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Research Article

Developing learning supplement book of Cell Mitotic Division material for Junior High School students

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Abstract: Cell division is an abstract material for middle school students in which learning resources and supporting learning media are compulsory to use. This research and development aimed at developing learning supplement book of mitotic cell material for IX graders which eases them to identify cell division, particularly in mitotic phase. This study was developed based on ADDIE model which comprised of four stages (i.e. Analysis, Design, Development, Implementation, and Evaluation). The validation test was conducted by teaching and learning material experts. The two stage tests were conducted in small and large trial groups. The qualitative and quantitative data gained were analyzed using percentage. The results showed that the percentage values were 86.2% (very feasible) for teaching material, 99.4% (very feasible) for learning material. The small-scale trial gained 87.8% (very feasible), meanwhile the large-scale test gained 88.3% (very feasible). In conclusion, the mitotic learning supplement book of cell division material for junior high school can be used as teaching material in classroom learning activities.

Keywords: ADDIE research; Cell mitotic; supplement book

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1. Introduction

Science learning is a learning process which involves the process of observing and analyzing natural phenomena. Maiyena and Pinta (2014) stated that not only is science learning process focused on cognitive aspect, but it also includes attitudes, products, processes, and the applications which are carried out as a whole. This because, in science learning, there is a process which emphasizes the relationship among natural phenomena.

Biology is a part of science which studies about living things and their natural surroundings. The objects in biology are often encountered in real life. According to (Minarno, 2001), learning biology must emphasize experiences achievement about the objects studied by students. Basically, not all study objects can be seen directly as there are many abstract concepts of science which are difficult to understand.

Cell division is one of abstract materials studied in biology. According to (Çimer, 2012), cell division has been considered as one of the difficult materials to comprehend. This because cell division is a process which cannot be seen directly. Cell division is an abstract material for students as they can only imagine it. Moreover, there are limited teaching materials which are supported with facts. In the other words, most of cell division materials are theoretical.

The low students' understanding related to cell division material, especially mitosis, is proven by the low score gained. Lestari (2014) reported that the IX-graders' daily exam scores, especially in cell division material, in the last two years were below the standard (below 70 as the minimum completeness criteria/MCC). The need analysis conducted by researchers in SMP Muhammadiyah 2 Malang in October 2018 also showed the same results. This means that students have not been able to understand the material of cell division optimally. This is occurred because the materials are presented in textbooks and

worksheets without being supported by sufficient facts to support learning activities based on observations. Furthermore, the need analysis results showed that 82% of students have never done learning to identify mitotic phases through real objects by conducting practicum. In addition, 96% students expected a teaching material which supports learning activities by observing real objects directly. The same problem was also found in the two other junior high schools i.e. SMP 4 Muhammadiyah and SMPN 8 Malang.

Teaching material plays an important role as supporting material in learning activities. Teaching material is used by teachers and students in learning activities. Hence, teaching material aims to ease teacher in delivering learning material learnt by students to achieve certain competencies. Teaching material is organized in several forms such as textbook, module, supplement book, handout, worksheet, model, audio teaching material, interactive teaching material, and so forth.

Supplementary book supports learning activities (Rani et al., 2020). It generally contains concepts in terms of information which complement main book (Lestari, 2014). Supplement book can also be developed based on the practicum observation. It facilitates students to observe cell division directly based on the need the facts of real objects. Thus, students obtain learning experiences directly, as the additional information is accurate and up-to-date. This will provide positive influence as the supplementary book is well managed and planned. Not all lesson materials can be loaded fully in textbook, thus, the existence of supporting books is necessary to facilitate students in achieving learning goals.

Based on the above premises, it is necessary to develop supplementary books which contain of mitotic phases material for IX graders. The supplementary book developed refers to the Curriculum 2013 with a good presentation and equipped with pictures of cell division phases. Thus, it can be used as teaching material to improve student understanding.

