Revitalization of textbook integrating STEMR learning to improve pre-service teacher professionalism

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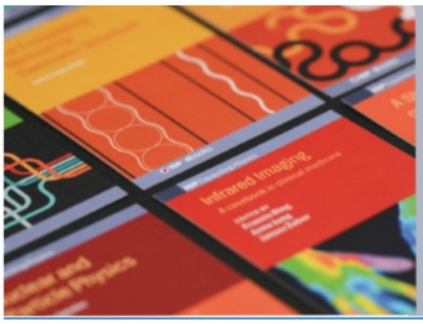

Revitalization of textbook integrating STEMR learning to improve pre-service teacher professionalism

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Abstract. This study aimed to develop STEMR (Science, Technology, Engineering, Mathematics, and Religion) biology book meeting the standard of competence and competitiveness that referred to Indonesia National Qualification Framework (INQF) with integration approach. This was a research and development study based on ADDIE design instructional model. The Alpha Cronbach of Instrument to analyze STEMR book used by experts (0.765) and pre-service teachers (0.841). The assessment results show that the experts strongly agreed on didactic (min=1.40 Sd=0.21), construction (min=1.55 Sd=0.23), and technical (min=1.49 Sd=0.28) requirements of the STEMR module. Moreover, pre-service teachers also strongly agreed on ease of use (min=1.74 Sd=0.50) and learning time efficiency (min=1.86 Sd=0.33) of the STEMR module. Thus, the presented STEMR module is suitable to be developed and implemented to contribute to the educational institutions and it provides a new value of knowledge integration.

1. Introduction

A teacher is a professional educator with primary jobs of educating, teaching, guiding, directing, training, assessing, and evaluating learners in formal early childhood education, basic education, and secondary education. A teacher is a professional who invents a quality process to develop Indonesian who is intelligent, competitive, faithful and devoted to God Almighty, healthy, knowledgeable, capable, creative, independent, having a noble character, and becoming a democratic and responsible citizen.

Being a professional teacher requires an ability to develop self-competence and comprehensive thinking. Mastering knowledge professionally can be translated as an ability to think comprehensively when solving problems integrated withs aspects of science, technology, engineering, and mathematics (STEM) [1].

This study was developed based on the vision, missions, and strategic issues in UIN Suska Riau, with the theme of "Science and Islamic integration" (integrating science, technology, and arts with Islamic values towards becoming a world-class university). The Republic of Indonesia's Government Regulation Number 19 Year 2005 on National Education Standards and Number 23 Year 2013 in Amendments of National Education Standards Article 1 Paragraph 8 also states that educators and education personnel should meet the pre-service and in-service educational criteria and requirements.

In international benchmarking, Indonesia refers to three primary studies as instruments to assess global competence, which are progress in international reading literacy study (PIRLS), Third

international mathematics and science study (TIMSS), and program of international student assessment (PISA) [2].

A study in 2006 shows that the Indonesian literacy score was 407, positioning Indonesia as a country with literacy lower than the average score (500). In fact, Indonesia ranked as the fifth from the bottom compared to other countries participating in PIRLS 2006. Moreover, the results of PISA show that among 42 surveyed nations, Indonesian students ranked in 39th place with the average of 371. The literacy skills involve a person's ability to find information, understand and interpret the readings it, includes one's abilitys to also reflect and assess what has been read [2].

Furthermore, in PISA 2006, Indonesian student ranked 50th place among 57 participants in science literacy, with the average score of 393. This score was lower than the average score of 395 achieved in PISA 2003. Meanwhile, in a study conducted by TIMSS in 2007, Indonesian students ranked 35th place of 47 participants [3]. It is essential to develop alternative methods to improve teacher competence by providing a better understanding of various knowledge as one comprehensive unit [4][5].

Teachers' responsibilities nowadays involve providing a better understanding of STEMR (science, technology, engineering, mathematics, and religion) for their students. Therefore, this study aimed to revitalize integration of STEMR to improve teachers' professionalism.

2. Importance of STEMR learning

STEM learning supports the extension of engineering in other subjects, even for the secondary and elementary education. STEM is focus for every student, not only the talented one. In 2012, then-President Barack Obama changed and expanded former "Mathematics and Science Partnership (MSP)" program to award grants for all states to improve teacher education.

