BioEdu

Vol. 12 No. 1 Tahun 2023 | Hal: 188-200

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APPLICATION OF CK-12 ON BACTERIAL TOPIC CONSTRUCTED ON INQUIRY-BASED LEARNING TO ENHANCE CRITICAL THINKING ABILITY OF 10th GRADE HIGH SCHOOL STUDENTS

Pemanfaatan CK-12 berbasis Inquiry-Based Learning pada Materi Bakteri Kelas X SMA untuk Meningkatkan Keterampilan Berpikir Kritis

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Abstract

The availability of learning media that facilitates the needs of students to enhance critical thinking skills in integration with ICT is still very limited nowadays. Bacteria are still considered as materials that are difficult for 10th graders to understand and master. Various uses of bacteria in the surrounding life are also difficult to understand. Therefore, it is necessary to apply a Learning Management System that is integrated with critical thinking skills training. Inquiry-Based Learning is a relevant learning model integrated in improving students' critical thinking skills on the topic of bacteria. This study aims to apply the CK-12 constructed on Inquiry-Based Learning as a practical, straightforward, and easy-to-use learning instrument to enhance critical thinking skills. This study uses the ADDIE research model amount to analysis of curriculum, students, concepts, and assignments; design and development on CK-12 platform; implemented in the classroom for 3 weeks; and evaluated on every phases mentioned, accompanied by validation method, implementation observation, and student response questionnaire method which was carried out on 85 grade 10th students of SMAK Untung Suropati Sidoarjo and the data obtained were analysed using descriptive-quantitative techniques. This study resulted in the application of the CK-12 with a validity score of 3.8; the implementation of learning is 83.69; and the positive response of students was 92.89%. Thus, the application of CK-12 on bacterial topic constructed on Inquiry-Based Learning to enhance critical thinking skills for 10th grade high school students is very feasible in terms of validity, implementation, and student responses.

Keywords: CK-12, bacteria, inquiry-based learning, critical thinking skills.

Abstrak

Ketersediaan media belajar yang memfasilitasi kebutuhan siswa untuk meningkatkan keterampilan berpikir kritis terintegrasi penguasaan TIK masih terbatas dewasa ini. Salah satu materi ajar biologi yang masih dianggap sulit dikuasai oleh siswa adalah materi bakteri. Beragam pemanfaatan bakteri dalam kehidupan sekitar juga masih sulit dimengerti dalam konteks yang relevan. Maka dari itu, diperlukan pengaplikasian Learning Management System (LMS) yang diintegrasikan dengan pelatihan keterampilan berpikir kritis. Inquiry-Based Learning merupakan model pembelajaran yang relevan diintegrasikan dalam meningkatkan keterampilan berpikir kritis siswa pada topik bakteri. Penelitian ini bertujuan untuk mengaplikasikan Flexbook CK-12 berbasis Inquiry-Based Learning sebagai perangkat belajar yang praktis, memiliki keterlaksanaan yang baik, serta mudah digunakan untuk meningkatkan keterampilan berpikir kritis. Penelitian ini menggunakan model pengembangan ADDIE yang terdiri atas analisis kurikulum, siswa, konsep, dan penugasan; desain dan pengembangan pada platform CK-12; implementasi di kelas selama 3 minggu; dan evaluasi pada setiap tahapan model pengembangan, disertai metode validasi, observasi keterlaksanaan, dan metode angket respon siswa yang dilaksanakan pada 85 siswa kelas 10 SMAK Untung Suropati Sidoarjo dan data yang diperoleh dianalisis dengan teknik deskriptif-kuantitatif. Penelitian ini menghasilkan pemanfaatan Flexbook CK-12 dengan skor validitas sebesar 3,8; keterlaksanaan pembelajaran sebesar 83,69; dan respon positif siswa sebesar 92,89%. Dengan demikian

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

pengaplikasian CK-12 berbasis Inquiry-Based Learning pada materi bakteri kelas 10 SMA untuk meningkatkan keterampilan berpikir kritis sangat layak ditinjau dari validitas, keterlaksanaan, dan respon penggunaan siswa.

Kata kunci: CK-12, bakteri, inquiry-based learning, keterampilan berpikir kritis.

INTRODUCTION

In the era of disruption and rapid technological development, the requirement for mastery of science and technology becomes a top priority in a sustainable community development. Furthermore, the assertion of highly competitive life skills such as critical thinking is also one of the parameters of skill development nowadays. Education is an important milestone that continuously strives to comply with the ability to mastery science and technology and think critically, and be able to implement it in various forms of innovation, both independently and in communal groups (Sundari *et al.*, 2020). More specifically, in the Regulation of the Minister of Education and Culture number 20 of 2016 for high school student it is emphasized that there is mastery of cognitive competence at the level of understanding, applying, analysing, and evaluating, while psychomotor competence is at the level of critical and creative acting skills.