2. Materials and Methods

This research and development employed ADDIE model constructed by Dick and Carry. This model comprised of five stages i.e. Analysis, Design, Develop, Implement, and Evaluate. This study developed a supplementary book and cell division preparations utilized to support learning activities in improving student understanding.

2.1. Analysis

The analysis was carried out through two activities consisted of teachers' and students' need analysis and curriculum analysis. The need analysis stage was carried out in SMP Muhammadiyah 2 Malang. The activities carried out at this stage were interview with science teachers and distributing questionnaires to 20 students. Meanwhile, the curriculum analysis was conducted to ensure that the supplementary book developed is in accordance with Curriculum 2013. At this stage, the analysis was done to ensure that the Competency standard and Competency Achievement Indicators set by government are covered in the learning material developed. This stage was conducted through interviews during initial observations done with science teachers at school.

2.2. Design

At this stage, planning is carried out to determine the elements needed in supplement book such as competence and indicators according to the Curriculum 2013, learning strategies, methods, and evaluation techniques.

2.3. Develop

At the development stage, several activities were conducted. They were started with searching and collecting various sources which are relevant to the material, manufacturing mitotic supplement book presented with original images based on the results of observations, layouts setting, validating teaching materials, revision I, limited trial, and revision II (if needed).

2.4. Implement

At the large-scale trial stage, it was determined whether the product feasible or not based on the both material and learning media aspects. Thus, the final product is feasible and can be produced and utilized in learning activities especially in cell division material. The trial test was done on 30 participants at SMP 2 Muhammadiyah Malang.

2.5. Evaluate

The evaluation stage was carried out at each stage in terms of formative evaluation. The results of the formative evaluation were used as a reference for improvement steps at each stage in case any improperness were found on the teaching materials

3. Results

The results of development research can be described through stages as follows.

3.1. Analysis

The needs analysis results showed that the student needs for supplement book that was 100%. This means that all respondents (students) tended to gain an additional book in the form of supplement book which can support their learning activities in terms of bringing them closer to the facts directly. In addition, the interview results with some students indicated that the learning activities of this material had never used teaching materials which approach students to the real facts and display the original image.

Meanwhile, based on the learning goals and curriculum analysis, a specific goal for supplement book development was determined. The goal was to support the implementation of all core competencies, basic competencies, and specific indicators of mitotic cell division sub material. Thus, the concepts understanding can be achieved optimally.

3.2. Design

The preparation of the supplementary book framework includes gathering information related to competencies and learning objectives, developing information into learning materials, and developing subject matter from literature studies. The literature sources include the Curriculum 2013 student science book, the Curriculum 2013 teacher science book, the Biology Volume 2 of Campbell (2008), as well as several literature sources from the internet. In addition, in this phase, the validation of supplementary book, content, as well as teacher and student response questionnaires were also carried out.

3.3. Development

The development product resulted was a supplement book. The validation of the product was done by expert lecturers and science teachers. The validation process covered teaching materials and content. The validation results of teaching material validation questionnaires can be seen in Table 1.

Table 1. The validation results of supplementary book by teaching material experts

No.	Assesment criteria	Presentage (%)	Category	Validation level
1	The properness with teaching material principles	60	Fair	Revision required
2	Book format	70	Feasible	No revision
3	Content feasibility	75	Feasible	No revision
4	Prersentation	60	Fair	Revision required
5	Language	70	Feasible	No Revision
6	Benefit	80	Feasible	No revision
Total		**73**	**Feasible**	**No revision**

The validation results of the supplementary book after revision are served in Table 2.

Table 2. The validation results of supplementary book by teaching materials experts after revision

No.	Assesment criteria	Presentage (%)	Category	Validation Level
1	The properness with teaching material principles	80	Feasible	No revision
2	Book Format	87.7	Feasible	No revision
3	Content feasibility	80	Feasible	No revision
4	Prersentation	85	Feasible	No revision
5	Language	85	Feasible	No revision
6	Benefit	100	Feasible	No revision
Total amount		**86.2**	**Feasible**	**No revision**

The validation assessment results of supplementary book by material experts are served in Table 3.

