
INTEGRATING SCIENCE AND ISLAM : DEVELOPMENT OF TEACHING MATERIALS FOR ENVIRONMENTAL CHEMISTRY COURSES

Buchori Muslim¹, Nahadi², Sjaeful Anwar³

^{1,2,3}Chemistry Education, Indonesia University of Education

¹Chemistry Education, Syarif Hidayatullah State Islamic University Jakarta

E-mail: buchorimuslim@upi.edu, nahadi@upi.edu, Sjaefulanwar@upi.edu

Received: xxx; Revised: xxx; Accepted: xxx

Abstract

The teaching materials of chemistry integrated in islam are not yet available at the University level. Teaching materials can be used in learning activities. This study aims to develop islamic integrated chemistry teaching materials in Environmental Chemistry Courses. This research uses the Four Steps Material Teaching Development method (4STMD). 4STMD consists of four stages, namely the selection stage, structuring stage, characterization stage, and reduction stage. At the stage of selection and structuring, the results of integration between environmental chemistry subjects and the Qur'an, Hadith, Fiqih, and Aqeedah Morals are obtained. At the characterization stage, the overall concepts tested have easy characteristics, with an overall overall score of 86.9%. Based on the results of the characterization test, the reduction phase in this research was not carried out because all concepts have easy characteristics. The teaching materials that has been completed is then tested for its feasibility by experts based on material aspects, presentation, language, and graphics. Based on the results of the feasibility test of the teaching materials, the average score is 95%. This shows that the teaching materials is declared to be worthy with a 'very good' predicate.

Keywords: Teaching Materials; Islamic Integrated Chemistry; Environmental Chemistry.

Abstrak

Bahan ajar kimia terintegrasi keislaman belum tersedia di tingkat Universitas. Bahan ajar dapat digunakan dalam kegiatan pembelajaran. Penelitian ini bertujuan untuk mengembangkan bahan ajar kimia terintegrasi keislaman pada Mata Kuliah Kimia Lingkungan. Penelitian ini menggunakan metode Four Steps Teaching Material Development (4STMD). 4STMD terdiri dari empat tahapan, yaitu tahap seleksi, tahap strukturisasi, tahap karakterisasi, dan tahap reduksi. Pada tahap seleksi dan strukturisasi, didapatkan hasil integrasi antara mata kuliah kimia lingkungan dengan Al Qur'an, Hadits, Fikih, dan Akidah Akhlak. Pada tahap karakterisasi, keseluruhan konsep yang diujikan memiliki karakteristik mudah, dengan nilai keseluruhan rata-rata sebesar 86,9%. Berdasarkan hasil uji karakterisasi, tahap reduksi pada penelitian ini tidak dilakukan karena seluruh konsep memiliki karakteristik mudah. Bahan ajar yang telah selesai disusun selanjutnya di uji kelayakannya oleh ahli berdasarkan aspek materi, penyajian, bahasa, dan grafika. Berdasarkan hasil uji kelayakan bahan ajar, didapatkan nilai rata-rata sebesar 95%. Hal ini menunjukkan bahwa bahan ajar dinyatakan layak dengan predikat sangat baik.

Kata Kunci: Bahan ajar, Kimia Terintegrasi Keislaman, Kimia Lingkungan

How to Cite : xxx

Permalink/DOI: xxx

Introduction

Education aims "to develop the potential of students to become human beings who believe and devote to God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, become democratic and responsible citizens" (UU RI No.20 Tahun 2003). To achieve these objectives, we need a guideline called a curriculum. The curriculum is a set of plans and arrangements regarding learning outcomes of graduates, study materials, and assessment processes that are used as guidelines for the implementation of the study program (Permenristekdikti, 2015). The curriculum used in Higher Education refers to the Indonesian National Qualifications Framework (KKNI) curriculum.

