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Validation of the virus teaching module based on project based learning on creative thinking ability

Aminuddin Prahatama Putra [(1)] *, Muhammad Zaini [(1)], Mella Mutika Sari [(2)]

[(1)] Study Program of Biology Education, Faculty of Teacher Training and Education, Universitas Lambung Mangkurat, Banjarmasin City, South Kalimantan, Indonesia
[(2)] Study Program of Natural Science Education, Faculty of Teacher Training and Education, Universitas Lambung Mangkurat, Banjarmasin City, South Kalimantan, Indonesia

**Corresponding Author Email:* aminuddinpatra@ulm.ac.id

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Abstract

The virus teaching module based on project based learning (PjBL) was developed as an innovative learning medium and is expected to accommodate students' learning needs to improve their creative thinking abilities. This research aims to validate the PjBL-based virus teaching module for valid creative thinking abilities. This research uses a four-D (4D) research and development model but only reaches the product validity stage. Validation was carried out by two validators, namely experts in the field of biology, especially regarding viruses, and education experts. The instrument used is a validity sheet which includes aspects of suitability of content, grammar, sentences with indicators of creative thinking abilities. Data were analyzed using quantitative descriptive techniques with a Likert scale resulting from validation carried out by the validator. The research results show that the average open module validity score is 3.3 with a very valid category. Therefore, the PjBL module based on the teaching virus that was developed is very valid and can be used to train the creative thinking of class X SMA/MA students. This research needs to be followed up by continuing the implementation of broader research to prove how practical and effective the PjBL-based virus teaching module is when used by students in learning.

Abstrak

Modul ajar virus berbasis *project based learning* (PjBL) dikembangkan sebagai media pembelajaran yang inovatif dan diharapkan dapat mengakomodasi kebutuhan belajar peserta didik untuk meningkatkan kemampuan berpikir kreatif. Penelitian ini bertujuan untuk memvalidasi modul ajar virus berbasis PjBL terhadap kemampuan berpikir kreatif yang valid. Penelitian ini menggunakan model penelitian dan pengembangan *four-D models* (4D) namun hanya sampai pada tahap validitas produk. Validasi dilakukan oleh dua orang validator yaitu pakar dalam bidang biologi khususnya mengenai virus dan pakar pendidikan. Instrumen yang digunakan berupa lembar validitas yang meliputi aspek kesesuaian isi, tata bahasa, kalimat dengan indikator kemampuan berpikir kreatif. Data dianalisis menggunakan teknik deskriptif kuantitatif dengan skala Likert hasil validasi yang dilakukan oleh validator. Hasil penelitian menunjukkan skor rata-rata validitas modul ajar sebesar 3,3 dengan kategori sangat valid. Oleh karena itu, modul ajar virus berbasis PjBL yang dikembangkan sangat valid dan dapat digunakan untuk melatih berpikir kreatif peserta didik kelas X SMA/MA. Penelitian ini perlu ditindaklanjuti dengan melanjutkan penelitian implementasi yang lebih luas untuk membuktikan seberapa praktis dan efektif modul ajar virus berbasis PjBL saat digunakan oleh peserta didik dalam pembelajaran.

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A. Introduction

Education is a program with several components that work together to achieve programmed goals. Education is a human learning process that aims to form a better personal character in terms of morals, norms, and customs. Education is important to people's lives worldwide, including in Indonesia. Consistency in the educational program or curriculum development needs to be maintained to create systematic education (Sadikin et al., 2023).

The independent curriculum emphasizes learning that supports critical, creative thinking abilities, skills, knowledge proficiency, and mastery of technology or media that students must have (Febriannisa & Ardi, 2023). In implementing this curriculum, educators and students cannot be separated from supporting tools in the learning process, one of which is learning media. According to Fitri et al. (2021), the learning media commonly used is books, charts, handouts, and student worksheets or teaching modules. According to Marshel (2020), the learning media that is more appropriate to use is student worksheets or teaching modules, which have many advantages, making it easier for educators to learn. Students will learn independently and learn to understand and carry out written or digital assignments. Muskita & Subali (2020) stated that learning media in teaching modules is more suitable because it can improve students' critical and creative thinking skills.