Inquiry-Based Learning is a learning method implemented to facilitate students in searching, finding, and building appropriate knowledge concepts from various learning resources to solve an actual problem (Arianti *et al.*, 2018). Inquiry-Based Learning allows meaningful learning to occur through the discovery process and teaches the scientific process for students (Laila and Puspitawati, 2019). Inquiry-Based Learning which is applied in the classroom and integrated with the development of Information and Communication Technology (ICT) will accommodate the requirement for mastery of science and technology and critical thinking.

The integration of Inquiry-Based Learning method with ICT in digital learning is a strategic step to embrace and reach all students and their needs quickly, accurately, and inclusively (Zamjani *et al.*, 2019). However, in practice, special attention is required because there are two challenges that often end up as implementation obstacles. First, in the practice of digital learning, there are still many digital disparities, namely conditions where the ability and opportunity to access technology is not evenly distributed from one region to another. Second, the implementation of digital learning is currently still in the non-formal education sector as a form of supplementation for formal education. This can be seen clearly in the use of digital learning instrument which has just been implemented well at the university level, and is very rarely found in secondary education (Devaux *et al.*, 2017).

The development of interactive learning instrument using Inquiry-Based Learning method constructed on the inquiry syntax is an effort to provide learning in accordance with the directions of the K-12 curriculum (Ali *et al.*, 2014). Interactive learning instruments are able to support the construction of concepts, perspectives, and facilitate the learning process, so as to strengthen the theory of connectivism in learning (Zamjani *et al.*, 2019). Another study conducted by Ijtimaiyah *et al.*, (2016) explained that the development of a specific learning instrument based on the guided inquiry method for growth and development materials was able to enhance scientific process skills up to 95%. Scientific process skills in students also experienced a significant increase with the development of guided inquiry-based learning instrument that used the habituation of high-level cognitive and psychomotor skills (Habsari *et al.*, 2016). The development and utilization of the learning management system along with all related learning instruments using the CK-12 application are able to bridge the requirement for developing learning instrument constructed on the inquiry-based learning method.

CK-12 is an application with a mild interface, easy for students to understand and apply, and allows students to develop good ICT mastery skills. More specifically, the development of learning instrument constructed on the inquiry-based learning method that is integrated with ICT needs to be carried out, especially on the bacterial topic for grade 10 high school students. Rochma and Ibrahim (2019) confirmed that most teachers had difficulty in delivering the bacterial topic properly, especially in the sub-topics of structure, reproduction, and the role of bacteria in life. Bacterial topic does not dominate in various assessment instruments, but students still need to be accustomed to applying the knowledge concepts they have learned with critical thinking skills (Kemendikbud, 2019).

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

Research on the development of learning instruments has been carried out for the last 10 years. However, the development that has been implemented tends to be partial. This trend is clearly seen in the lack of research on the development of an integrated Learning Management System (LMS). Maknun (2017) in his research explains that development research still focuses on developing learning models (25%), practicum (10%), textbooks, learning media, and student worksheets (9.8%), as well as assessments (7.4%). Research in the field of biology education is also very lacking when viewed from the use of bacterial material. This can be seen clearly from the use of biological materials which are dominated by organ system materials (31%), environmental pollution (18%), and ecology (10%) (Maknun, 2017).

Responding to actual research conditions and needs, researchers developed a CK-12 Learning Management System constructed on Inquiry-Based Learning on bacterial topic to enhance critical thinking skills in 10th grade high school students. This study aims to produce an integrated learning instrument and describe the validity, ease of use, and response to the use of CK-12. This study focuses on enhancing students' critical thinking skills in the inference and discussion-explanation phases. The contribution of this research is significant, especially in providing references to the use of an integrated CK-12 Learning Management System through the implementation of Inquiry-Based Learning-based learning on 10^{th} grade bacteria which is still rarely developed.

METHODS

The research carried out is a development research using ADDIE research design that consists of Analyse, Design, Development, Implementation, and Evaluation phases which is applied in a student-centred learning process with a focus on instructional approach. The analysis phase carried out in this research includes an analysis of curriculum, students, concepts, and assignments. Design and development phases carried out using the Flexbook CK-12 platform and implemented in the classroom for 3 weeks, and evaluation carried out at each stage of the research scheme to evaluate every phase comprehensively. The ADDIE model was chosen because it provides evaluation on every phase, which allows re-forming development and implementation of the learning instrument (Alnajdi, 2018).

