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Development of LKPD based on project-based learning oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA/MA

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Abstract
This development research was conducted to develop a teaching material in the form of a project-based learning worksheet (LKPD) based on chemo-entrepreneurship-oriented learning on hydrocarbon material for phase F SMA / MA. The validity and level of practicality will be known. The type of research used is educational design research (EDR) with the Plomp development model which has three stages, namely preliminary research (initial investigation), prototyping phase (prototype formation stage), and assessment phase (assessment/testing). However, the assessment phase was not carried out in this study where the research was carried out until the results of the validity and practicality of the LKPD were obtained. The validity test was conducted by 3 chemistry lecturers at FMPA UNP and 2 chemistry teachers at SMAN 3 Padang using a validity questionnaire sheet. Practicality was conducted by 2 chemistry teachers and 9 students of phase F SMAN 3 Padang. The results of the study based on the validity test showed an average Aiken'V 0.87 with a valid category and based on the practicality test showed an average of 90% by students with a very practical category and 94% by teachers with a very practical category. The research results of project-based learning-based LKPD oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA / MA have been valid and practical.

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INTRODUCTION

The complexity of 21st-century problems is deeply felt today. Climate issues, which lead to decreased food production, have severe impacts on the current socio-economic conditions globally (Carleton & Hsiang, 2016; Chusni et al., 2020; Hulyadi et al., 2024). It is crucial to develop learning that fosters creativity, high-order thinking skills, and robust problem-solving abilities to produce students who are creative and adaptive to changing times (Akpur, 2020; Alsaleh, 2020; Belecina & Jose M Ocampo, 2018). Project-based learning (PBL) that results in economically valuable products can be an effective solution to face 21st-century challenges.

Climate change, which leads to reduced food production, ecosystem disruptions, and increasingly frequent natural disasters, must be addressed wisely, particularly by teachers who are at the forefront of preparing students to be adaptive and creative (Afdareza et al., 2020). This climate change has a tangible impact on the current socio-economic conditions globally. Economic inequality, rising unemployment, and poverty affect global social and political stability (Gasper et al., 2011). To face this complexity, students need to develop various skills:

the ability to think out-of-the-box and create innovative solutions; the capability to analyze, evaluate, and create based on available information; and the capacity to identify problems, find solutions, and apply them effectively. If all these competencies are developed, students will become creative and adaptive individuals who can handle the changes and challenges of the times (Ardiansah & Zulfiani, 2023; Fong et al., 2017).

Project-based learning (PjBL) that produces economically valuable products can be an effective solution for developing these skills. Creative teachers should be able to encourage students to create products that are not only innovative but also economically valuable, making them relevant to the real world and tailored to the context of chemistry education (Pazicni & Flynn, 2019). Through this activity, students are expected to develop essential skills needed to face global challenges (Almazroui, 2023; Baran et al., 2021). Contextual learning can provide meaningful education (Hulyadi et al., 2023). Students learn through direct experience, gaining a better understanding of concepts and the application of knowledge. When students understand the meaning of learning, their motivation increases. They become more motivated because they are involved in a meaningful and relevant process to real life.

Project-based learning that results in economically valuable products can help students develop the skills needed to face the complexity of 21st-century problems. This approach can enhance creativity, high-order thinking skills, and problem-solving abilities, preparing students to become creative and adaptive individuals who can navigate the changing times (Agussuryani et al., 2022; Liline et al., 2024).In its application, the learning model that can be used to develop students' competencies in accordance with the independent curriculum is a project-based learning model known as project-based learning (PjBL). This learning model is a learning method that is centred on learners and facilitated by teachers. PjBL is an important tactic in developing students, students solve problems, plan, organise experiments, solve questions, draw conclusions, report their findings, and apply this knowledge to real daily life under a learning environment that is created so that students develop and gain meaningful work experience (Kurniawati, 2020). In addition, the learning process is certainly inseparable from the use of teaching materials. The use of teaching materials can help students achieve competence in accordance with the material studied, especially project-based teaching materials (Diana et al., 2021; Purwaningsih et al., 2020).

Learning resources that can be used by teachers and students to facilitate the learning process, one of which is teaching material in the form of student worksheets (LKPD). LKPD serves as a valuable guide for students in investigating the material being studied. Learners can share their thoughts and develop conclusions through LKPD. In this case, LKPD supports students to be more involved in the learning process (Kosasih, 2021).

Learning tools using the Project-Based Learning (PjBL) model for chemistry products with economic value are crucial to be developed in the form of student worksheets (LKPD). LKPD that is designed to be engaging and innovative can foster student creativity and develop critical thinking skills (Ardiansah & Zulfiani, 2023). Visually appealing LKPD can increase students' interest in learning. LKPD that is relevant to real life makes students more interested and motivated to learn. LKPD containing innovative projects challenges students to think creatively and produce new products (Setiawati et al., 2023). LKPD that provides room for exploration allows students to discover various ways to solve problems (Abrami et al., 2015). LKPD with trigger questions encourages students to think critically and analytically (Erawun & Al, 2021; Zamudio et al., 2008). The reflection and evaluation section in LKPD helps students analyze their learning process and outcomes. Learning with the PjBL model based on chemistry products with economic value in the form of engaging and innovative LKPD is essential. This LKPD not only increases students' motivation to learn but also encourages their creativity, critical thinking, and problem-solving skills. With this approach, students can be better prepared to face complex challenges in the 21st century (Zamudio et al., 2008)..