The material used in the PjBL-based teaching module is viral because previously, the average student had difficulty understanding the material, so student learning outcomes were not optimal. Virus material is Biology learning material for class X SMA/MA in phase E by the independent curriculum. The material taught is (1) the characteristics and structure of viruses, (2) virus replication, and (3) the role of viruses in everyday life.

This teaching module research is based on PjBL. The PjBL model refers to an inquiry-based learning method that involves students in knowledge construction by asking students to complete meaningful projects and develop real-world products. The PjBL has several advantages; students gain new and useful experiences, focus on learning objectives, participate in educational activities, collaborate between students, and create real and new things (Guo et al., 2020). According to Du & Chaaban (2020), the characteristics of PjBL are: (1) students participate in research on authentic topics through group work containing several students as members, (2) students produce meaning and build their results in this process, and (3) students present their results in written or oral form to other students.

PjBL-based teaching modules require students to do anything or be accessible during the learning process, make decisions, and present to other students until all of them are active in the learning process (Arsana et al., 2021). The teaching module is structured based on PjBL steps, which can develop students' analytical, creative, and metacognitive thinking abilities. The learning syntax uses a project work model that prioritizes students in creating independent products with a consistent process. This is the nature of metacognition, which requires students to think about how they think and do things independently and consistently. The metacognitive characteristics of each student are unique and varied, so they cannot be forced to use their respective metacognitive talents (Yasinta et al., 2023).

One thing that students need to master in the independent curriculum is creativity or creative thinking. According to Kaplan (2019), creativity is very important in supporting the learning process and teaching, one of which is that students are more active in developing new experiences in the learning process to find various solutions or think about concepts that are studied more broadly. According to Setiawan & Indina (2021), creativity is the ability to modify existing things or discover new things and be open to new or different perspectives. According to Hidayat et al. (2023), creative thinking is a habit of sharp thinking by moving imagination, expressing new things, and discovering amazing ideas.

Several studies state that PjBL-based modules can improve students' creative thinking skills. Research by Iklina & Fadilah (2022) found that PjBL-based teaching modules to increase students' creativity meet the valid category with an average score of 90.25%. Research by Sriwindari et al. (2022) shows PjBL-oriented teaching modules can improve creative thinking skills with a score of 88.9% in the very good category. Research by Agung et al. (2022) also states that PjBL-based teaching modules can improve student learning outcomes, especially on creative thinking.

Based on the description above, this research is to describe the validity of the PjBL-based virus teaching module on creative thinking abilities, which was validated by two people, namely experts in the field of biology, especially regarding viruses and education experts. The PjBL-based teaching module is developed as an innovative learning medium and is expected to accommodate students' learning needs to improve creative thinking abilities, increase learning motivation, reduce learning boredom, and improve student learning outcomes.

B. Material and Method

This research uses the 4D research and development model but only reaches the product validity stage. Validation was carried out by two people, namely an expert in the field of biology, especially regarding viruses, and an education expert. The instrument used is a validity sheet, which includes the suitability of content and language with indicators of creative thinking ability. Data were analyzed using quantitative descriptive techniques with a Likert scale from the validation results carried out by the validator, which are shown in Table 1.

Table 1 Module Validity Scoring Guidelines Teach Viruses based on Likert Scale

Scale	Keterangan
1	Not good
2	Pretty good
3	Good
4	Very good

(Source: Adapted from Setiawan & Indina, 2021)

Then the data is analyzed using the following Formula 1. The data that has been obtained is interpreted based on the Table 2.

$$\text{Validity} = \frac{\sum \text{total score from all aspects}}{\sum \text{number of aspects}} \text{.....Formula 1}$$

Table 2 Guidelines for Interpreting Module Validity Teach Virus

Average Score	Category
1,00 – 1,75	Invalid
1,76 – 2,50	Less Valid
2,51 – 3,25	Valid
3,26 – 4,00	Very Valid