The target of this research is the use of CK-12 based on Inquiry-Based Learning on bacterial topic to enhance critical thinking skills, which was carried out in a limited trial on 85 students of 10^{th} science grade in SMAK Untung Suropati. The distribution of students is heterogeneous, both in terms of gender and academic ability. The limited trial was carried out in May 2022 in 3 weeks learning meeting in the classroom.

Research variables include the validity and level of CK-12 instrument's ease of use. Validity is a result obtained after the validation process carried out by the validator. Validity was expressed in the form of a statement describing the quality of the bacterial module development in CK-12. The bacterial module in the CK-12 device that has been developed is declared feasible if the assessment score is more than 2.51 (Table 1).

Table 1. Validity score interpretation criteria

Score	Criteria
3.51 ≤ P ≤ 4	Very feasible
2.51 ≤ P ≤ 3.50	Feasible
1.51 ≤ P ≤ 2.5	Less feasible
0 ≤ P ≤ 1.5	Not feasible

Adapted from Çelik & Oral (2016)

The level of ease of use of the CK-12 instrument was obtained through observing the implementation of learning and student responses. The ease of use of CK-12 instrument in terms of the observation of the implementation of learning is declared practical if the assessment score is more than 50% (Table 2). The ease of use of CK-12 instrument in terms of student responses is declared easy-to-use if the student response score is more than 60% (Table 3).

Table 2. Ease of use interpretation through observing the implementation criteria

Score	Criteria
75 ≤ P ≤ 100	Very practical
50 ≤ P ≤ 74	Practical
25 ≤ P ≤ 49	Less practical
0 ≤ P ≤ 24	Not practical

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

Table 3. Ease of use interpretation through student responses criteria

Score	Criteria
80 ≤ P ≤ 100	Very easy
60 ≤ P ≤ 79	Easy
40 ≤ P ≤ 59	Neutral
20 ≤ P ≤ 39	Not easy
0 ≤ P ≤ 19	Very not easy

Adapted from Prihandono *et al.* (2017)

Data instruments used to collect assessments in this study include validation sheets, implementation observation sheets, and student response questionnaires. The validation sheet is used to provide an assessment of the development of CK-12 bacterial material, so that it can be declared feasible to use, both in terms of concept correctness, content presentation, and language. The validation sheet is filled out by material expert lecturers, education expert lecturers, and biology subject teachers.

The implementation observation sheet contains observation indicators that are used to provide an assessment of the implementation of the learning process by utilizing CK-12 based on Inquiry-Based Learning. Observation indicators are prepared with reference to the learning implementation process and filled in by three observer teachers during the learning process.

Student response questionnaires were used to measure student responses regarding the ease of use of the CK-12 device based on Inquiry-Based Learning on bacterial material. The response questionnaire contains indicators of presentation, grammar, content display, material concepts, and critical thinking skills. Student response questionnaires were packaged using Google Forms and filled in after students completed the learning process.

RESULT AND DISCUSSION

This research resulted in the use of the CK-12 platform based on Inquiry-Based Learning on bacteria for 10th grade of high school students with a validity score of 3.8, the percentage of practical degree in terms of implementation observations of 85.67, and 92.89% positive responses from students.

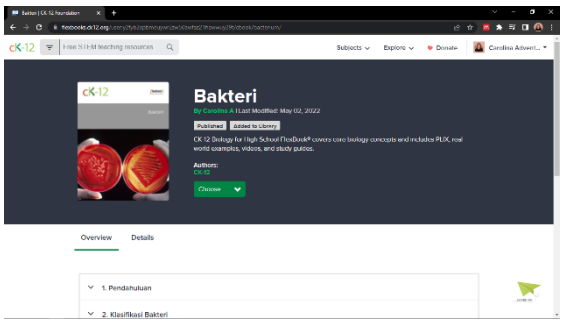

Figure 1. Landscape orientation of Flexbook CK-12 Bakteri on PC

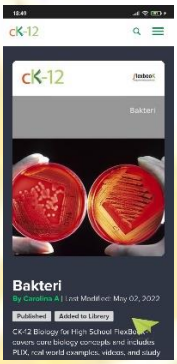

Figure 2. Portrait orientation of Flexbook CK-12 Bakteri on smartphone

The use of the Flexbook CK-12 in this study contains features that facilitate students in improving their critical thinking skills. Flexbook CK-12 Bacteria can be accessed online either through a PC with a landscape orientation (Fig. 1), or a smartphone with a portrait orientation (Fig. 2).