In addition to using models and teaching materials that are in accordance with the material to be taught. Teachers can also innovate involving various approaches that foster learner interest, one of which is related to entrepreneurship. The world of education in Indonesia is preparing to face rapid developments and changes in technology, culture, and lifestyle through the development of skills and entrepreneurial spirit of learners. One way to address this is through workshop subjects (Alfaniah et al., 2022). In addition, other disciplines, especially contextual ones such as science, especially chemistry, can also help develop and create individuals who have an entrepreneurial spirit in addition to the workshop subject itself (Rahmah, 2016). Chemistry is closely related to everyday life so that with the knowledge and skills that students have, it is possible for students to apply chemistry learning to produce a product related to a business field that forms the creation of an entrepreneurial spirit so that students can become an entrepreneur or entrepreneur who links chemical concepts with real objects or is called Chemo-entrepreneurship (CEP).

Chemoentrepreneurship is a project-based chemistry learning concept where students are encouraged to develop chemical products with economic value (Ni'mah & Suwardi, 2023). In this approach, students not only learn chemical theory but also apply their knowledge to create marketable products with business potential (Sutarto et al., 2021). The primary goal of chemoentrepreneurship is to integrate chemistry education with entrepreneurial skills, preparing students for the workforce and equipping them with the ability to create business opportunities in the field of chemistry (Dewi & Mashami, 2019).

Chemoentrepreneurship can be implemented through various projects, such as creating cosmetics, eco-friendly cleaning products, healthy food and beverages, and alternative fuels. This approach not only enhances students' understanding of chemistry but also prepares them to become successful entrepreneurs with creativity and adaptability to address the complexities of 21st-century challenges (Dewi & Mashami, 2019; Hulyadi et al., 2023).In gaining knowledge, students remember more chemical concepts and procedures that have been learned, the chemo-entrepreneurship learning approach (CEP) can be a learning that has an impact on improving the achievement of learning because it produces meaningful chemistry learning. This is in line with the cone of learning experience which states that students learn 90% of what they do and say, 70% of what is done, 50% of what is seen and heard, 30% of what is seen, 20% of what is heard, and 10% of what is read (Supartono et al, 2009).

Based on the needs analysis that researchers conducted to chemistry teachers at SMAN 3 Padang and SMAN 4 Padang, it was found that the learning tools needed to support learning in these schools were teaching materials in the form of student worksheets (LKPD) based on project-based learning (PjBL), and the results also explained that teachers in schools had never implemented hydrocarbon materials that utilised LKPD based on PjBL. The results also explained that five out of six teachers had never linked hydrocarbon material with daily life phenomena that support chemo-entrepreneurship (CEP).

In the era of globalization and rapid technological development, 21st-century education demands a paradigm shift in the learning process. One approach that can meet these demands is Project-Based Learning (PjBL) integrated with Chemoentrepreneurship (Arfin et al., 2018; Ni'mah & Suwardi, 2023). This model not only fosters creativity and higher-order thinking skills but also trains students to produce economically valuable products. However, the application of LKPD based on economically valuable products is still minimal in the educational field. Therefore, this study aims to outline the urgency of implementing the PjBL model LKPD with a Chemoentrepreneurship approach (Prayitno et al., 2024).

Dewi (2019), Dewi & Mashami (2019), and Sumarti et al. (2018) reported that the Chemoentrepreneurship approach in PjBL allows students to explore new ideas and develop products with market value. This process encourages students to think creatively in finding solutions to real problems they face in projects. Thus, students not only learn theoretical concepts but also how to apply them in practical and innovative contexts. Ruliyanti et al. (2020) stated that PjBL with a Chemoentrepreneurship approach requires students to combine various disciplines and skills to complete projects. This includes the ability to analyze, synthesize, and evaluate, which are part of higher-order thinking skills. Students are encouraged to think critically and reflectively, as well as to make decisions based on data and evidence (Setyaningsih et al., 2021).

Almulla (2020) and Diana et al. (2021) stated that one strength of the PjBL model is its ability to relate learning to real-life situations faced by students. With the Chemoentrepreneurship approach, students can see the relevance of chemistry in the economic and industrial contexts. This makes learning more meaningful and interesting for students, as well as increasing their motivation to learn (Ni'mah & Suwardi, 2023). Almazroui (2023), Chi Hyun et al. (2020), and Chusni et al. (2020) reported that the 21st century demands different skills from before, such as collaboration, communication, technological skills, and project management. The PjBL model with a Chemoentrepreneurship approach is designed to develop these skills. Students learn to work in teams, communicate effectively, use technology to complete tasks, and manage projects from start to finish.

Arfin et al. (2018) stated that chemoentrepreneurship emphasizes the creation of economic value from products generated by students. This provides a basic understanding of entrepreneurship, which is very important in an increasingly competitive world of work. Students learn how to identify market opportunities, develop product ideas, design prototypes, and market their products. The implementation of the PjBL model LKPD with a Chemoentrepreneurship approach is crucial in addressing the demands of 21st-century education. This model not only enhances creativity and higher-order thinking skills but also makes learning relevant to everyday life, develops 21st-century skills, and fosters entrepreneurial spirit among students. Therefore, it is important for the educational field to start applying this model more widely and intensively. Based on the exposure of the background of the problem above, the researchers are interested in conducting a study entitled Development of Project Based Learning Based LKPD Oriented Chemo-Entrepreneurship on Hydrocarbon Material for Phase F SMA / MA, with the hope that the LKPD developed can help teachers and students in learning activities in accordance with the demands of the independent curriculum.