One step to develop the KKNI curriculum is to determine learning outcomes in each Study Program. Based on Permenristekdikti No. 44 of 2015, each study program is allowed to increase learning outcomes in accordance with the vision of the university. This is one step to maintain and improve the quality of management of study programs in learning. The learning achievements added by the Chemistry Education Study Program at Syarif Hidayatullah State Islamic University in Jakarta are mastering knowledge of integrated science, Islam, and Indonesianness in chemistry learning.

Integration comes from the idea of a dichotomy between the general sciences and the religious sciences (Rifai, Fauzan, Sayuti, & Bahrissalim, 2014). Integration can be defined as a combination of one element with another element so that it forms a unity (Anas, Alwi, Razali, Subki, & Bakar, 2013; Ramli, 2014). Several countries such as Yemen, Malaysia, and Brunei Darussalam have implemented

integration between science and Islam (Al-hadabi, 2016; Hashim & Abdallah, 2013; Lubis, 2015; Zain, Ahmad, Ismail, Salah, & Mohamad, 2016)

The way to integrate chemistry with Islam is by incorporating Islamic contexts sourced in the Qur'an, Hadith, and natural phenomena (Fauzan, 2017; Munadi, 2016) into chemical matter. Many scientific verses in the Qur'an. There are approximately 750 scientific verses that talk about the natural aspects (Al-hadabi, 2016; Ashtankar, 2016; Manoiu, Düzgüneş, Azzeddine, & Manoiu, 2016). The verses talk about the relationship between humans and nature, plants, animals, organisms and their environment (Manoiu et al., 2016)

The integration between chemistry and Islam is important in the learning process (Muslim, 2016). But in fact, the integration between chemistry and Islam cannot be implemented further. This is because there is no chemical teaching material integrated with Islam. In the teaching and learning activities, teaching materials have a very important role (Fitriani, Mahmud, & Darmana, 2016; Silaban, Septiani, & Hutabarat, 2015). Islamic integrated teaching materials that can increase the knowledge of readers, both in terms of science, skills, and personality (Perbukuan, 2014).

One of the courses that do not have an integrated into Islamic is the Environmental Chemistry Course. Course material in Environmental Chemistry is considered very important for students in Higher Education. Hopefully, by the knowledge of Environmental Chemistry, it can be a joint movement to preserve the environment, for the sake of a comfortable and healthy environment in the future (Nusnowati, 2012).

Method

This study uses the Research and Development (R & D) method. The research uses the Four Step Teaching Materials Development Method (4STMD), developed by Sjaeful Anwar (2014), then evaluate the results of development by conducting a feasibility test. 4STMD consists of four stages, namely the selection stage, structuring stage, characterization stage, and didactic reduction stage.

Selection stage

At the selection stage, various information is selected according to needs, so that the information obtained is effective and related to the material to be developed (Hendri & Setiawan, 2016). The selection phase includes: 1) analysis of learning outcomes related to environmental chemistry courses; 2) develop indicators; 3) concept analysis; 4) develop values that can be incorporated into teaching material; and 5) validation by experts.

The instrument used in the selection stage is a concept suitability validation sheet with Islamic integration. This validation sheet uses a Guttman scale questionnaire.

Table 1: Criteria scoring Guttman Scale

No.	Answers	Score
1.	Yes	1
2.	No	0

Structuring

Structuring phase aims to connect between one concept with another concept so that there is no partial learning (Ashri & Hasanah, 2016). The procedure in the structuring stage includes: 1) create a concept map of the concepts that exist in the draft collection of selection material; 2) create a macro structure;

and 3) adjusting the structure of the subject matter into a draft product to be developed.