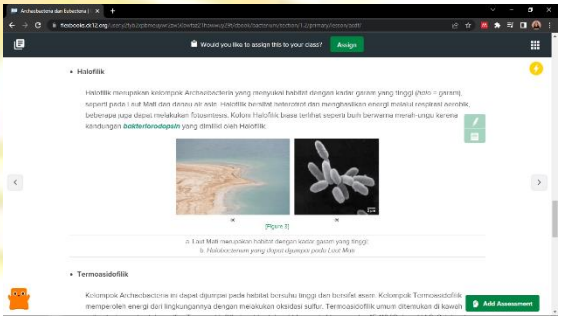

Figure 3. Material explanation of Flexbook CK-12 Bakteri to enhance students' conceptualization and analysis phases on critical thinking syntax

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

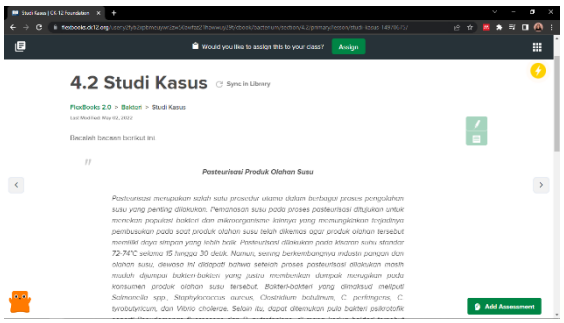

Figure 4. Studi Kasus feature on pasteurization of dairy products topic to enhance investigation and evaluation phases on critical thinking syntax

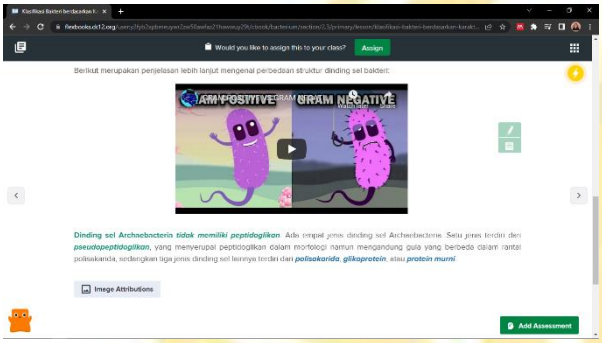

Figure 5. Interactive video attached on Flexbook CK-12 Bakteri to enhance students' authentic investigation process on critical thinking syntax

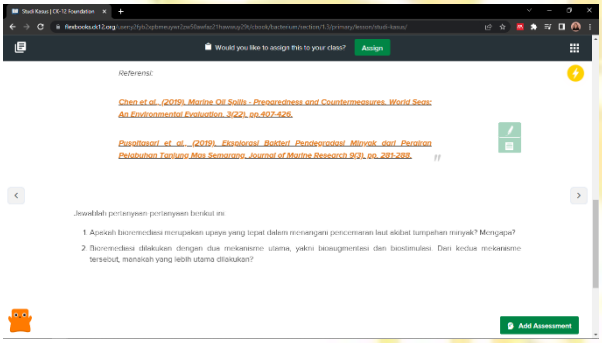

Figure 6. Reflective questions to foster students' self-regulation ability on critical thinking syntax

The material section includes reference images that are relevant to actual conditions and accompanied by a good explanatory narration (Fig. 3). The most important feature in the development of Flexbook CK-12 lies in the Studi Kasus (case study) feature which contains narratives of actual cases that are closely related to the use of bacteria in everyday life (Fig. 4).

The application of Flexbook CK-12 has been validated by three validators, consist of education expert, material expert, and high school biology teacher, who marked aspects of presentation, content, and linguistic properness. The following is a recapitulation of the validity of developing a book on bacteria based on Inquiry-Based Learning to enhance critical thinking skills (Table 4).

Tabel 4. Validity of Flexbook CK-12 constructed on inquiry-based learning recapitulation

No	Indicator	Score V1	V2	V3	Avg
PRESENTATION					
A	Technical Presentation				
	1. Can be accessed via laptop or smartphone	4	4	4	4
	2. There is a navigation system that makes it easy to move from one sub-material to another simultaneously	3	4	4	3.67
	3. There is a hyperlink that can be accessed directly to the intended page	3	4	4	3.67
	4. Using a contrasting paragraph system so as to provide a clear distinction between sections	4	4	4	4
	5. Use easy-to-read fonts	4	4	4	4
	6. Use different font colors to emphasize important words	4	3	4	3.67
	Average/Criteria	3.84 / Very feasible			
B	Interface Quality				
	7. The interface is attractive and simple	4	4	4	4
	8. The interface supports the listed material	4	4	4	4
	9. The arrangement of the material is neat and makes learning easy	4	3	4	3.67
	Average/Criteria	3.89 / Very feasible			
C	Picture Quality				