METHOD

The type of research conducted is educational design research (EDR). EDR is a research approach designed in order to formulate solutions to complex problems that arise in the implementation of education where these problems do not yet have the right solution or clear guidelines in solving them. EDR is considered a comprehensive research that includes the process of designing, developing, and evaluating educational instruments with the aim of increasing or improving the quality of educational activities or programmes (Putrawangsa, 2018). EDR is research that aims to design and develop educational instruments such as strategies, programmes, materials, products, and systems (Plomp et al., 2013).

The development model carried out is the Plomp development model developed by Tjeed Plomp which consists of preliminary research, development of prototyping phase, and assessment phase (Plomp et al., 2013). This research is limited to the development stage or the production of a valid and practical prototype IV. The stages that will be carried out can be seen in Figure 1. This development research was conducted at FMIPA UNP and SMAN 3 Padang with the number of subjects in this study, namely 3 chemistry lecturers FMIPA UNP, 2 chemistry teachers and 9 students at SMAN 3 Padang. The object of the research is LKPD based on project-based learning oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA/MA.

Preliminary research was conducted in several stages, namely needs and context analysis, literature study, and conceptual framework development. The needs analysis was conducted by analysing the problems faced by teachers and students by distributing needs analysis questionnaires to get an overview of the problems faced and find solutions to these problems. To produce products that are in accordance with the problems faced in the needs analysis, a context analysis was conducted. This analysis was carried out by examining the curriculum used in schools. The Literature review stage by looking for sources and references related to the research activities to be carried out. While at the stage of Develompment of conceptual framework, researchers connect concepts that become the object of research. To develop this conceptual framework based on the needs and context analysis and literature study that has been done.

After the preliminary research stage, the Prototyping phase is next. In the development and prototyping phase, the prototype can be continuously refined (from the results of formative evaluation and reflection on the development of the prototype). Formative evaluation, which is an evaluation that aims for improvement and takes place at all stages of prototype development. In prototype I, the design of the product to be developed is carried out, then the first formative evaluation stage is carried out, namely self evaluation, which if there are deficiencies, improvements will be made so as to produce prototype II.

In prototype II, the next formative evaluation was carried out, namely expert review with the aim of providing an assessment, as well as suggestions for the product being developed. This assessment was carried out using an assessment instrument in the form of a validation questionnaire sheet addressed to UNP chemistry department lecturers and high school chemistry teachers. If there is input from the validator, revisions will be made, the purpose of the revision is to improve the quality of the prototype so as to produce a valid prototype III. In prototype II, a one to one evaluation was also carried out to find out the students' responses to the products developed.

After producing a valid prototype III, then a small group trial was conducted with 9 students who had different abilities based on the teacher's direction. Learners will be asked to read, understand, and fill in the LKPD with directions from the researcher, then fill out the practicality questionnaire provided. The practicality test is also carried out to the teacher and an evaluation is carried out. The evaluation results obtained are then analysed and revised. If revisions are needed according to suggestions from teachers and students, then revisions are made to improve the product so that a valid and practical prototype IV is produced.