Table 3. Validation results of supplementary book by content experts

No	Assessment criteria	Percentage (%)		Category	Validation level
		Before revision	After revision		
1	Content feasibility	98.3	100	Very feasible	No revision
2	Language	100	100	Very feasible	No revision
3	Presentation	100	100	Very feasible	No revision
Average		**99.4**	**100**	**Very feasible**	**No revision**

The results of student responses are available in Table 4.

Table 4. Small-Scale Trial Results

No	Presentation	Respondent number	Total score
1	The appearance of the supplement book is interesting	5	20
2	The colors used in the supplement book are interesting	5	19
3	The letters used in the supplement book are appropriate	5	16
4	The material in the supplement book is easy to understand	5	16
5	The command questions in the supplement book are easy to understand	5	16
6	The picture on the supplement book is clear	5	18
7	Adding new knowledge	5	18
Total			**123**
Maximum score per item			**4**
Total maximum score			**140**
Precentage			**100%**

The results of a large-scale trial with 26 grade IX junior high school students consisting of 26 students can be seen in Table 5.

Table 5. The results of large-scale trial of supplementary book

No	Assessment aspect	Respondent number	Total score
1	The supplementary book presentation is interesting	26	94
2	The color used on the book is interesting	26	89
3	The alphabets used on the book is appropriate	26	88
4	The materials served in the book are easy understood	26	91
5	The instructions used in the book are easy understood	26	90
6	The figures served in the book are clear	26	92
7	The book contents add new knowledge	26	99
Total			**643**
Maximum score per item			**4**
Total maximum score			**728**
Percentage			**100%**

At this trial stage, data from the field trial results will be presented from the supplement book product to see the effectiveness after using the mitosis learning supplement book on cell division material in junior high school. After using the supplement book, students were given an evaluation question regarding mitotic learning for 45 minutes with a total of 30 students. The results of the evaluation test data can be seen in Table 6.

Table 6. Grade IX students' work evaluation scores using learning supplement books

No	Name	Minimum Completeness Criteria	Evaluation Score
1	S A I	73	87
2	R E	73	81
3	F P	73	85
4	D I P	73	87
5	A M	73	80
6	A P	73	88
7	F A M	73	87
8	K P L	73	86
9	A S	73	85
10	A P	73	84
11	C T P	73	80
12	A I P	73	80
13	K M	73	83
14	S P I	73	82
15	J A	73	85

No	Name	Minimum Completeness Criteria	Evaluation Score
16	F A P	73	75
17	R U K	73	78
18	A K	73	85
19	A F	73	86
20	Q B I	73	87
21	N I P	73	87
22	A S	73	80
23	D N	73	80
24	A U H	73	90
25	S H	73	85
26	M P	73	85
27	R A M	73	83
28	S D	73	87
29	L A	73	86
30	S S	73	82

Based on the difference in the results of the evaluation data after using the mitosis learning supplement book with the school's KKM score, it showed significant results that there was an increase in the score or score obtained by students. Based on these results, when compared with other classes that have not used supplement books as supporting teaching materials, there is a difference in grades, namely Class B and C have an average score of 77 and 79 respectively. Meanwhile, class A who has used supplement books obtained the average grade before the use of the supplement book was 78 then after the application of the supplement book the grade average was 83.

3.4. Evaluation

The evaluation stage is carried out through formative evaluation activities by collecting data through several methods, namely observation, interviews at the initial research activities so as to produce data that can be used to improve this supplement book.

4. Discussion

The supplementary book development was started by conducting need analysis. It is one of crucial step to ensure that the learning media developed is really needed by the subjects targeted. Heong et al. (2012) stated that need analysis is a key factor in generating idea. In this study, 100% of the respondents stated that they need supplementary book to support their learning activities. The same analysis was done by many researchers to develop high quality learning media (Bowling et al., 2008; Ilma et al., 2018) and other learning attributes (Hudha et al., 2017) . In the other words, the demand of the supplementary book is high, thus, the supplementary book development is the right solving for the issue, in terms of teachers and students' needs. Thus, the development process can be proceeded.