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

No	Indicator	Score V1	V2	V3	Avg
	10. The images used support the concept and material	4	4	3	3.67
	11. The images used are clear and contrasting	4	4	4	4
	12. Pictures with clear descriptions	4	3	3	3.33
	13. Loading source and shooting license	4	4	4	4
	Average/Criteria	3.75 / Very feasible			
D	Video Quality				
	14. The video used supports the concept and material	3	4	4	3.67
	15. The video used is clear and makes it easier for visual understanding	4	4	4	4
	16. Videos can be viewed directly from the video source (YouTube)	4	4	4	4
	Average/Criteria	3.89 / Very feasible			
E	Interactive Quality				
	17. Allows giving additional notes on each sub-material	4	4	4	4
	18. Allows highlighting each sub-material	4	4	4	4
	19. Allows search for other learning resources integrated into Flexbook 2.0	4	3	4	3.67
	20. Allows learning autonomy for each student according to their needs using the Flexbook 2.0	4	4	4	4
	Average/Criteria	3.92 / Very feasible			
Presentation Score/Criteria		**3.86 / Very feasible**			
CONTENT					
A	The suitability of the material with the Basic Competencies and Learning Objectives				
	1. The material presented is in accordance with the demands of Basic Competence (KD)	3	4	4	3.67
	2. The material presented is in accordance with the learning objectives	3	4	4	3.67
	Average/Criteria	3.67 / Very feasible			
B	Appropriateness and correctness of the concept				
	3. Materials are arranged in order from simple to complex	4	3	4	3.67
	4. The material presented is correct and appropriate	4	3	4	3.67
	5. The material presented is clear and easy to understand	4	4	4	4
	Average/Criteria	3.78 / Very feasible			
C	Suitability of the concept				
	6. Using a minimum of 5 references published in the last 5 years	4	3	4	3.67
	Average/Criteria	3.67 / Very feasible			
D	Flexbook 2.0 . Systematics				
	7. The cover image selection for the Flexbook 2.0 interface is attractive and appropriate	4	4	4	4
	8. The cover of Flexbook 2.0 includes author, contributor, and license information	4	3	4	3.67
	9. The table of contents makes it easy to navigate to the sub-material you want to go to	4	4	4	4
	10. Contains the learning objectives to be achieved and keywords in the introduction	4	4	3	3.67
	11. Loading a concept map to facilitate learning that is listed in the introduction	3	4	3	3.33

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

No	Indicator	Score V1	V2	V3	Avg
	12. The material is presented in the form of narrative text, pictures, tables, and videos	4	4	4	4
	Average/Criteria	3.78 / Very feasible			
E	Conformity with Inquiry-Based Learning syntax and Critical Thinking indicator				
	13. Orientation and Interpretation - Flexbook 2.0 helps students understand the phenomenon of problems in each sub-material	3	4	4	3.67
	14. Conceptualization and Analysis - Flexbook 2.0 helps students to identify approaches and basic arguments based on basic knowledge concept for the problem phenomena in each sub-material	4	4	4	4
	15. Inference - Flexbook 2.0 helps students to identify the information needed to strengthen arguments related to the problem phenomena in each sub-material	4	4	4	4
	16. Investigation and Evaluation - Flexbook 2.0 helps students to investigate and evaluate the truth and credibility of the sources of information used	4	3	4	3.67
	17. Discussion Explanation - Flexbook 2.0 helps students to compose a coherent explanation regarding the discussion process along the problem phenomena in each sub-material with appropriate information				
	18. Conclusion and Self-Regulation - Flexbook 2.0 helps students to construct conclusion and exercise self-control over the cognitive processes they go through and ensure a comprehensive understanding of each sub-material	4	4	4	4
	Average/Criteria	3.89 / Very feasible			
Content Score/Criteria		**3.76 / Very feasible**			
LINGUISTIC					
A	Language Use				
	1. Informative	4	4	4	4
	2. Communicative	4	4	4	4
	3. Straightforward and firm	4	3	4	3.67
	Average/Criteria	3.89 / Very feasible			
B	Use of the Term				
	4. Use consistent terms	4	3	4	3.67
	5. Use appropriate biological terms	4	3	4	3.67
	6. Use terms that support the delivery of material	4	4	4	4
	Average/Criteria	3.78 / Very feasible			
C	Language Structure				
	7. There are no typos	4	3	3	3.33
	8. No double meaning	4	4	4	4
	9. Compliant with PUEBI	4	3	4	3.67
	10. Sentences represent the delivery of content well	3	4	4	3.67
	Average/Criteria	3.67 / Very feasible			
Linguistic Score/Criteria		**3.78 / Very feasible**			
Average of all indicators		**3.8**			
Criteria		**Very feasible**			