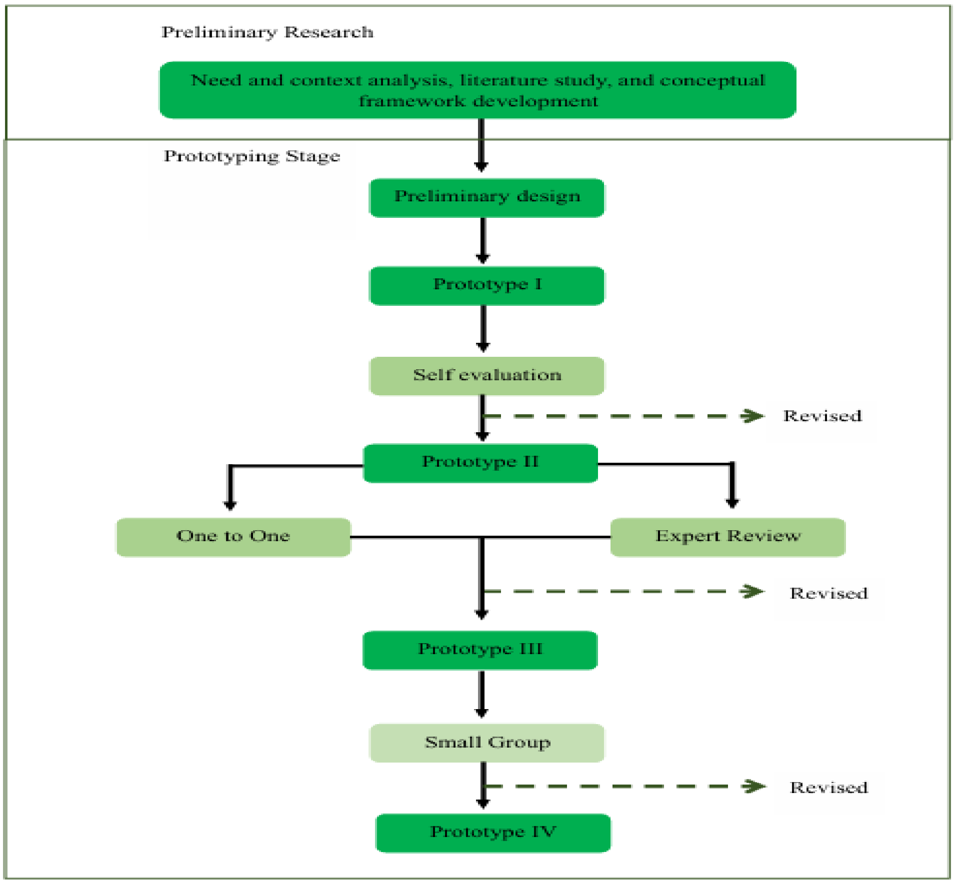

Figure 1. Research Desain

The data analysis techniques needed are validity tests and practicality tests to determine the feasibility of the products developed. The validity analysis technique is based on categorical judgements modified by Boslaugh, where the validator is given a statement which then provides an assessment of each question submitted. The validator's assessment of each question was analysed using Aiken's V formula as follows.

$$V = \frac{\sum s}{n(c-1)}$$

$$s = r - lo$$

Description:
n = number of validators
c = number of categories chosen by the validator (5)
lo = lowest score in the scoring category (1)
r = validator's chosen category score
s = the score assigned by the validator minus the lowest score used

The validator assessment criteria use Aiken's V scale.

Table 1. Aiken’V scale Categories

Aiken’V Scale	Kategory
V < 0.8	Not valid
V ≥ 0,8	Valid

(Aiken, 1985)

The Practicality Analysis Technique was obtained and analyzed using the following formula.

$$NP = \frac{R}{SM} X\ 100\%$$

Description:
SM = Ideal maximum score of learner response
R = Raw score obtained by students
NP = Percent value sought or expected

Table 2. Practicality Level Category

Score	Kategory
86%-100%	Very Practical
76%-85%	Practical
60%-75%	Moderately Practical
55%-59%	Less Practical
≤ 54%	Not Practical

(Purwanto, 2012)

RESULTS AND DISCUSSION

The results obtained from this study, namely producing products in the form of project-based learning-based LKPD oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA / MA that are valid and practical. Through several stages with the Plomp development model consisting of preliminary research, development of prototyping phase, and assessment phase (Plomp et al., 2013). This research was only conducted until the prototyping phase and was not continued until the assessment phase. The research results of the two stages of the Plomp model can be described as follows.

Preliminary Research

The stages carried out at this preliminary research stage are needs analysis, context analysis, literature study, and conceptual framework development. The following is a description of each stage.

Needs and context analysis

The activities carried out at the needs analysis stage in the research on the development of project-based learning-based LKPD based on chemo-entrepreneurship on hydrocarbon material for phase F SMA / MA are carried out by distributing needs analysis questionnaires to six chemistry teachers to two high schools in Padang city. Questionnaires were given to three chemistry teachers at SMA Negeri 3 Padang and three chemistry teachers at SMA Negeri 4 Padang to find out the learning tools needed, and the level of need for teaching materials needed in this case in the form of student worksheets (LKPD).

The results that can be drawn from the results of distributing questionnaires, namely learning tools needed to support learning in schools are teaching materials in the form of student worksheets (LKPD) based on project-based learning (PjBL). The results also explain that teachers at school have never implemented hydrocarbon material that utilizes PjBL-based LKPD. Furthermore, five out of six teachers stated that it was very important to prepare PjBL-based hydrocarbon LKPD. As for statements related to learning activities, five out of six teachers stated that they had never linked the concept of hydrocarbons with phenomena in everyday life that support chemo-entrepreneurship (CEP). Based on the results of the questionnaire analysis given to students at SMAN 3 Padang, it was concluded that students were interested in project-based hydrocarbon learning and associated with daily life that supports entrepreneurship.

The results of the context analysis were carried out by reviewing the curriculum used at school. This analysis is carried out to determine learning outcomes, learning objectives, and to detail, identify, and systematically lead the concepts studied in the material to develop LKPD. This analysis can be in the form of analyzing Phase F learning outcomes, namely understanding organic chemistry including its application in everyday life. Based on these learning outcomes, learning objectives and the flow of learning objectives for hydrocarbon material can be formulated.

Literature review

This literature study is used as a reference that refers to research on the development of project-based learning-based LKPD oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA / MA. This activity is carried out to support the implementation of learning in accordance with the needs and context analysis. At this stage, it is done by looking for sources and references related to the research activities to be carried out to increase insight into the products to be developed. Literature studies that support this research come from books, journal articles, theses, and others related to research activities that discuss the independent curriculum, LKPD, PjBL, and CEP so that a solution to the existing problems is obtained, namely by developing chemo-entrepreneurship-oriented project-based learning-based LKPD on hydrocarbon material for phase F SMA/MA.

Develompment of conceptual framework

The conceptual framework aims to connect the basic concepts in the development of CEP-oriented PjBl-based LKPD on hydrocarbon material for phase F SMA/MA. The development of this conceptual framework is based on the needs and context analysis, as well as the literature study that has been done. In this framework, the researcher connects the concepts that become the object of research. The identification of problems concluded from the needs and context analysis is that an LKPD is needed to support the learning process based on the demands of the independent curriculum, namely project-based with CEP orientation. the development of the conceptual framework can be seen in Figure 2.