Moreover, the curriculum analysis showed that the standardized competence in Curriculum 2013 can be determined as the basis for supplementary book development. In the development stage, learning media validation is compulsory. This aims to guarantee that the media developed functions well. Not only in developing book, several previous researchers did validation on their evaluation instrument (Gormally et al., 2012), (Hudha et al., 2017), module (Irwan et al., 2019), and so forth (Dung & Fatmawati, 2018; Gulbinskienė et al., 2017). Table 1 proved that, according to material experts, the supplementary book was still need to be revised for several points. The lowest percentage

achieved in the book was the properness of the book with the teaching material principles as considerable as its presentation. Thus, the researchers need to revise them.

Notwithstanding that there only two aspects are necessary to revise, but the researcher did revise all criteria assessed to optimize the book. Thus, the feasibility of the book was great (Table 2). Furthermore, based on material expert assessment (Table 3), there, actually, were no criteria need to be revised. The only criteria below 100% was content feasibility (98.3%). Yet, the researchers need to optimize this criterion to meet 100%.

In addition to validation assessment, the small- scale trial achieved was 100% (Table 4). This means that the book developed was well accepted by student. Similarly, in the large-scale trial, the maximum score was gained by the supplementary book (Table 5). Trial process in developing learning attributes is a considerable step to measure the effectiveness of the attributes developed (Muhaimin, 2015; Rani et al., 2020; Septiani & Rustaman, 2017; Tang et al., 2020).

Not only were stop in the validity assessment and trial steps, but the supplementary book feasibility was also ensured by assessing students scores. The results (Table 6) showed that all students achieved the scores above the minimum completeness criterion (73). The lowest scores gained by student were 75 and 78; while the 28 student's scores remain were above 80. This is an important prove that the supplementary book developed is applicable to support students' learning process.

5. Conclusions

This research and development produced a supplementary book for cell division material in term of mitosis based on ADDIE model which contained of five stages, namely: 1) Analysis, 2) Design, 3) Development, 4) Implementation, 5) Evaluation. To go further, the supplementary book was validated by material experts and teaching materials experts. The average validation score of the three aspects (feasibility, language, and presentation) assessed is 99.4% which is in the very feasible category. The validation of teaching materials experts was also done on six aspects, namely, teaching materials, book format, content feasibility, presentation, language, and benefits. The average value gained in the first stage validation is 73%. Meanwhile, the second stage validation achieved the average value of 86.2% of all aspects with a very decent category. The small-scale trial obtained the average score of 87.5% (very decent) and the average score for the large-scale trial is 88.3% (very decent). Furthermore, the evaluation results showed that there was an improvement of students' achievement as they used the book. The students' scores reached above the minimum completeness criterion determined by school (73). Thus, the book is feasible to be used in improving students' understanding about cell division material, especially in mitosis.

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6. References

Bowling, B. V., Acra, E. E., Wang, L., Myers, M. F., Dean, G. E., Markle, G. C., Moskalik, C. L., & Huether, C. A. (2008). Development and evaluation of a genetics literacy assessment instrument for undergraduates. *Genetics, 178*(1), 15–22. https://doi.org/10.1534/genetics.107.079533

Çimer, A. (2012). What makes biology learning difficult and effective: Students' views. *Educational Research and Reviews, 7*(3), 61–71. https://doi.org/10.5897/ERR11.205

Dung, N. T., & Fatmawati, D. (2018). General informatics teaching with B-Learning teaching

model. *JPBI (Jurnal Pendidikan Biologi Indonesia), 4*(1), 85. https://doi.org/10.22219/jpbi.v4i1.5312