Note:

V1 : 1st validator (education expert)

V2 : 2nd validator (material expert)

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

V3 : 3rd validator (high school biology teacher)

Avg: average score

Based on the recapitulation of the results of the Flexbook CK-12 device validity test in table 4, it is stated that the Flexbook CK-12 device has a validity of 3.8 with a very valid interpretation of the criteria. These results can then be used as a consideration for the use of Flexbook CK-12 instrument in student-centred learning process that allows students to use a variety of learning resources, both in the form of text, images, sound, video, to simulations for active learning (Djamas *et al.*, 2018) . Each group of indicators of validity obtained a value of 3.6-3.92 which indicates that each group of indicators meets the valid provisions.

The highest validity value is found in the interactive qualitative indicator, where the use of Flexbook CK-12 consistently facilitates students to add notes to important sections, access other learning resources that have been integrated, and have learning autonomy according to the needs of each student. The validity of this feature is in line with the need for developing learning tools that allow teachers to motivate each student to use available learning resources according to their needs and the required depth of understanding (Rahman *et al.*, 2021).

The lowest validity value is found in the indicator of the suitability of the content with the requirement of basic competencies and learning objectives along with the updated concept of 3.67. This score indicates that the utilization of the Flexbook CK-12 needs to be developed more comprehensively constructed on the basic competence requirements and learning objectives. Based on the validator's suggestions, it is necessary to consider the weighting of basic competencies at each meeting along with the more ideal allocation of learning time for each learning objectives.

The development of learning tools aimed at improving critical thinking skills must be accompanied by an appropriate allocation of time according to specific learning objectives. This is because one of the characteristics of learning that enhance critical thinking skills must be accompanied by providing a long enough learning duration to facilitate students in building concepts independently from various available sources (Asdarina *et al.*, 2019).

Reflecting on the evaluation and development suggestions provided by the validators and through the revision process, the Flexbook CK-12 was then used in a trial in 3 classes X IPA SMAK Untung Suropati Sidoarjo. The trial was carried out for 3 weeks of meetings. During the trial carried out in the learning process, there were observations of the implementation of the learning process by 3 teachers and filling out student response questionnaires after the series of learning processes were successfully implemented. The following is attached a summary of the implementation observations in Table 5.

Table 5. Recapitulation of implementation observations using Flexbook CK-12 constructed on inquiry-based learning

No.	Activity	Implementation		
		O1	O2	O3
1.	Teacher opens the meeting by greeting.	90	85	90
2.	Teacher facilitates a demonstration of the use of CK-12 and Flexbook 2.0 – Bacteria.	90	80	80
3.	Teacher gives a brief apperception related to the material on each sub-topic.	90	90	90
4.	Teacher provides motivation and positive affirmations to students.	90	90	90
5.	Teacher conveys the objective of learning, the learning methods used, learning outputs, as well as the assessment and assignment system used at this meeting.	85	80	85
6.	Teacher facilitates students to enter the material section of the CK-12 Flexbook 2.0 – Bacteria.	85	85	80
7.	Teacher facilitates students to find an initial orientation on the phenomenon of bacterial utilization (interpretation).	90	90	90

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

No.	Activity	Implementation		
		O1	O2	O3
8.	Teacher facilitates students to carry out conceptualization on the phenomenon of bacterial utilization (analysis).	90	85	90
9.	Teacher facilitates students to carry out investigations on the phenomenon of bacterial utilization (evaluation).	90	85	90
10.	Teacher facilitates students to carry out discussions on the phenomenon of the use of bacteria (inference).	85	80	85
11.	Teacher facilitates students to carry out a conclusion evaluation on the phenomenon of the use of bacteria (explanation).	85	80	90
12.	Teacher facilitates students to carry out self-regulation on the phenomenon of the use of bacteria (self-regulation).	85	90	90
13.	Teacher facilitates to draw conclusions about learning outcomes related to the introduction and classification of bacteria.	80	70	85
14.	Teacher corrects students' concepts that are not quite right and gives appreciation and positive reinforcement to student learning process.	80	70	85
Average		86.79	77.14	87.14
Total Average		**83.69**		
Criteria		**Very practical**		

Note:

V1 : 1st validator (education expert)

V2 : 2nd validator (material expert)

V3 : 3rd validator (high school biology teacher)

Based on the recapitulation of the results of the observation's result on the implementation of learning in Table 5, it is stated that the Flexbook CK-12 instrument has a significance of 83.69 with a very valid interpretation of the criteria for the implementation of learning the topic of bacteria. These results can then be used as a reference for the use of the Flexbook CK-12 instrument in the learning process to improve understanding of knowledge and skills thoroughly. This is because in the frequency of study and time allocation, the habituation of persistent learning situations positively has a more significant impact in increasing knowledge and critical thinking skills (Jung & Lee, 2019).

