita Puspitasari, Agus Trianto, and Jusup Supriyanto, "Eksplorasi bakteri pendegradasi minyak dari perairan Pelabuhan Tanjung Mas, Semarang," *Journal of Marine Research* 9, no. 3 (2020): 281–88, <https://doi.org/10.14710/jmr.v9i3.27606>.

²⁶ N Ginting, "Biomethanization technology application on slaughterhouse in Indonesia," *IOP Conference Series: Earth and Environmental Science* 963, no. 1 (January 1, 2022): 012037, <https://doi.org/10.1088/1755-1315/963/1/012037>; Fatma Y. Hassaneen et al., "Impact of innovative nanoadditives on biodigesters microbiome," *Microbial Biotechnology*, November 22, 2022, 1751-7915.14173, <https://doi.org/10.1111/1751-7915.14173>; Handi Trianto and Dodit Ardiatma, "Pengolahan kotoran sapi sebagai bahan pembuatan biogas di kandang komunal Dusun Sukunan Kelurahan Banyuraden Kecamatan Gamping Sleman Yogyakarta," in *Prosiding SAINTEK: Sains dan Teknologi*, vol. 1, 1 (Call for papers dan Seminar Nasional Sains dan Teknologi Ke-1 2022, Bekasi: Fakultas Teknik, Universitas Pelita Bangsa, 2022), 490–99, <https://www.jurnal.pelitaibangsa.ac.id/index.php/SAINTEK/article/view/1361>.

²⁷ Uly Zakiyah Kurniati, *Ringkasan materi dan latihan soal biologi kelas X SMA/MA kurikulum 2013* (Jakarta: Bhuana Ilmu Populer, 2020).

²⁸ Kemendikbud, *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 37 Tahun 2018* (Jakarta: Kementerian Pendidikan dan Kebudayaan, 2018), <https://jdih.kemdikbud.go.id/sjdih/siperpu/dokumen/salinan/Permendikbud%20Nomor%2037%20Tahun%202018.pdf>.

²⁹ Kemendikbud, *Panduan Praktis Penyusunan E-Modul Tahun 2017* (Direktorat Pembinaan Sekolah Menengah Atas Direktorat Jenderal Pendidikan Dasar dan Menengah Kementerian Pendidikan dan Kebudayaan Tahun 2017, 2017), file:///C:/Users/YES/Downloads/12333-34623-1-PB.pdf.



Figure 1. Biology E-Module Cover Design

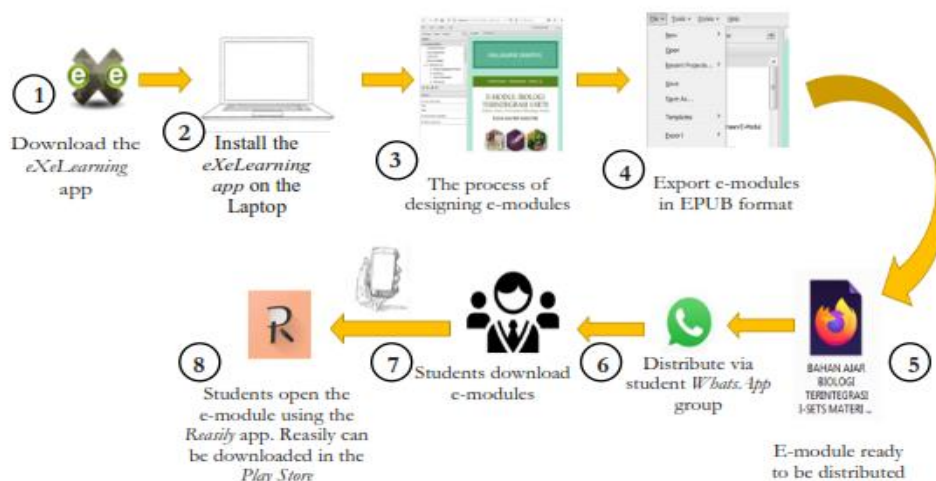


Figure 2. The Flow of Biology E-Module Design using eXeLearning

3. Developing Stage

At the development stage, the biology e-module testing process is carried out. Tests include validity tests and practicality tests shown in Table 7.