Characterization

Students' understanding of the concepts in the draft product is measured through a characterization test. Concept characterization is done by giving instruments to students questions. Data obtained from the results of the characterization test are then given a value, for the correct answer given a value of 1 (one), and for the wrong answer given a value of 0 (zero). Each question is then calculated using the following formula (Ashri & Hasanah, 2016):

$$\% \text{ item} = \frac{\text{gain score}}{\text{total score}} \times 100\%$$

The criteria for achieving concept understanding tests can be seen in Table 2 (Arifin & Sjaeful, 2016):

Table 2: Criteria understanding the concept

Percentage	Level of Understanding
60% <P ≤ 100%	High
40% <P ≤ 60%	Medium
P ≤ 40%	Low

Reduction

Reduction is the process of adjusting or reducing the level of difficulty in the product developed. The reduction of the level of difficulty in the concept phase reduction is carried out in several ways, including (1) the annotations in the form of images, symbols, sketches and experiments; (2) use of analogies; (3) generalization; and (4) particular mechanism (Arifin & Sjaeful, 2016)

Evaluation

The product of teaching materials that has been reduced further tested for its feasibility by experts. The feasibility test of the product uses a questionnaire sheet which includes aspects of the feasibility of content (material), presentation, language, and graphics. Here are the criteria for assessing the feasibility of product:

Table 3: Likert Scale Scoring Criteria

Criteria	Score
Appropriate	4
Most appropriate	3
A small portion matches	2
Not suitable	1

(Adapted from Puskurbuk, 2016)

To determine the feasibility of the product as a whole, the calculation of the overall value is obtained from each aspect. The product are declared feasible if they meet the criteria in Table 4 (Perbukuan, 2014, p. 48):

Table 4: Final Score Total and Its Meaning

Final score	Meanings
Score ≥ 85	Worthy with a very good predicate
$55 \leq \text{Score} < 85$	Worthy of a good predicate
Score < 55	Not feasible

Results and Discussion

In the selection stage, the selection of information related to the material that will be developed in the product is done, namely material on environmental chemistry. In this step, the researchers conducted an analysis of the PLO and CLO environmental chemistry

courses. Based on the results of the analysis, the PLO contained in the chemistry education study program is "master knowledge integrated science, Islam and Indonesianness in learning chemistry". CLO subject of environmental chemistry is "explain the meaning of pollution, type of pollution, sources of pollution, factors that affect pollution, and the impact of pollution".

The next step is to collect references that will be used to develop an integrated Islamic environmental chemistry. References that have been collected are then selected based on the completeness of the material contained in the reference source. The main reference used is a book written by Manihar Situmorang (2017). This book was chosen because the material in the book is more complete than other references. The book can be seen in Figure 1

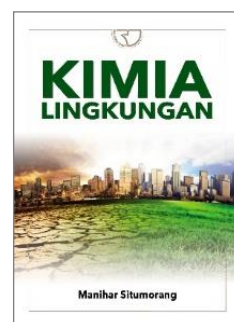


Figure 1: The main reference used to develop teaching materials integrated with islam

Other references are used, among others, Achmad, R. (2004). *Kimia Lingkungan*. Yogyakarta: ANDI; Keraf, S., (2010). *Krisis dan Bencana Lingkungan Hidup Global*. Yogyakarta: Kanisius; Manahan, S. E. (2000). *Environmental Chemistry*. New York: CRC Press LLC; Nugroho, A. (2005). *Bioindikator Kualitas Udara*. Jakarta: Penerbit Universitas Trisakti; Saeni, M. S. (1989). *Kimia Lingkungan*. Bogor: Institut Pertanian Bogor; Sastrawijaya, A. T. (2009). *Pencemaran Lingkungan*. Jakarta: Rineka Cipta; Sodik, M.

(2014). Ilmu Kealaman Dasar. Jakarta: Kencana Prenada Media Grup.

Integration between environmental chemistry and Islamic context is based on the qauliyah verse that is Al Qur'an & Hadith, kauniyah verse that is natural phenomena, Fiqih and Akidah Moraal. According to Hamzah (2015), integration is aimed at complementing and reinforcing the material of one discipline with other disciplines.