In 2006, US National Academies were concerned because of declining STEM education in the United States. The Committee on Science, Engineering, and Public Education then developed the list of ten actions. Three of its recommendations are:

a. Improving American talent by refining K-12 of science and mathematics.
b. Strengthening teacher skills through additional training in science, mathematics, and technology.
c. Improving students' opportunity to enter universities and graduate with STEM degree.

Integration of the STEM approach will help students in analyzing and solving real-world problems in their future occupation. Knowledge used to solve the problems is the definition of science literation, and how to use the knowledge to identify question, gain new knowledge, explain scientific phenomenon, and to find conclusion based on the evidence [6]. However, STEM approach developed in the United States does not consider religious teachings; therefore we developed a new model of STEMR with the integration of Islamic values.

The Qur'an, apart from the primary Islamic law reference, also contains much explanation of the scientific phenomenon. In Yaasin Chapter Verse 36, it is explained that Allah creates everything in pairs. This is also repeated in Adz-Zaariyat Chapter Verse 49, where Allah says, "And of everything We have created pairs, that you may remember (the Grace of Allah)." In this verse, Allah not only creates humans in pairs but anything, from everything that lives on the Earth to the smallest particles. Paul Dirac, an English scientist, proved that every matter is created in pairs. He named his finding as 'Parite' and received the Nobel prize in Physics in 1933. Many other scientific findings come from contemplating the content of the Qur'an [7].

3. Research Methodology

This was a research and development study using mix method (a combination of qualitative and quantitative) approach [8]. The analysis results were used as a reference to design and develop the STEMR (science, technology, engineering, mathematics, and religion) book for the biology subject based on the Indonesia National Qualification Framework (INQF) with integration approach. The STEMR module is validated by 7 expert lecturers to assess didactic, construction and technical requirements, and 37 students to assess various aspects of the ease of use and time efficiency.

Instruments used in this study were questionnaires as an assessment form. The instrument used to analyze the STEMR book in this study was SPSS software in order to yield the Alpha Cronbach value

of 0.765. The instrument of practicality used by pre-service teachers had the Alpha Cronbach value of 0.841. These results show that the book analysis instrument had a good quality for use in this study. Data were analyzed using descriptive statistics in SPSS software.

4. Result and Discussions

4.1 General description of STEMR module development

In this study, we developed the STEMR module for pre-service biology teachers. The basic design and learning development referred to the ADDIE (analyze, design, develop, implement, evaluate) design instructional model [9]. The ADDIE model was selected because it is based on a system involving teaching materials for a course or a curriculum. This model is often used in a study that aims to create a product. The ADDIE model has five developmental stages, which are: analysis, design, development, implementation, and evaluation.

4.2 Assessment of STEMR module by experts

The STEMR (science, technology, engineering, mathematics, and religion) biology book according to the standard of competence and competitiveness that refers to the Indonesia National Qualification Framework (INQF) was assessed by experts in several aspects and requirements, which were didactic, construction, and technical. The assessment is displayed in Tables 1 – 3.

Table 1. Result of experts' assessment of didactic requirement in learning using STEMR module

No	Assessed aspect	Result of descriptive analysis			
		N	Mean	SD	Assessment
A	**Didactic requirements**				
1	Material refers to INQF	5	1.40	0.548	Strongly agree
2	Material of STEMR module supports learning achievements in INQF standard	5	1.40	0.548	Strongly agree
3	STEMR module is appropriate for the standard of Bachelor degree competence	5	1.60	0.548	Strongly agree
4	STEMR module supports concepts understanding	5	1.40	0.548	Strongly agree
5	STEMR module improves efficiency of learning process	5	1.40	0.548	Strongly agree
6	STEMR module can be used in individual and group learning	5	1.60	0.548	Strongly agree
7	Material presentation in STEMR module is related directly to other subjects holistically to improve students understanding of the material	5	1.40	0.548	Strongly agree
8	STEMR module has an interconnection between subjects in the form of a concept map that can be used as training to test concept understanding	5	1.20	0.447	Strongly agree
9	Observation activities in STEMR module increase learning interest	5	1.40	0.548	Strongly agree
10	STEMR module provides an opportunity for continuous learning according to the learning rate of each student	5	1.20	0.447	Strongly agree
	Didactic requirements	37	1.40	0.21	Strongly agree