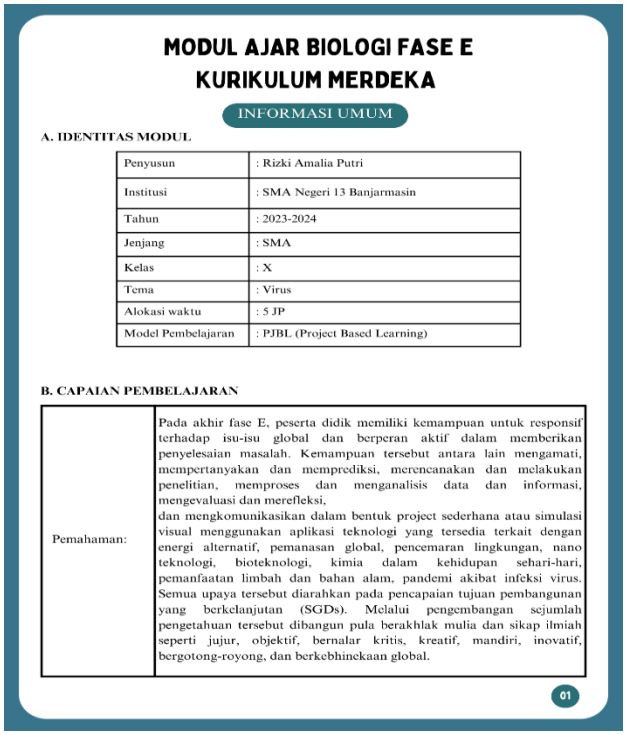
(Source: Adapted from Setiawan & Indina, 2021)

Based on Table 2, the PjBL-based virus teaching module for creative thinking skills developed is declared valid if the score obtained is ≥ 2.51.

C. Results and Discussion

Development research produced a virus teaching module based on PjBl for the creative thinking abilities of class X high school students. The development of PjBL-based modules has been adapted to the PjBL syntax, which aims to improve creative thinking abilities at each step. The display description is presented in Figures 1, 2, 3, 4, 5, 6, and 7.

Figure 1
The main cover contains the logo, book title, class, organizer, identity, and so on virus illustration (in Indonesian)


MODUL AJAR BIOLOGI FASE E
KURIKULUM MERDEKA

INFORMASI UMUM

A. IDENTITAS MODUL

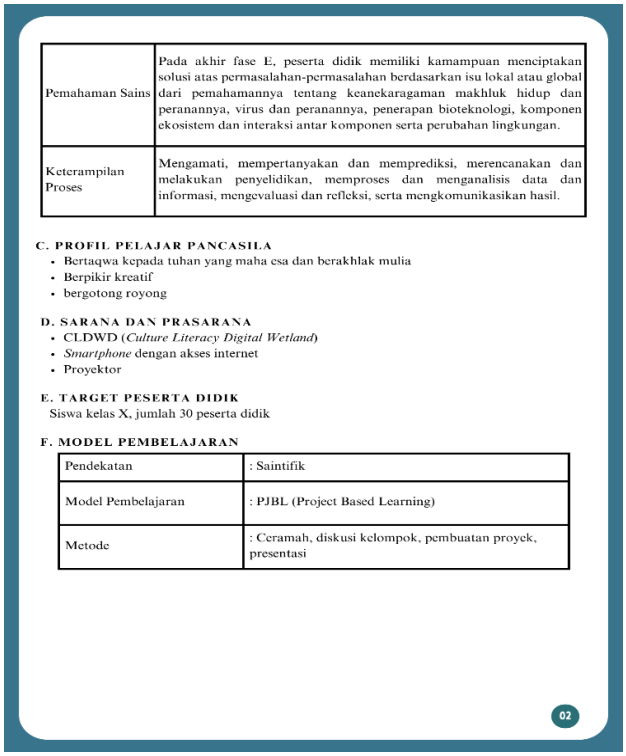
Penyusun	: Rizki Amalia Putri
Institusi	: SMA Negeri 13 Banjarmasin
Tahun	: 2023-2024
Jenjang	: SMA
Kelas	: X
Tema	: Virus
Alokasi waktu	: 5 JP
Model Pembelajaran	: PJBL (Project Based Learning)