Table 5: Results of Integration of Environmental Chemistry Concepts with Islam

No.	Concept of Environmental Chemistry	Islamic Integrated
1	Environmental pollution	Qur'an Surah Ar Rum, verse 41
2	Water pollution	Qur'an Surah Al-Anbiya, verse 30
3	Air Pollution Indicators (change color, taste, and smell)	Hadith Ibn Majah history (of holy water)
4	Sources of Water Pollution	Qur'an Surah Ar Rum, verse 41
5	Water Pollution by Agriculture	Qur'an Surah Al Araf, verse 31
6	Impact of Water Pollution	Qur'an Surah Syuraa, verse 30
7	Air Pollution Impacts on aesthetics	Hadith Muslim History, No. 91
8	Countermeasures of Water Pollution	The attitude of responsibility, in the Qur'an Surah Al Mudatsir, verse 38
9	Soil pollution	Qur'an Surah Al Araf, verse 25

No.	Concept of Environmental Chemistry	Islamic Integrated
10	Soil Pollution Indicators	Qur'an Surah Al A'raf, verse 56 letters
11	Soil Pollution Sources	Qur'an Surah Al Hadid, verse 22
12	Internal factors Soil Pollution	Qur'an Surah Al Araf, verse 31
13	External Factors Soil Pollution	Qur'an Surah Al Araf, verse 58
14	Soil Contamination Countermeasures	Qur'an surah An Nahl, verse 8
15	Air pollution	An attitude of gratitude in the Qur'an Surah an-Nahl, verse 18
16	Sources of Air Pollution	Qur'an Surah Al Qasas, verse 77
17	Impact of Air Pollution (fog photochemistry)	The story of the days of the Quraish, the Qur'an Surah Ad Dukhan, verses 10-11 & 15-16
18	Impact of Air Pollution (Acid Rain)	Hadith narrated by Ahmad (XIII / 291 no. 7554) Hadith narrated by Ahmad (III / 140).
19	Air Pollution Reduction	Hadith history of Imam Muslim, No. 1552

The next step is to do validation by scientific integration experts. Validation is done to obtain the truth and accuracy of Islamic integration content that has been developed, before being used for the next stage

(Hendri & Setiawan, 2016). Based on the validation results, it was found that the integration of the inserted Islamic context was "appropriate" with the concept of material on environmental chemistry.

The next step is structuring. According to Ashri & Hasanah (2016), the purpose of structuring is to connect learning between one concept and another concept. The structuring stage consists of (1) concept mapping; (2) create a macro structure; and (3) adjusting draft teaching materials with material structure.

The concept map in this study was made from the concepts in the draft material as a result of concept analysis. Concept maps consist of concepts that are usually included in circles, squares, and other shapes. Relations between the concept indicated by the line connecting these two concepts (Novak & Cañas, 2008). Then make a macro structure, serves to maintain the accuracy and clarity of the correlation between texts to facilitate the writing of teaching materials (Marfu'ah & Anwar, 2018)

The next stage is characterization. Characterization is done by giving instruments in the form of questions to students. This aims to find out concepts that are considered easy and difficult by students. The questions given are in the form of test questions determining the main ideas and determining the difficult or easy concepts developed.

The question instrument was compiled from the draft teaching materials integrated with islam that had been developed previously. The number of concept understanding test questions consisted of 15 questions and was given to the Chemistry Education Students as many as 62 students. Students were asked to assess their understanding of the text presented and give answers that form the main idea (label

concept) of the text. Understanding is calculated by the number of correct questions divided by the total score, then averaged. The characterization test results can be seen in Table 6.