Table 1 shows that the experts strongly agreed (mean=1.40 Sd=0.21) that didactic requirements of the STEMR biology book meet the standard of competence and competitiveness that is refered to in the Indonesia National Qualification Framework. Every item in didactic requirements had mean value between 1.2 to 1.6, and the standard deviation ranged from 0.21 to 0.548. The results show that the experts had the highest agreement on the topic of whether STEMR module provides an opportunity for continuous learning according to the learning rate of each student. The STEMR module has an interconnection between subjects in the form of a concept map that can be used as training to test

concept understanding. In contrast, the lowest agreement was obtained on the topic of whether STEMR module is appropriate for the standard of Bachelor degree competence.

Table 2. Result of experts' assessment of construction requirement in learning using STEMR module

No	Assessed aspect	Result of descriptive analysis			
		N	Mean	SD	Assessment
B	**Construction requirements**				
1	STEMR module has clear learning objectives that are in line with the indicators.	5	1.40	0.548	Strongly agree
2	STEMR module has correct and appropriate Indonesian grammar	5	1.60	0.548	Strongly agree
3	STEMR module uses language that is simple and easy to understand	5	1.80	0.447	Strongly agree
4	STEMR module contains main topics and their description that are in line with actual issues	5	1.40	0.548	Strongly agree
5	STEMR module has clear identity (chapter title)	5	1.20	0.447	Strongly agree
6	STEMR module has comprehensible sections (learning instruction, supporting information, assignments, and work steps)	5	1.80	0.447	Strongly agree
7	STEMR module contains material directly related to knowledge integration	5	1.60	0.548	Strongly agree
8	STEMR module contains activities to improve scientific skills of the students	5	1.60	0.548	Strongly agree
	Construction requirements	37	1.55	0.23	Strongly agree

As can be seen in Table 2, the experts strongly agreed (mean=1.55 Sd=0.24) on whether construction requirements of STEMR biology book meet the standard of competence and competitiveness that refers to the an integration approach Indonesia National Qualification Framework. Every item in construction requirements had mean value between 1.2 to 1.8, and the standard deviation ranged from 0.447 to 0.548. The results show that the experts had the highest agreement on the topic of whether STEMR module has a clear identity (chapter title). On the contrary, the lowest agreement was obtained on the topic of whether STEMR module uses language that is simple and easy to understand, and whether the STEMR module has comprehensible sections (learning instruction, supporting information, assignments, and work steps).

Table 3. Result of experts' assessment of technical requirement in learning using STEMR module

No	Assessed aspect	Result of descriptive analysis			
		N	Mean	SD	Assessment
C	**Technical requirements**				
1	STEMR module has an interesting presentation	5	1.60	0.548	Strongly agree
2	STEMR module uses clear and appropriate letters	5	1.60	0.548	Strongly agree
3	Images displayed in STEMR module are appropriate	5	1.40	0.548	Strongly agree
4	Images displayed in STEMR module are clear, interesting, and fit the context	5	1.60	0.548	Strongly agree
5	Source of each image is cited in the STEMR module	5	1.20	0.447	Strongly agree
6	Phenomenon and themes in the STEMR module are appropriate and fit the material	5	1.40	0.548	Strongly agree
7	Activities in the STEMR module are appropriate and fit the material	5	1.60	0.548	Strongly agree
	Technical requirements	37	1.49	0.28	Strongly agree

Table 3 displays that the experts strongly agreed (mean=1.49 Sd=0.28) on whether technical requirements of STEMR biology book meet the standard of competence and competitiveness that refers to Indonesia National Qualification Framework with integration approach. Every item in technical requirements had mean value between 1.2 to 1.6, and standard deviation ranged from 0.447 to 0.548.

The use of sections to divide the text of the paper is optional and left as a decision for the author. The results show that the experts had the highest agreement on the topic of whether the source of each image is cited in the STEMR module. In contrast, the lowest agreement was obtained in the topics of whether STEMR module has an interesting presentation, uses clear and appropriate letters, images displayed in STEMR module are clear, and Activities in the STEMR module are appropriate and fit the material. This important because students who indicate that they are interested in pursuing a career in a science-related field were three times more likely to graduate with a science degree, making career aspirations during middle school an important predictor for STEM professions [10].