B. CAPAIAN PEMBELAJARAN

Pemahaman:	Pada akhir fase E, peserta didik memiliki kemampuan untuk responsif terhadap isu-isu global dan berperan aktif dalam memberikan penyelesaian masalah. Kemampuan tersebut antara lain mengamati, mempertanyakan dan memprediksi, merencanakan dan melakukan penelitian, memproses dan menganalisis data dan informasi, mengevaluasi dan merefleksi, dan mengkomunikasikan dalam bentuk project sederhana atau simulasi visual menggunakan aplikasi teknologi yang tersedia terkait dengan energi alternatif, pemanasan global, pencemaran lingkungan, nano teknologi, bioteknologi, kimia dalam kehidupan sehari-hari, pemanfaatan limbah dan bahan alam, pandemi akibat infeksi virus. Semua upaya tersebut diarahkan pada pencapaian tujuan pembangunan yang berkelanjutan (SGDs). Melalui pengembangan sejumlah pengetahuan tersebut dibangun pula berakhlak mulia dan sikap ilmiah seperti jujur, objektif, bernalar kritis, kreatif, mandiri, inovatif, bergotong-royong, dan berkebhinekaan global.

01

Figure 2
The first page of general information contains model identity, learning achievements, P5, facilities and infrastructure, student targets, and learning model (in Indonesian)



Pemahaman Sains	Pada akhir fase E, peserta didik memiliki kamampuan menciptakan solusi atas permasalahan-permasalahan berdasarkan isu lokal atau global dari pemahamannya tentang keanekaragaman makhluk hidup dan peranannya, virus dan peranannya, penerapan bioteknologi, komponen ekosistem dan interaksi antar komponen serta perubahan lingkungan.
Keterampilan Proses	Mengamati, mempertanyakan dan memprediksi, merencanakan dan melakukan penyelidikan, memproses dan menganalisis data dan informasi, mengevaluasi dan refleksi, serta mengkomunikasikan hasil.

C. PROFIL PELAJAR PANCASILA
- Bertaqwa kepada tuhan yang maha esa dan berakhlak mulia
- Berpikir kreatif
- bergotong royong

D. SARANA DAN PRASARANA
- CLDWD (*Culture Literacy Digital Wetland*)
- *Smartphone* dengan akses internet
- Proyektor

E. TARGET PESERTA DIDIK
Siswa kelas X, jumlah 30 peserta didik

F. MODEL PEMBELAJARAN

Pendekatan	: Saintifik
Model Pembelajaran	: PJBL (Project Based Learning)
Metode	: Ceramah, diskusi kelompok, pembuatan proyek, presentasi

02

Figure 3
The second page of general information contains model identity, learning achievements, P5, facilities and infrastructure, student targets, and learning model (in Indonesian)

KOMPONEN INTI

A. TUJUAN PEMBELAJARAN
Berdasarkan alur tujuan pembelajaran berikut:
10. Menganalisis karakteristik virus dan peranannya dalam fenomena-fenomena yang terjadi di lingkungan sekitar tempat tinggal serta peserta didik dapat menyajikan data tentang ciri-ciri, cara replikasi, dan peranan virus.

Kemudian dibagi menjadi tujuan pembelajaran berikut:
10.1 Peserta didik menganalisis karakteristik dan struktur virus
10.2 Peserta didik menguraikan cara replikasi virus, yaitu siklus litik dan siklus lisogenik.
10.3 Peserta didik mampu menganalisis peranan virus dalam kehidupan sehari - hari.