Table 6: Characteristics Test Results

No.	label concept	Concept Training (%)	Criteria Text Concept
1	Water pollution	96.8	Easy
2	Physical indicators of water pollution	85.5	Easy
3	Source of water pollution	61.3	Easy
4	agricultural waste	93.5	Easy
5	The impact of water pollution	87.1	Easy
6	Water pollution prevention	79.0	Easy
7	pollution of soil	96.8	Easy
8	Biological indicators of soil pollution	87.1	Easy
9	Sources of soil contamination	91.9	Easy
10	Internal factors pollution of soil	88.7	Easy

No.	label concept	Concept Training (%)	Criteria Text Concept
11	bioremediation	87.1	Easy
12	Air pollution	88.7	Easy
13	Sources of air pollution	87.1	Easy
14	The impact of air pollution	79.0	Easy
15	Reduction of air pollution	95.2	Easy
	Average	86.9	Easy

The Characteristic Test results show that of all the concepts tested, the average percentage was 86.9%. According to Arifin & Sjaeful (2016) if the percentage is above 60%, the concept developed has a high level of understanding. This product has easy characteristics based on the results of student assessment of the easy or difficult concept developed.

The last stage is didactic reduction. The reduction stage is the step taken to reduce the difficulty level of teaching materials. But in this study didactic reduction was not used, because based on the results of the characterization test, all the concepts developed had easy characteristics.

The product teaching materials integrated with islam has been compiled, then the feasibility test is carried out by learning media experts. The purpose of the validation is to find out the weaknesses and deficiencies contained shortcomings found in the product developed. These weaknesses and shortcomings will be an improvement material in order to produce a better product.

The average percentage for the material / content, language, presentation, and graphic feasibility aspects is 95%. According to Perbukuan (2014, p. 48), if the percentage results obtained are above 85%, then the product developed is declared to be very good. The final product of this research is teaching materials integrated with islam, which consists of 10 pages of the initial section, 94 pages of contents, and 6 pages of the final section.

Conclusion

Based on the research that has been done, it was concluded that the development of teaching materials integrated with islam was carried out using the 4-STMD stage, namely selection, structuring, characterization, and reduction. Environmental chemistry material can be integrated with the Qur'an, Hadith, Fiqih, and Aqeedah Morals. The characterization test results obtained an average of 86.9%.

Based on these data, it can be stated that all concepts have a high level of understanding in accordance with student understanding. In this study the reduction was not carried out because based on the results of the characterization of the concepts developed it was included in the easy criteria. The results of the feasibility test of the teaching materials integrated with islam carried out on the expert, have decent criteria with a very good category with a percentage of 95%.

References

- Al-hadabi, A. S. D. (2016). Integrating the Qur ' n Verses into Secondary School Science Curriculum of Yemen: An Islamic Perspective. *International Journal of Humanities and Social Science Research*, 2, 37–48.
- Anas, N., Alwi, E. A. Z., Razali, M. H. H.,