Tan (2003) argues that expert assessment of learning media is essential in developing an effective learning media [5]. The STEMR module is interesting, and fit the context so that students start to make decisions about their future careers as early as middle school [10]. These changes have the most impacts on their future interest than any other time of their lives. Most university students in science and engineering made career choices based on decisions made at this age [6][11].

4.3 Assessment of STEMR module by pre-service teachers

The practicality of the STEMR (science, technology, engineering, mathematics, and religion) biology book according to the standard of competence and competitiveness that is refered to in the Indonesia National Qualification Framework (INQF) was also assessed by pre-service teachers regarding ease of use and STEMR book learning time efficiency. The assessment results of pre-service teachers are displayed in Tables 4 and 5.

Table 4. Practicality test results of STEMR module's ease of use

No	Assessed aspect	Result of descriptive analysis			
		N	Mean	SD	N
A	**Ease of use**				
1	STEMR module is easy to use because it has clear steps	37	1.73	0.450	Strongly agree
2.	STEMR module uses language that is simple and easy to understand	37	1.84	0.442	Strongly agree
3.	STEMR module is constructed systemically, which makes it easy to understand	37	1.73	0.508	Strongly agree
4.	STEMR module can be used in group or individual learning by the students	37	1.76	0.548	Strongly agree
5	Materials of integrated knowledge learning system in the STEMR module help to explain the concepts	37	1.68	0.530	Strongly agree
6	Activities in the STEMR module help to explain the concepts	37	1.73	0.508	Strongly agree
7	Figures in the STEMR module help teachers to guide the students finding concepts in the materials	37	1.73	0.508	Strongly agree
Ease of use		37	1.74	0.50	Strongly agree

As can be seen in Table 4, the pre-service teachers strongly agreed (mean=1.74 Sd=0.50) on whether the ease of use of the STEMR biology book meets the standard of competence and competitiveness that refers to Indonesia National Qualification Framework. Regarding, ease of use every item had a mean value between 1.68 to 1.84, and standard deviation ranged from 0.442 to 0.548. The results show that the pre-service teachers had the highest agreement on the topic of whether materials of integrated knowledge learning system in the STEMR module help to explain the concepts. In contrast, the lowest agreement was obtained on the topic of whether STEMR module uses language that is simple and easy to understand.

Table 5 displays that the pre-service teachers strongly agreed (mean=1.86 Sd=0.33) on whether learning time efficiency of the STEMR biology book meets the standard of competence and competitiveness that refers to Indonesia National Qualification Framework with integration approach. Every item in learning time efficiency had mean value between 1.76 to 1.92, and standard deviation ranged from 0.393 to 0.640.

Table 5. Practicality test results of STEMR module's learning time efficiency

No	Assessed aspect	Result of descriptive analysis			
		N	Mean	SD	N
B	**Learning time efficiency**				
1	STEMR module makes the learning time more efficient and effective	37	1.92	0.640	Strongly agree
2.	STEMR module is one of the learning media in structured group assignment	37	1.76	0.495	Strongly agree
3.	Teachers can use questions on the worksheet as a benchmark	37	1.89	0.393	Strongly agree
4.	STEMR module helps to understand the knowledge comprehensively	37	1.81	0.462	Strongly agree
5	STEMR module reduces misconception	37	1.92	0.547	Strongly agree
	Learning time efficiency	37	1.86	0.33	Strongly agree

The results show that the pre-service teachers had the highest agreement on the topic of whether the STEMR module is one of the learning media about structured group assignment. On the other hand, the lowest agreement was obtained on the topic of whether the STEMR module makes the learning time more efficient and effective and whether it reduces misconception. A study conducted by Osman & Vebrianto (2016) reported that the use of diverse and interesting learning media could improve its practicality, which will lead to the improvement of learning achievement [12]. Research has shown that, having students actively participate in authentic activities similar to those in which professionals participate, holds great potential for promoting students' interest and engagement[6][13].

These findings indicate that our STEMR integration intervention was effective at developing our participants' interest towards ease of use and time efficiency, as previous research shows that interest plays an important role in influencing the decision to choose STEM-related fields [1][14].