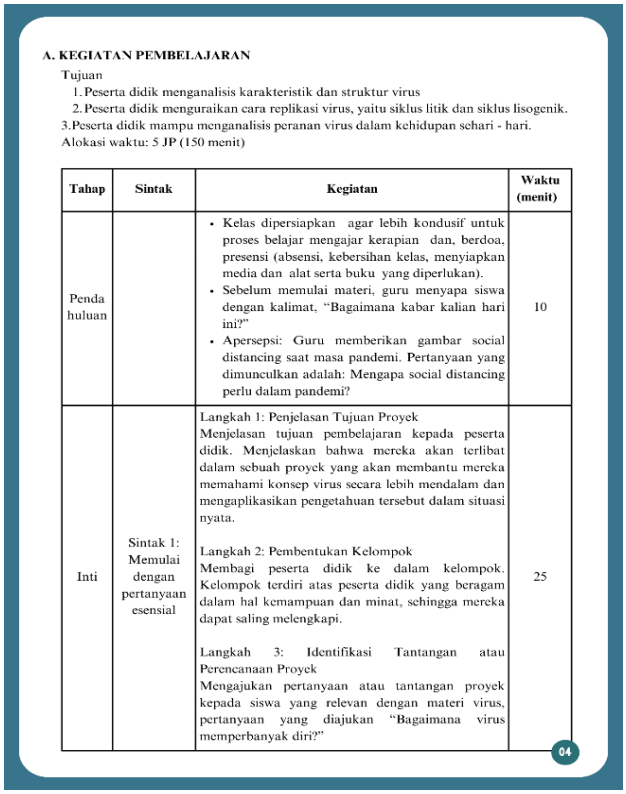
B. PEMAHAMAN BERMAKNA
Virus merupakan mikroorganisme yang tidak dapat dilihat secara langsung, namun memiliki peranan dalam kehidupan manusia baik merugikan atau menguntungkan. Dua tahun terakhir ini dunia telah dilemahkan oleh peranan virus corona. Faktor faktor terdampak antara lain ranah pendidikan yang mengakibatkan seluruh aktivitas hanya dapat dilakukan melalui daring/ online. Virus corona merupakan keluarga virus yang mengakibatkan terjadinya infeksi saluran pernapasan ringan, sedang hingga kematian. Penyakit akibat virus ini disebut covid-19. Virus tersebut dapat menyerang siapa saja mulai dari lansia, orang dewasa, anak- anak, bayi sampai ibu hamil dan menyusui. Beberapa hal yang bisa disyukuri dari kejadian tersebut antara lain bisa berkumpul dengan keluarga dan menghargai arti kata sehat.

C. PERTANYAAN PEMANTIK
1. Perhatikan gambar di bawah ini!

Dua tahun belakangan ini dunia dihebohkan dengan munculnya virus COVID-19 yang mulai menyebar ke seluruh penjuru dunia. Para ilmuwan mulai mengembangkan vaksin untuk meminimalisir infeksi dan penyebaran yang diakibatkan oleh virus tersebut. Sebenarnya apa sih vaksin dan mengapa perlu ada vaksin?

03

Figure 4
Core competencies include learning aims, understanding meaningful, and trigger questions (in Indonesian)



A. KEGIATAN PEMBELAJARAN
Tujuan
1. Peserta didik menganalisis karakteristik dan struktur virus
2. Peserta didik menguraikan cara replikasi virus, yaitu siklus litik dan siklus lisogenik.
3. Peserta didik mampu menganalisis peranan virus dalam kehidupan sehari - hari.

Alokasi waktu: 5 JP (150 menit)

Tahap	Sintak	Kegiatan	Waktu (menit)
Penda huluan		• Kelas dipersiapkan agar lebih kondusif untuk proses belajar mengajar kerapian dan, berdoa, presensi (absensi, kebersihan kelas, menyiapkan media dan alat serta buku yang diperlukan). • Sebelum memulai materi, guru menyapa siswa dengan kalimat, "Bagaimana kabar kalian hari ini?" • Apersepsi: Guru memberikan gambar social distancing saat masa pandemi. Pertanyaan yang dimunculkan adalah: Mengapa social distancing perlu dalam pandemi?	10
Inti	Sintak 1: Memulai dengan pertanyaan esensial	Langkah 1: Penjelasan Tujuan Proyek Menjelasan tujuan pembelajaran kepada peserta didik. Menjelaskan bahwa mereka akan terlibat dalam sebuah proyek yang akan membantu mereka memahami konsep virus secara lebih mendalam dan mengaplikasikan pengetahuan tersebut dalam situasi nyata. Langkah 2: Pembentukan Kelompok Membagi peserta didik ke dalam kelompok. Kelompok terdiri atas peserta didik yang beragam dalam hal kemampuan dan minat, sehingga mereka dapat saling melengkapi. Langkah 3: Identifikasi Tantangan atau Perencanaan Proyek Mengajukan pertanyaan atau tantangan proyek kepada siswa yang relevan dengan materi virus, pertanyaan yang diajukan "Bagaimana virus memperbanyak diri?"	25

04

Figure 5
Learning activities contain objectives, stage, syntax, activity, and time (in Indonesian)

MATERI AJAR

Virus merupakan unit biologi parasit obligat dan bersifat patogen. Infeksi virus terhadap makhluk hidup di antaranya: tumbuhan, hewan bahkan manusia menimbulkan masalah yang sangat serius. Selain menimbulkan penyakit bahkan kematian terhadap makhluk hidup, dampak yang ditimbulkan juga beraneka ragam. Seperti yang terjadi pada saat ini, wabah covid-19 yang disebabkan oleh infeksi virus SARS-CoV-2 yang merupakan golongan virus RNA menimbulkan dampak yang sangat besar. Berbagai aspek diantaranya: pendidikan, ekonomi, sosial, pariwisata dan lainnya mengalami dampak yang sangat signifikan (Wang, 2020 dan Sun, 2020). Hampir seluruh sektor vital lumpuh akibat ganasnya wabah virus tersebut (Priastomo et al., 2021).