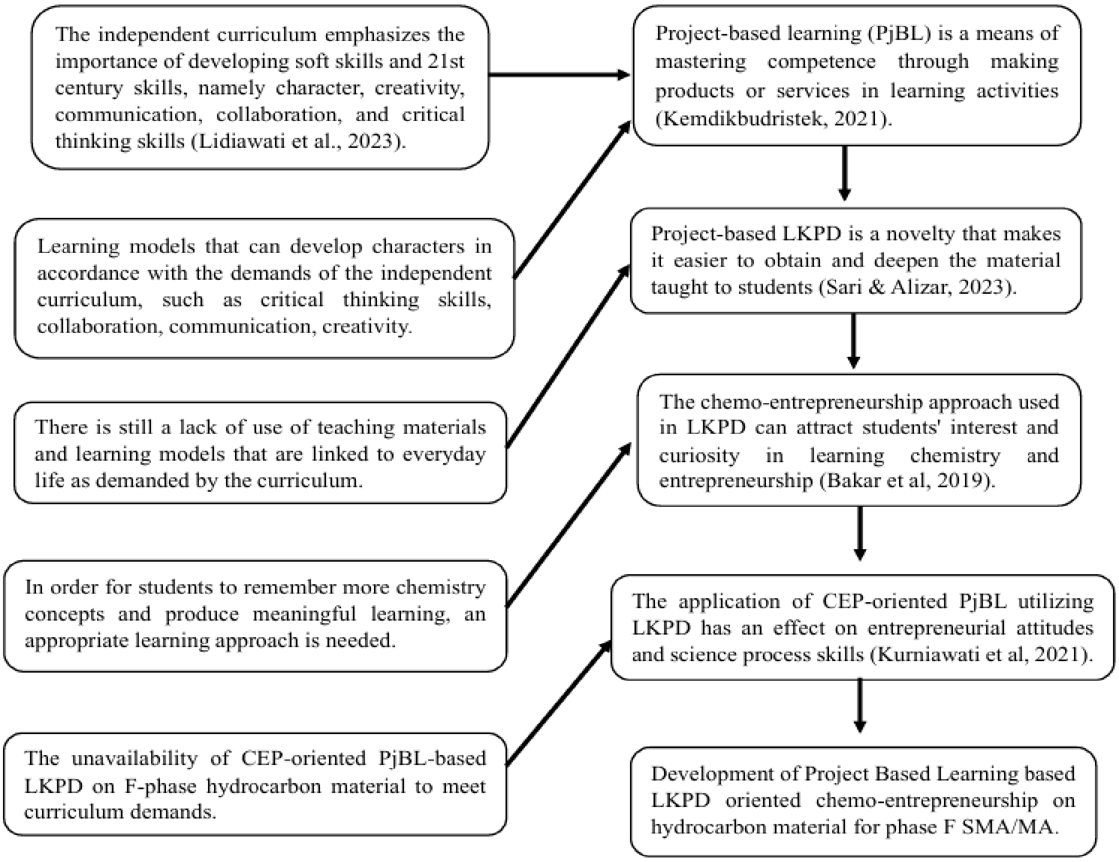

Figure 2. Conceptual framework

Prototyping Phase

Protorype I

Prototype I is the initial design of the developed LKPD, at this stage of prototyping, product design is carried out, namely CEP-oriented PjBL-based LKPD on hydrocarbon material for phase F SMA/MA. The product is designed by paying attention to the components of the LKPD and the learning syntax developed by The George Lucas Educational Foundation (2007). Then a self-evaluation is carried out which is useful for seeing the use of language that is not neat and seeing the completeness of the contents and components of the LKPD which are adjusted to the components that should be. The revised results of this self-evaluation are in the form of prototype II.

Protorype II

Project-based learning-based LKPD oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA/MA as prototype II will be tested through expert assessment and individual evaluation. The validity of the LKPD was carried out to 5 validators who came from 3 chemistry lecturers FMIPA UNP and 2 chemistry teachers SMAN 3 Padang. The results of the validity of the developed LKPD can be seen in Table 3 below.

Table 3. Results of Data Analysis on the Validity of All Aspects

No.	Aspects assessed	V	Kategory
1	Content Component	0,86	Valid
2	Linguistics Component	0,86	Valid
3	Presentation Component	0,86	Valid
4	Graphics Component	0,89	Valid
	Average	**0,87**	**Valid**

In diagram form, it can be seen as Figure 3 below.