5. Conclusion

The STEMR (science, technology, engineering, mathematics, and religion) approach is builton western countries, STEM (science, technology, engineering, and mathematics) by adding consideration of moral and religious values, particularly Islamic ones. Experts' assessment on didactic, construction, and technical requirements and pre-service teachers' evaluation of its practicality show that the STEMR biology book meets the standard of competence and competitiveness that refers to Indonesia National Qualification Framework with an integration approach. The experts strongly agreed on didactic (mean=1.40 Sd=0.21), construction (mean=1.55 Sd=0.23), and technical (mean=1.49 Sd=0.28) requirements of the STEMR module. Meanwhile, pre-service teachers also strongly agreed on ease of use (mean=1.74 Sd=0.50) and learning time efficiency (mean=1.86 Sd=0.33) of the STEMR module. Therefore, the STEMR module can be published as a reference for pre-service teachers in the faculty of education and teacher training, UIN SUSKA RIAU. We expected this book to contribute to the educational institution and provide a new value of knowledge integration.

References

[1] Sanders, M. (2009). STEM, STEM Education,STEMmania.Technology Teacher 68 (4:):20–26.
[2] Bahrul Hidayat & Suhendra Yusuf.(2010). *Benchmark Internasional Mutu Pendidikan*. Jakarta: Bumi Aksara.

[3] Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., and Brenwald, S. (2008). *Highlights From TIMSS 2007: Mathematics and Science Achievement of U.S. Fourth- and Eighth-Grade Students in an International Context* (NCES 2009–001). National Center for Education Statistics, Institute of Educationn Sciences, U.S. Department of Education. Washington, DC.
[4] Vebrianto, R., & Osman. K. (2014). BIOMIND: Strategic approach science learning Indonesians towards preparing 21st century.Technics Technologies Education Management 9 (2), 361-368.
[5] Tan, O.S., (2003). Problem-Based Learning Innovation:Using Problem to Power Learning in the 21st Century.Singapore: GALE Cengage Learning.
[6] Edy Hafizan Mohd Shahali, Lilia Halim, Mohamad Sattar Rasul, Kamisah Osman & Nurazidawati Mohamad Arsad (2018): Students' interest towards STEM: a longitudinal
[7] Hamzah, F. (2015). Studi Pengembangan Modul Pembelajaran IPA Berbasis Integrasi Islam – Sains pada Pokok Bahasan Sistem Reproduksi Kelas IX Madrasah Tsanawiyah. *Jurnal Pendidikan Islam*. 1(1), 41-53.
[8] Creswell, J., W. (2012). *Educational Research: palnning, conducting abd evakuating quantitative dan qualitative research* (4th ed.). Boston; Pearson Education, Inc.,
[9] Gagne, R. M., Wager, W.W., Golas, K. C. & Keller, J. M (2005). Principles of Instructional Design (5th edition). California: Wadsworth.
[10] Tai, R., C. Liu, A. Maltese, and X. Fan. (2006).Planning Early for Careers in Science.Science 312 (5777): 1143–1144. doi:10.1126/science.1128690.
[11] Jenkins, D. (2006). What Community College Management Practices Are Effective in Promoting Student Success? A Study of High- and Low-Impact Institutions. New York: Community College Research Centre, Institute on Education and the Economy, Teachers College, Columbia University. http://ccrc.tc.columbia.edu/Publication.asp?UID=419.
[12] Vebrianto, R., Rery, R. U., & Osman, K. (2016). BIOMIND portal for developing 21st century skills and overcoming students' misconception in biology subject. *International Journal of Distance Education Technologies*, *14*(4), 55-67. DOI: 10.4018/IJDET.2016100105
[13] Blumenfeld, P. C., T. M. Kempler, and J. S. Krajcik. (2006).Motivation and Cognitive Engagement in Learning Environment In The Cambridge Handbook of Learning Sciences, ed R. K. Sawyer, 475–488. New York, NY: Cambridge University Press.
[14] Riskowski, J., C. D. Todd, B. Wee, M. Dark, and J. Harbor. (2009). Exploring the Effectiveness of an Interdisciplinary Water Resources Engineering Module in an Eighth Grade Science Course. International Journal of Engineering Education 25 (1): 181–195.

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