Table 7. Validity and Practicality Test Results Data

No.	Assessment by Experts	Average	Criteria
1.	Validation by Material Expert I	94%	Very Valid
2.	Validation by Material Expert II	95%	Very Valid
	Average score	94,5%	Very Valid
3.	Validation by Media Expert I	95%	Very Valid
4.	Validation by Media Expert II	95%	Very Valid
	Average score	95%	Very Valid
5.	Practicality by Biology Teacher	94%	Very Practical

Based on Table 2, the biology e-module was tested for validity by material experts with an average of 94.5% and validity test results by media experts of 95%. Furthermore, the results of the biology e-module practicality test by biology teachers were 94%. The acquisition of this percentage is following the interpretation criteria in Table 1. So, the developed e-module is included in the very valid and very practical criteria. This study is in line with the development of e-modules using *eXeLearning* to improve science literacy tested to be very valid and practical.³⁰ Furthermore, the results of Andila's study show that contextual-based e-modules on business and energy materials using *eXeLearning* are well-tested and suitable for use in science learning.³¹ Related to the I-SETS approach, the results of Alatas and Solehat's study show that the development of I-SETS-based physics practicum audiovisual media has been proven to be very feasible and practical to use in learning in the new normal era.³²

4. Implementing Stage

After the biology e-module was tested for validity and practicality, the researchers conducted a small-scale trial of 10 students to determine the student's response to the developed e-module.³³ In the initial stage, the biology e-module and its guidance are distributed to students. Furthermore, researchers shared a questionnaire of student responses through the google form link. The results of the student response test on a limited basis are shown in Figure 3.

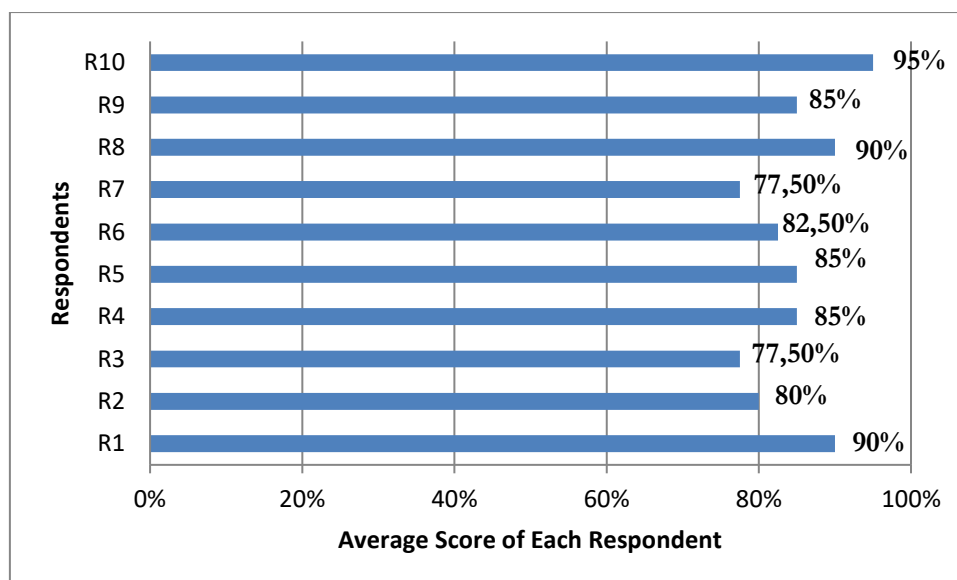


Figure 3. Result in Data of Students' Response to The Biology E-Module

³⁰ Rini Muzijah, Mustika Wati, and Saiyidah Mahtari, "Pengembangan *E-Modul* menggunakan aplikasi *eXe-Learning* untuk melatih literasi sains," *Jurnal Ilmiah Pendidikan Fisika* 4, no. 2 (2020): 89–98, <https://doi.org/10.20527/jipf.v4i2.2056>.

³¹ Andila, Yuliani, and Syar, "Pengembangan bahan ajar fisika berbentuk *E-Modul* berbasis Kontekstual menggunakan aplikasi *eXe-Learning* Pada Materi Usaha Dan Energi."

³² Fathiah Alatas and Devi Solehat, "Pengembangan media audiovisual praktikum fisika dasar berbasis I-SETS (*Islamic-Science, Environment, Tecnology, Society*) sebagai solusi praktikum saat new normal," *Jurnal Penelitian Pembelajaran Fisika* 13, no. 1 (April 30, 2022): 103–16, <https://doi.org/10.26877/jp2f.v13i1.11401>.

³³ Bambang Sri Anggoro, Nukhbatul Bidayati Haka, and Hawani Hawani, "Pengembangan majalah biologi berbasis Al-Qur'an Hadist pada mata pelajaran biologi untuk peserta didik kelas X di tingkat SMA/MA: The development of Al-Qur'an Hadith based on biology subject for class X Student High Scholl/MA Level," *BIODIK* 5, no. 2 (September 8, 2019): 164–72, <https://doi.org/10.22437/bio.v5i2.6432>.