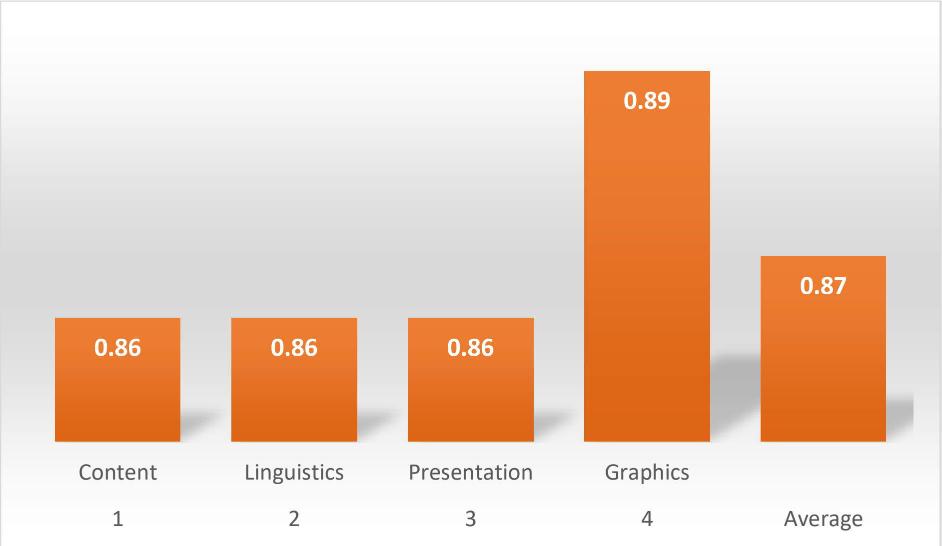

Figure 3. Validation Result

Teaching materials should target a need and all elements should be based on the latest research (content validity, also known as relevance) and consistently connected to each other (construct validity, also known as consistency). If a teaching material fulfils these criteria, it is considered valid (Plomp et al., 2013). The validity of teaching materials shows that the results of a measurement describe the aspects or aspects being measured. The validity of this teaching material includes content validity and construct validity. Content validity, berkaitan dengan isi dan format dari bahan ajar. Apakah bahan ajar tepat mengukur yang ingin diukur, apakah butir–butir pertanyaan tepat mengukur hal yang ingin diukur, apakah butir-butir pertanyaan telah mewakili aspek–aspek yang akan diukur, apakah pemilihan format bahan ajar sesuai untuk mengukur segi tersebut (Sukmadinata, 2011). Validitas isi menunjukkan bahwa bahan ajar yang dikembangkan didasarkan pada kurikulum yang berdasar pada rasional teoretik yang kuat (Rochmad, 2012).

Construct validity refers to the extent to which abstract concepts operationalized as variables make sense and are measurable (Boslaugh & Watters, 2008). This validity shows the internal consistency between components, namely syntax, reaction principles, social systems, support systems, and indirect and direct effects. This validity conducts a series of research activities to see whether one component does not conflict with other components, the syntax in the developed product leads to the achievement of development goals, social and reaction principles, and systems support the implementation of the syntax developed (Rochmad, 2012).

One to one evaluation is conducted to 3 learners who have different abilities according to recommendations by the teacher. In this assessment, students will be interviewed and asked to provide criticism and suggestions for the developed LKPD. The revised results of this expert and individual assessment are called prototype III.

After the two stages are carried out on prototype II, it can be seen from the analysis table by paying attention to the aspects assessed which consist of 4 aspects which include aspects of the content component, language, presentation, and graphical components, it can be seen that the average value of the product developed is 0.87, which means that the product developed can be classified in the valid category. The results of the expert and individual assessments are called prototype III.

Prototype III

At this stage, the percentage value of the practicality of the project-based learning-based LKPD oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA/MA developed will be produced. The practicality test was conducted to 2 chemistry teachers of SMAN 3 Padang, with the results can be seen in Table 4 below.

Table 4. Results of Teacher Practicality Data Analysis on All Aspects

No.	Aspects Assessed	NP	Kategory
1	Ease of Use	97%	Very Practical
2	View	93%	Very Practical
3	Learning Efficiency	95%	Very Practical
4	Benefit	90%	Very Practical
	Average	**94%**	**Very Practical**

The practicality of LKPD was also carried out to students, which was a small group stage conducted to 9 students at SMAN 3 Padang. The results of the practicality assessment by students can be seen in Table 5 below.

Table 5. Results of Data Analysis of Practicality of Learners on All Aspects

No.	Aspects Assessed	NP	Kategory
1	Ease of Use	90%	Very Practical
2	View	90%	Very Practical
3	Learning Efficiency	91%	Very Practical
4	Benefit	87%	Very Practical
	Average	**90%**	**Very Practical**

Teacher and learner analysis data can be presented in the diagram in Figure 4 below.