- Subki, R. N., & Bakar, A. N. A. (2013). The Integration of Knowledge in Islam : Concept and Challenges. *Global Journal Of Human Social Science Linguistics & Education*, 13(10), 50–55.
- Arifin, & Sjaeful, A. (2016). The Development Of Air-Theme Integrated Science Teaching Material Using Four Steps Teaching Material Development. *Jurnal Pendidikan Fisika Indonesia*, 12(1), 8–18.
- Ashri, N., & Hasanah, L. (2016). Uji Keterpahaman Dan Kelayakan Bahan Ajar Ipa Terpadu. *EDUSAINS*, 8(2), 145–149.
- Ashtankar, O. M. (2016). Islamic perspectives on environmental protection. *International Journal of Applied Research*, 2(1), 438–441.
- Fauzan. (2017). Integrasi Islam dan Sains dalam Kurikulum Program Studi Pendidikan Guru MI Berbasis KKNl. *Journal of Madrasah Ibtidaiyah Education*, 1–13.
- Fitriani, F., Mahmud, & Darmana, A. (2016). Pengembangan dan Standarisasi Bahan Ajar Kimia Terintegrasi Nilai-Nilai Spiritual Untuk Kelas XI SMA / MA Semester 1 Berdasarkan Badan Standar Nasional Pendidikan. *Jurnal Pendidikan Kimia*, 8(1), 12–18.
- Hamzah, F. (2015). Studi Pengembangan Modul Pembelajaran IPA berbasis Intregrasi Islam-Sains Pada Pokok Bahasan Sistem Reproduksi Kelas IX madrasah Tsanawiyah. *Jurnal Pendidikan Islam*, 1(1), 41–54.
- Hashim, R., & Abdallah, S. S. (2013). Islamization of Human Knowledge in Theory and Practice: Achievements, Challenges and Prospects in the IIUM context Rosnani Hashim & Ssekamanya Siraje Abdallah Institute of Education, International Islamic University Malaysia (IIUM). *IIUM Journal of Educational Studies*, 1(1), 1–11.
- Hendri, S., & Setiawan, W. (2016). The Development Of Earth Quake Teaching Material For Junior The Development Of Earth Quake Teaching Material For Junior High School By Four Step Teaching Materials Development Method Pengembangan Bahan Ajar Tema Gempa Bumi Menggunakan Four Step Teaching M. *Jurnal Pendidikan Fisika Indonesia*, 12(1), 65–76.
- Lubis, M. A. (2015). Effective Implementation Of The Integrated Islamic Education. *GJAT*, 5(1), 59–68.
- Manoiu, V., Düzgüneş, E., Azzeddine, M., & Manoiu, V.-S. (2016). A Qualitative Exploration Of The Holy Quran’s Environmental Teachings. *International E-Journal of Advances in Education*, 2(5), 209–217.
- Marfu’ah, S., & Anwar, S. (2018). How to develop SETS-based colloidal system teaching materials? *International Conference on Mathematics and Science Education*, 3, 298–303.
- Munadi, M. (2016). Integration of Islam and Science: Study of Two Science Pesantrens (Trensain) in Jombang and Sragen. *Jurnal Pendidikan Islam*, 5(2), 287–303.
- Muslim, B. (2016). Kimia Dalam Perspektif Islam. *Proceeding SEMINAR & BEDAH BUKU “ISLAM DAN SAINS: Upaya Pengintegrasian Islam Dan Ilmu Pengetahuan Di Indonesia”* 138–149.
- Novak, J. D., & Cañas, A. J. (2008). *The Theory Underlying Concept Maps and How to Construct and Use Them*. 1–36.
- Nusnowati. (2012). Pengembangan Perkuliahan Kimia Lingkungan Berbasis Masalah Untuk Meningkatkan Nilai-Nilai Karakter Mahasiswa. *Lembaran Ilmu Kependidikan*, 41(2), 109–113.
- Perbukuan, P. K. dan. (2014). *Pedoman Penilaian Buku Nonteks Pelajaran*.
- Permenristekdikti. (2015). *Standar Nasional*

Pendidikan Tinggi.

- Ramli, M. (2014). Integrasi Pendidikan Agama Islamke Dalam Mata Pelajaran Ilmu Pengetahuan Alam di Madrasah Tsanawiyah Negeri Mulawarman Banjarmasin. *Ittihad Jurnal Kopertais Wilayah XI Kalimantan*, 12(21), 111–132.
- Rifai, N., Fauzan, Sayuti, W., & Bahrissalim. (2014). Integrasi keilmuan dalam pengembangan kurikulum di UIN se-Indonesia: *Tarbiya*, 1(1), 13–34.
- Silaban, R., Septiani, B., & Hutabarat, W. (2015). Penyusunan Bahan Ajar Kimia Inovatif Materi Laju Reaksi Terintegrasi Pendidikan Karakter Siswa SMA. *Jurnal Tabularasa PPS UNIMED*, 12(1), 78–88.
- Undang-undang Republik Indonesia Nomor 20 Tahun 2003. *Sistem Pendidikan Nasional*.
- Zain, S., Ahmad, Z., Ismail, A. F., Salah, M., & Mohamad, S. A. (2016). Development of integrated science textbooks by applying the enrich tool. *Journal of Education and Social Sciences*, 5(2011), 6–13.