Figure 3 shows the average results of the biology e-module trial limited to 10 respondents (R1-R10). From the results of the score of 10 respondents, the average response of all students was 85% (Calculations using *Microsoft Excel*). As per interpretation criteria, 81%-100% belong to the very good category.³⁴ The interpretation of the criteria in this study is different from Andila's research which showed the results of student responses to physics e-modules of 80.59% in the practical category.³⁵

5. Evaluating Stage

In the ADDIE model, there are two types of evaluation, namely formative evaluation and summative evaluation. However, this study only uses formative evaluation because it focuses on perfecting the e-module.³⁶ This study is in line with Puspasari and Suryaningsih who explained that this type of evaluation is related to the stages of development research to improve the resulting product.³⁷ The results at this stage are in the form of improved biology e-modules that have been validated based on suggestions and comments by expert validators' presented in Table 8.

Table 8. Revisions based on Expert Validators' Comments and Suggestions

No.	Validator	Comments and Suggestions	Revisions to the Biology E-Module
1	2	3	4
1.	Material Expert Validator I	In the biology e-module, it is necessary to add pictures of microorganisms according to the material, applications in daily life, and quotations from verses of the Al-Qur'an with the correct harakat.	Revisions have been made by adding images of microorganisms according to bacterial material and adapted to their application in life. In addition, the harakat has been corrected for each quotation of the Al-Qur'an verses.
2.	Material Expert Validator II	<p>a. Spiral bacteria images do not yet exist</p> <p>b. Gram-positive-negative bacteria need to be described further</p> <p>c. The writing of <i>Escherichia coli</i>, <i>Neisseria gonorrhoea</i>, <i>Treponema pallidum</i> needs to be corrected</p>	<p>a. The revision has been done by adding images of spiral bacteria</p> <p>b. The revision has been made by adding further explanations about gram-positive and gram-negative bacteria</p> <p>c. The revision has been carried out by correcting the scientific name of the bacterium to <i>Escherichia coli</i>, <i>Neisseria gonorrhoeae</i>, and <i>Treponema pallidum</i> according to the rules of writing the correct scientific name</p>

³⁴ Zunaidah and Amin, "Developing the learning materials of biotechnology subject based on students' need and character of Nusantara PGRI University of Kediri."

³⁵ Andila, Yuliani, and Syar, "Pengembangan bahan ajar fisika berbentuk *E-Modul* berbasis Kontekstual menggunakan aplikasi *eXe-Learning* pada materi usaha dan energi."

³⁶ W Azura et al., "The Science Environment Technology Society (SETS) based e-Module development with Project Based Learning Model in Colloidal Learning," *Journal of Physics: Conference Series* 2157, no. 1 (January 1, 2022): 012046, <https://doi.org/10.1088/1742-6596/2157/1/012046>; Amir Hamzah, *Metode penelitian dan pengembangan (Research & Development): Uji produk kuantitatif dan kualitatif proses dan hasil dilengkapi contoh proposal pengembangan desain uji kualitatif dan kuantitatif* (Malang: CV Literasi Nusantara Abadi, 2021).

³⁷ Ratih Puspasari and Tutut Suryaningsih, "Pengembangan buku ajar kompilasi Teori Graf dengan Model Addie," *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang* 3, no. 1 (January 4, 2019): 137, <https://doi.org/10.31331/medivesveteran.v3i1.702>.

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1	2	3	4
		<p>d. There are names of adverse bacteria that are not yet italic</p> <p>e. In the biology e-module, it is necessary to add a little more about the explanation of lactic acid bacteria because it has to do with practicum using Yakult products.</p>	<p>d. The revision has been made by fixing the writing of the scientific names of bacteria in italics</p> <p>e. The revision has been made by adding an explanation of lactic acid bacteria.</p>
3.	Media Expert Validator I	It is necessary to add information to the instructions for use regarding how to navigate biology e-modules on <i>Android</i> .	Revisions have been made by adding information if navigation can be done by swiping the <i>Android</i> screen from the left edge to the center. Then moving the page can be done by swiping the <i>Android</i> screen from the middle to the left or right.
4.	Media Expert Validator II	No revisions. Biology e-modules can already be used in learning activities. The layout of the picture also does not disturb the concentration of students and does not cover the written material.	No revisions

In addition, revisions can also be made from the results of the practicality test of the biology e-module. However, based on the results of practicality tests, the I-SETS-based biology e-module on bacterial material using *eXeLearning* was declared no revision. The biology e-module can be used in biology learning.

Conclusion

Based on the results and discussion, it can be concluded that this study succeeded in developing an I-SETS-based biology e-module using *eXeLearning*. The developed biology e-module has been tested to be very valid, very practical, and very good. However, at the evaluation stage, only formative evaluation is carried out. Therefore, for future researchers, it is recommended to add a summative evaluation in its stages.

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