The novel objective of inquiry-based learning is to extend students' chance to learn something new on independent, sustainable, and lifelong learning habits, so that learning will be effectual, efficient, and meaningful (Herayanti *et al.*, 2020). The application of inquiry-based learning model along with the learning process provide students to investigate their ability to build up their concept and knowledge thoroughly. Positively students become very capable and amusingly in explaining existing problems after their study using inquiry-based learning that has been integrated to Flexbook CK-12. Students enjoy exploring every concept and knowledge in bacteria topic through Flexbook CK-12 and other online media. Herayanti *et al.*, (2020) states that through a relevant and feasible learning instrument, students theoretically able to analyse every problem well and more delightful. If implemented properly, the inquiry-based learning process will support students' independence in critical thinking (Amalia *et al.*, 2022).

Inquiry processes are very ideal to enhance students' critical thinking skills and improving students' ability on correlational thinking and hypothetical-deductive reasoning that are needed nowadays. Erlina *et al.*, (2018) states that causes of students' inability on correlational

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

thinking in consequences of there are no logical relationship to current concept in order to build up the reasonable arguments and the condition that students are lack of concept mastery. Besides, the cause of students' inability on hypothetical-deductive reasoning nowadays due to students apply the wrong concepts and the students' logical thinking skill was not used to relate concepts so there are no practical solutions (Erlina *et al.*, 2018).

Through the results of observations of the implementation of further learning, it is still necessary to carry out further reviews related to the ineffectiveness of the implementation of the conclusion synthesis and correcting misconceptions phases at the end of the learning phase. Wale and Bishaw (2020) explained that through the implementation of Inquiry-Based Learning syntax, students can formulate a synthesis of concept by discovery through various active learning processes. However, this cannot be achieved if any part of the syntax is not implemented. Thus, the phases of synthetizing conclusions and correcting misconceptions remain an important and inseparable part.

Based on the advice given by the observer, the implementation of learning process using Inquiry-Based Learning to improve critical thinking skills must be carried out with a pattern of dividing heterogeneous student groups, both in terms of gender and academic ability. The varied division of student groups allows for an increase in cognitive learning outcomes, better retention and understanding of material, as well as an increase in students' psychomotor abilities in applying knowledge (Lewis *et al.*, 2019). This condition can then be explained in more detail in the use of the Team-Based Inquiry Learning (TBIL) as a learning model that is relevant to the needs of today's STEM-based pedagogy.

After the learning took place, students were asked to fill out a response questionnaire on the use of the Flexbook CK-12. Students fill out a response questionnaire that has previously been developed in accordance with the indicators of existing features and is packed in the Google Form. The following is a recapitulation of filling in the student response questionnaires attached to Table 6.

Table 6. Recapitulation of students' responses on application of Flexbook CK-12 constructed on inquiry-based learning

No.	Indicators	Positive Responses	(%)
PRESENTATION			
1.	The sentences used in CK-12 are easy to understand.	71	83.5%
2.	Navigation between sections makes it easier to use CK-12 in the learning process.	85	100%
3.	The interface is simple and makes it easier to use CK-12 in the learning process.	81	95.3%
4.	Font size, type, and color are easy to read.	82	96.5%
5.	Linked hyperlinks make it easier to understand material with interactive links.	80	94.1%
Average/Criteria		**93.88%/ Very easy**	
LINGUISTIC			
1.	The language used in CK-12 is easy to understand.	69	81.2%
2.	CK-12 uses Indonesian grammar according to the General Guidelines for Indonesian Spelling (PUEBI).	84	98.8%
3.	The terms used are consistent and support the learning material.	83	97.6%
4.	There are no typos (typo).	79	92.7%
Average/Criteria		**92.63% / Very easy**	
CONTENT INTERFACE			
1.	CK-12 contains images and/or interesting ones.	76	89.4%
2.	The images presented are clear/HD (high definition).	78	91.8%