Virus berukuran sangat kecil dan sederhana. Kurangnya struktur dan mesin metabolisme yang ditemukan dalam sel, kebanyakan virus tidak lebih dari sekedar gen yang dikemas dalam lapisan protein. Apakah virus itu hidup atau mati? Kata Latin untuk kata tersebut virus berarti "racun" karena virus mampu menyebabkan berbagai macam penyakit dan dapat menyebar antar organisme. Para peneliti di akhir tahun 1800-an melihat adanya persamaan virus dengan bakteri dan mengusulkan bahwa virus adalah bentuk kehidupan yang paling sederhana. Namun, virus tidak dapat bereproduksi atau melakukan aktivitas metabolisme di luar sel inang. Kebanyakan ahli biologi mempelajari virus saat ini mungkin akan setuju bahwa mereka tidak hidup tetapi ada di tempat teduh area antara bentuk kehidupan dan bahan kimia. Ungkapan sederhana yang digunakan baru-baru ini oleh dua peneliti menggambarkannya dengan cukup tepat: Virus menjalani ~semacam kehidupan pinjaman." (Campbell, 2009).

Percobaan dengan virus memberikan bukti penting bahwa gen terbuat dari asam nukleat, dan mereka sangat penting dalam pekerjaannya· mencari tahu mekanisme molekuler yang mendasari proses replikasi, transkripsi, dan translasi DNA. Selain nilainya sebagai sistem eksperimental, virus juga mempunyai manfaat mekanisme genetik unik yang menarik benar dan itu juga membantu kita memahami bagaimana virus menyebabkan penyakit. Selain itu, studi tentang virus telah menyebabkan perkembangan pengembangan teknik yang memungkinkan ilmuwan memanipulasi gen dan memindahkannya dari satu organisme ke organisme lain. Teknologi ini memainkan peran penting dalam penelitian dasar, bioteknologi, dan aplikasi medis. Misalnya, virus digunakan sebagai agen transfer gen dalam terapi gen (Campbell, 2009).

08

Figure 6
Teaching material about virus structure, virus replication, phage reproduction cycle, and the role of viruses (in Indonesian)

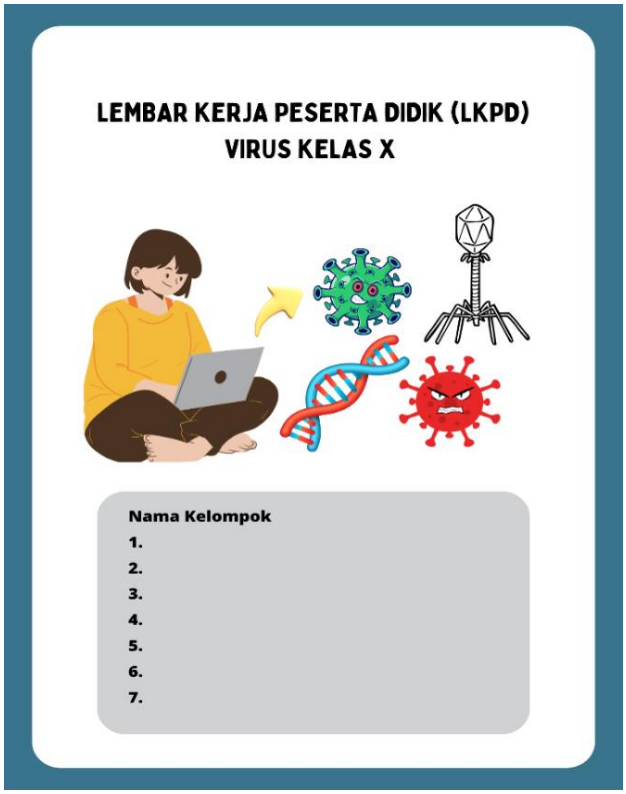


Figure 7
Student worksheets cover, questions, project objectives, tools, and materials (in Indonesian)

In Figures 2 and 3, P5 is an effort to encourage the achievement of the Pancasila Student Profile using a project-based approach. The final part, namely the assessment instrument, contains questions and a grid of pre-test and post-test questions, questions and grids for creative thinking skills, and an attached assessment sheet.