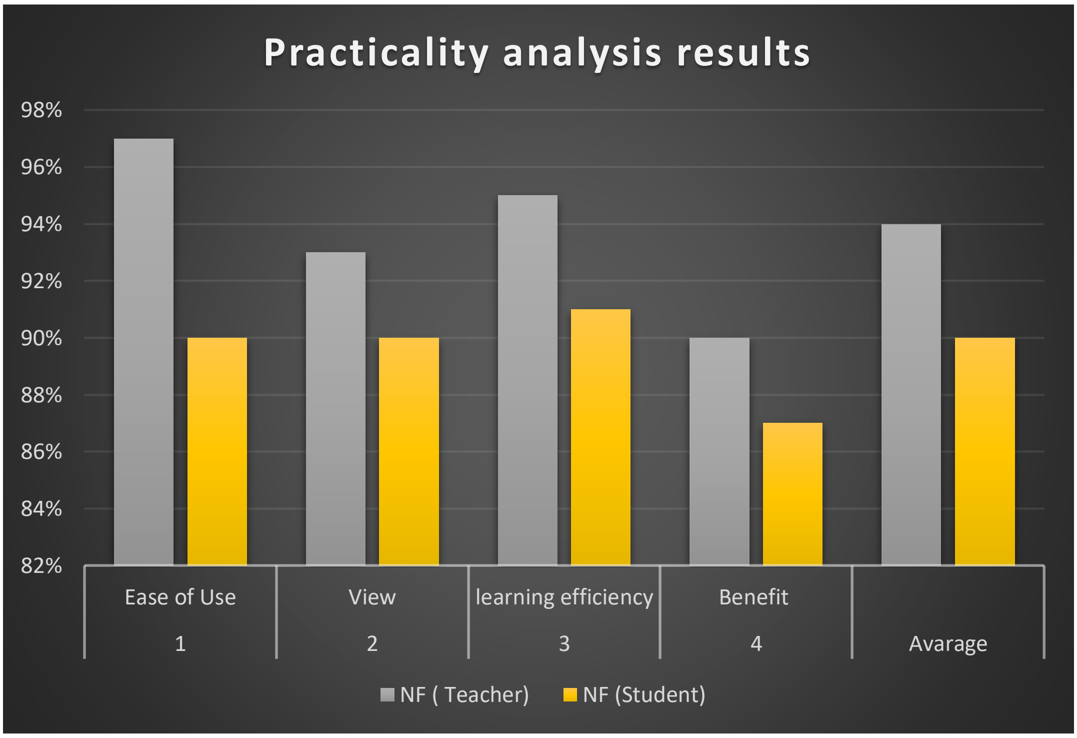

Figure 4. Practicality Result

Practical means easy to use, if the teaching material has met the requirements but is difficult to use, it means that it is not practical, this practicality is not only seen from the maker of teaching materials, but also from how other people who want to use these teaching materials (Arifin, 2012).

The second characteristic is that teachers or representatives of the target user group, find the teaching materials easy to understand and conducive to use in a way that is largely in line with the author's intentions. It can be said that this teaching material is practical if the requirements are met (Plomp et al., 2013). In Nieveen's (1999) activities related to the development of learning materials, it is found that Nieveen measures the level of practicality from the consideration of whether the material is easy and can be used by teachers and students. Niveen also explained that the developed teaching materials were concluded to be practical if experts and practitioners stated that the teaching materials could theoretically be applied in the field and the level of implementation of the teaching materials was included in the “good” category (Rochmad, 2012).

Based on the results of the revised prototype III, producing a valid product, then a small group trial was conducted with 9 students who had different abilities based on the teacher's direction. Learners will be asked to read, understand, and fill in the LKPD with directions from the researcher, then fill out the practicality questionnaire provided. The practicality test is also carried out to the teacher and an evaluation is carried out.

The evaluation results obtained were then analyzed and revised. If revisions are needed according to suggestions from teachers and students, then revisions are made to improve the product so that prototype IV is produced which is valid and practical. Judging from the results of the analysis of teacher and learner practicality data contained in Table 3 and Table 4. The average result of the analysis shows the percentage of practicality by the teacher is 94% with this can be categorized into a very practical category. Then from the results of the analysis of students obtained an average of 90% and categorized into a very practical category. This shows that the product developed is practical. So it can be stated that the development stages carried out have produced a valid and practical prototype IV.

An independent curriculum is one that has diverse intracurricular learning and gives students enough time to learn concepts and strengthen competencies. In an independent curriculum, teachers have the freedom to use a variety of teaching tools to tailor learning to the needs and interests of learners (Kemendikbudristek, 2021). The independent curriculum emphasizes the importance of fostering 21st century skills and soft skills such as critical thinking, collaboration, communication, creativity and good character. The independent curriculum aims to provide students with opportunities to participate actively, flexibly and creatively in the learning process (Lidiawati et al., 2023).

One of the learning models that is in line with the demands of the independent curriculum is project-based learning. The project-based learning model aims to encourage students to be creative and motivated in learning, improve students' ability to solve complex problems related to real-world situations, and be actively involved in making real products as a result of students' solutions. By implementing this project-based learning, each learner will be trained in cooperation, discipline, responsibility, and honesty (kurniawati et al., 2020).

Education in Indonesia is preparing to deal with rapid developments and changes in technology, culture and lifestyle through the development of skills and entrepreneurial spirit by presenting workshop subjects (Alfaniah et al., 2022). Workshop subjects provide opportunities for learners to actualize and express the skills they have about making goods or services innovatively and economically (Kemendikbudristek, 2021). Besides that, other subjects that can be used as a contribution to creating students who have an entrepreneurial spirit are chemistry subjects. chemistry is very close to everyday life so that with the knowledge and skills that students have, it is possible for students to become an entrepreneur who relates chemical concepts to real objects or what is called Chemo-entrepreneurship (CEP).

The chemo-entrepreneurship (CEP) approach is a chemistry learning approach that involves students directly with real objects or phenomena in everyday life. This approach allows students not only to obtain subject matter, but also to learn how to convert materials into products of economic value, and foster a spirit of entrepreneurship. This approach makes chemistry a fun, interesting, and more meaningful learning (Supartono et al., 2009).

The chemo-entrepreneurship (CEP) approach not only motivates students to have a spirit of entrepreneurship in the true sense, but it is also expected to foster the entrepreneurial spirit of students in the learning process such as creative, innovative, insightful, independent, and unyielding which is expected to become an inherent character in students (Tania & Azizah, 2014).