BioEdu

Vol. 12 No. 1 Tahun 2023 Hal: 188-200

Berkala Ilmiah Pendidikan Biologi https://ejournal.unesa.ac.id/index.php/bioedu

No.	Indicators	Positive Responses	(%)
3.	The videos are presented according to the topic of the material.	71	83.5%
4.	Videos support the learning process.	68	80%
5.	Videos can be watched well.	67	78.8%
6.	Linked biographical hyperlinks support learning.	81	95.3%
Average/Criteria		**86.47% / Very easy**	
CONCEPT			
1.	The bacterial material presented is interesting and in accordance with the topic of discussion.	84	98.8%
2.	Bacterial concepts and material presented in CK-12 are understandable.	78	91.8%
3.	The study case topics presented in CK-12 are relevant and related to the surrounding environment.	75	88.2%
4.	The case study topics presented in CK-12 help understand the actual sub-materials with everyday life.	76	89.4%
Average/Criteria		**92.05% / Very easy**	
CRITICAL THINKING			
1.	There is an opportunity to practice formulating and/or presenting the initial orientation of the problem (**interpretation**).	85	100%
2.	There is an opportunity to learn to analyze problems, both individually and in groups (**analysis**).	85	100%
3.	There is an opportunity to conduct investigations and problem solving (**evaluation**).	84	98.8%
4.	There is an opportunity to practice drawing conclusions (**inferences**).	85	100%
5.	There is an opportunity to present the results of the preparation of the conclusion (**explanation**).	83	97.6%
6.	There is an opportunity to practice evaluating learning processes and outcomes (**self-regulation**).	85	100%
Average/Criteria		**99.4%**	
Average of all indicators		**92.89%**	
Criteria		**Very easy**	

Based on the recapitulation of the student response questionnaires in Table 6, over all it is stated that it is very easy to use with a percentage of 92.89%. The developed student response questionnaire accommodates student assessment in terms of presentation, linguistics, content interface, concept, and critical thinking aspects on Flexbook CK-12 usage. The highest percentage of convenience is obtained in the critical thinking aspect of 99.4% and the lowest percentage of convenience is obtained in the content interface aspect of 86.47%. These results indicate the need to improve content development by adding interactive videos and images that are more clearly described. Interactive videos and pictures with clear descriptions significantly help increase students' interest and resilience in exploring the material presented (Ullah & Anwar, 2020).

The use of the Flexbook CK-12 in enhancing critical thinking skills was felt by students. This can be seen clearly from the percentage gain of 100% for the phases

of interpretation, analysis, inference, and self-regulation which can really be interpreted as a useful process by students. Meaningful engagement of students with the challenging concepts and advanced critical thinking skills needed to be facilitate by encouraging students to actively choose to incorporate new concept into their existing knowledge by their pace (Gupte *et al.*, 2021). Thus, the use of Flexbook CK-12 in critical thinking syntax can be considered better on similar materials in biology learning for high school students.

The presence of critical thinking syntax has been facilitated students to be consistent on each learning phase carefully and gradually. The result show consistency of students' learning process along with the group discussion. Susantini *et al.* (2021) states that teachers must apply student-centred learning design in any learning instrument to facilitate autonomous learning ability on each student.

Thus, the application of Flexbook CK-12 constructed on Inquiry-Based Learning on bacteria topic for 10th grade high school students to enhance critical thinking skills has been declared to have been successfully implemented. The Flexbook CK-12 Bacteria instrument can then be considered for its continued use in the learning process on a regular basis.

Acknowledgements

This research was supported by Dr. Isnawati, M. Si., Guntur Trimulyono, M. Si., and Mrs. Peppi Maria, S. Pd., who provided insight and review that greatly assisted the research and improved the manuscript and to all students of SMAK Untung Suropati Sidoarjo who have helped the process of data collecting for this research.

CLOSING

Conclusion

Application of Flexbook CK-12 constructed on Inquiry-Based Learning on bacteria topic to enhance critical thinking skills of 10th grade high school students acquired good result with 3,8 scores for validity, 83,69 scores for implementation observation, and 92,89% convenience usage by students' responses. Therefore, the application of Flexbook CK-12 constructed on Inquiry-Based Learning on bacteria topic is declared feasible, straightforward, and easy to use to enhance critical thinking skills of 10th grade high school students.

Suggestion

The researcher would like to suggest future research on the effectiveness the application of Flexbook CK-12 in the use of the Team-Based Inquiry Learning to increase students' resiliency and endurance on learning bacteria topic. The researcher also encouraged biology teachers to use this Flexbook CK-12, so the outcome of this research will advantage those who need it.

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