The validation stage is obtained from validation by the validator. The validity of the virus teaching module is theoretically stated to be very valid. A recapitulation of the validity results of the virus teaching module based on aspects of suitability of content, grammar and sentences is shown in Table 3. The average score of the virus teaching modules that were developed was different in each aspect of the assessment, consisting of the content suitability aspect, getting a score of 3.33 in the very valid category, the grammar and sentence aspects were 3.28 in the very valid category. The average for all aspects is 3.30 with a very valid category.

In validating the content suitability aspect, the virus teaching module received an average score of 3.33 in the very valid category. This means that the contents of this module are presented systematically and sequentially starting from the first creative thinking indicator to the last. Apart from that, the content of the teaching module is in accordance with indicators for measuring creative thinking abilities and the content covers all aspects of the data that you want to reveal. This is in accordance with research found by Nesri (2020), the criteria for a good module are that it must be arranged systematically, interestingly and clearly, help students learn independently, contain complete learning content. Module based thinking skills creative loading book identity, selection related material with Competency 4 (4C) skill as well as literacy and assignments that prioritize students' independent character (Himawan & Fathonah, 2020).

Table 3 Validation Result of the Virus Teaching Modul

Aspects that assessed		Result Score Validation				Flat Score	Category Evaluation
		1	2	3	4		
Content Suitability							
1.	Contents are presented in a way systematic and coherent starting from indicator think creative fisrt untuil final			√		3,33	Very Valid
2.	Fill in accordingly with indicator for measure ability think creative			√			
3.	Content include all aspects that data want to revealed				√		
Grammar and Sentences							
4.	Language easy understandable			√		3,28	Very Valid
5.	Sentence and word that served according EYD			√			
6.	Sentence no meaningful ambiguous			√			
7.	Letters and number written clearly				√		
8.	Sentence short, but still own meaning that clear			√			
9.	Which language used communicative			√			
10.	Clarity instruction charging and instruction				√		
Overage overall score						**3,30**	**Very Valid**

The virus teaching module received an average score of 3.28 with a very valid category in validating grammatical and sentence aspects. This means that this module uses language that is easy to understand, sentences and words presented are in accordance with EYD, sentences do not have ambiguous meaning, letters and numbers are written clearly, sentences are short but still have a clear meaning, the language used is communicative, and the instructions for filling in and directions are clear. This is in accordance with the opinion expressed by Apriani (2016) that language is one of the most important aspects of communication activities. As a communication tool, language has the function of generating feelings and thoughts that make someone actively collaborate with others. Apart from that, language also functions as a domain for conveying information. Language is a form of human thought and view. Language would not have emerged without the thought that initiated it.

Overall, the validation of the PjBL-based virus teaching module on creative thinking abilities from all aspects, namely the suitability of content, grammar and sentences, received an average score of 3.30 in the very valid category. These values and categories show that the project-based virus teaching module can improve students' creative thinking abilities. Therefore, this PjBL-based teaching module is declared suitable for students because it encourages students to implement their knowledge by creating projects in groups so that students think more creatively and critically, this is in accordance with research by Desrinelti & Miaz (2022) which states that one way is to improve quality learning, namely student worksheets or teaching modules that have been declared valid by the validator because the teaching module is an activity sheet which is based on direct experience in the environment around the students, where students are also required to implement the knowledge they have gained during learning through tasks that must be done in groups or individual, and according to Sari et al. (2022), teaching modules are guidelines for improving critical and creative thinking and student responsibility in participating in direct learning.

D. Conclusion

Based on the description above, it can be concluded that the PjBL-based Virus teaching module on students' creative thinking skills as a result of validation in the aspects of suitability of content, grammar and sentences was declared very valid with the average score obtained being 3.30. This research needs to be followed up by continuing with wider implementation to prove how practical and effective this PjBL-based virus teaching module is when used by students in learning.

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