Gormally, C., Brickman, P., & Lutz, M. (2012). Developing a Test of Scientific Literacy Skills (TOSLS): Measuring undergraduates' evaluation of scientific information and arguments. *CBE—Life Sciences Education, 11*(4), 364–377. https://doi.org/10.1187/cbe.12-03-0026

Gulbinskienė, D., Masoodi, M., & Šliogerienė, J. (2017). Moodle as virtual learning environment in developing language skills, fostering metacognitive awareness and promoting learner autonomy. *Pedagogika, 127*(3), 176–185. https://doi.org/10.15823/p.2017.47

Heong, Y. M., Yunos, J. M., Othman, W., Hassan, R., Tee, T. K., & Mohamad, M. M. (2012). The needs analysis of learning higher order thinking skills for generating ideas. *Procedia - Social and Behavioral Sciences, 59*, 197–203. https://doi.org/10.1016/j.sbspro.2012.09.265

Hudha, A. M., Amin, M., Bambang, S., & Akbar, S. (2017). Study of instructional models and syntax as an effort for developing "OIDDE" instructional model. *Jurnal Pendidikan Biologi Indonesia, 2*(2). https://doi.org/10.22219/jpbi.v2i2.3448

Ilma, S., Superli, S., Zulfadli, Z., & Rupa, D. (2018). Developing poster based on diversity of Nepenthes in Padat Karya forest, Krayan Nort Kalimantan. *JPBI (Jurnal Pendidikan Biologi Indonesia), 4*(1), 67–74. https://doi.org/10.22219/jpbi.v4i1.5231

Irwan, Maridi, & Dwiastuti, S. (2019). Developing guided inquiry-based ecosystem module to improve students ' critical thinking skills. *JPBI (Jurnal Pendidikan Biologi Indonesia), 5*(1), 51–60. https://doi.org/10.22219/jpbi.v5i1.7287

Lestari, R. (2014). Pengembangan media pembelajaran pembelahan sel dengan menggunakan Macromedia Flash untuk Kelas XII SMA. *Jurnal Ilmiah Edu Research, 3*(2), 133–138.

Maiyena, S., & Pinta, Y. (2014). Pengaruh penggunaan media film dokumenter harun yahya terhadap hasil belajar IPA siswa kelas X SMKN 1 Guguk [The influence of Harun Yahya documentary film media on students' natural science learning outcomes of class X SMKN 1 Guguk]. *Ta'dib, 17*(1), 1–13. https://repo.iainbatusangkar.ac.id/xmlui/handle/123456789/13082

Minarno, E. B. (2001). Pembelajaran bioetika secagai pengawal perkembangan biologi modern dan penyelamatan lingkungan hidup. *El–Hayah, 3*(1), 35–40. https://doi.org/10.18860/elha.v3i1.2217

Muhaimin, M. (2015). Implementasi model pembelajaran berbasis masalah lokal dalam mengembangkan kompetensi ekologis pada pembelajaran IPS. *SOSIO DIDAKTIKA: Social Science Education Journal, 2*. https://doi.org/10.15408/sd.v2i1.1409

Rani, K. B., Widiyaningrum, P., & Ulung Anggraito, Y. (2020). Effectiveness of research based booklet media of conventional Biotechnology application as a supplement of Biotechnology teaching materials in Senior High School. *JISE, 9*(3), 295–300. http://journal.unnes.ac.id/sju/index.php/jise

Septiani, A., & Rustaman, N. Y. (2017). Implementation of performance assessment in STEM (Science, Technology, Engineering, Mathematics) Education to detect science process skill. *Journal of Physics: Conference Series, 812*(1), 012052. https://doi.org/10.1088/1742-6596/812/1/012052

Tang, T., Abuhmaid, A. M., Olaimat, M., Oudat, D. M., Aldhaeebi, M., & Bamanger, E. (2020). Efficiency of flipped classroom with online-based teaching under COVID-19. Interactive *Learning Environments, 0*(0), 1–12. https://doi.org/10.1080/10494820.2020.1817761