Some forms of CEP presentation contained in the developed LKPD can be seen in Figure 5 below.

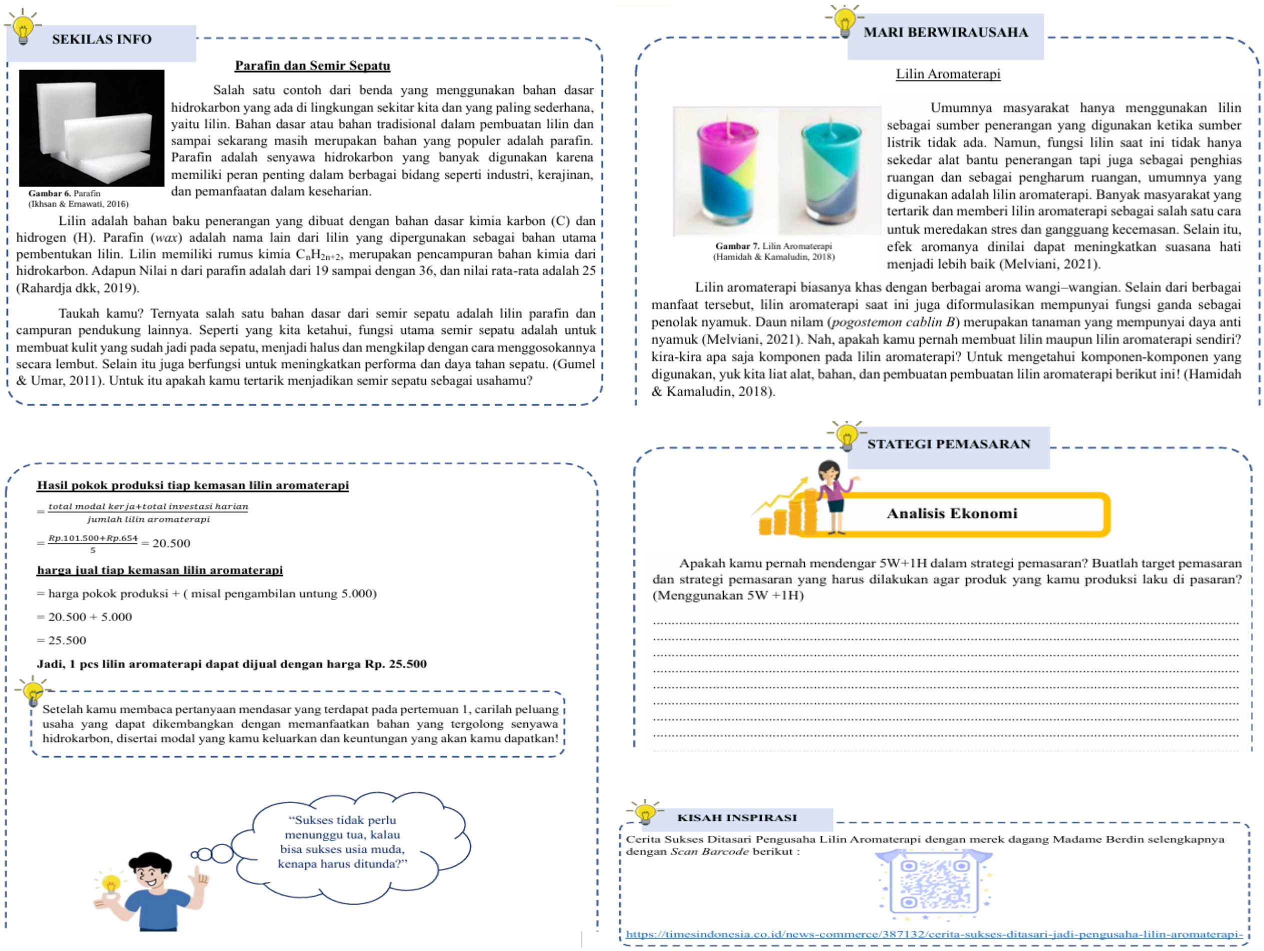

Figure 5. CEP display in LKPD

Based on the model and learning approach in accordance with the demands of the independent curriculum, it requires researchers to develop teaching materials that can be used and applied directly to the learning process, one of which is LKPD. The development of this LKPD is able to assist the learning process that can be adjusted, especially with learning models and approaches such as teaching materials in the form of project-based learning-based LKPD oriented chemo-entrepreneurship on hydrocarbon material for phase F SMA / MA. Based on the results of the research that has been carried out, it can be seen that the products developed are valid and practical, in other words, the LKPD has been developed in accordance with the demands of the independent curriculum which is expected to provide benefits to the learning process.

CONCLUSION

Based on the results of the research and data analysis that has been done, it is concluded that Project-based learning-oriented chemo-entrepreneurship-based LKPD on hydrocarbon material for phase F SMA / MA can be developed using the Plomp development model. The LKPD that has been developed has a validity and practicality level with the validity value of LKPD, which is 0.87 included in the valid category. The practicality value of teachers on LKPD, which is 94%, is included in the very practical category and the practicality value of students on LKPD, which is 90%, is included in the very practical category.

RECOMMENDATIONS

This research is limited to validity and practicality tests, so it is recommended to conduct an effectiveness test on the products developed.

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