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Analysis of Student Interest in Entrepreneurship Oriented Chemistry Learning

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Abstract: This study aims to determine how much student interest in learning chemistry through the Chemo-Entrepreneurship (CEP) approach integrated with the PjBL model. The integration of the PjBL model in CEP is done by learning chemistry that produces products that have economic value. The subjects of this study were students of SMA Negeri 19 Surabaya class X-5 in the academic year 2024-2025 The data collection technique in this study was purposive sampling with questionnaires and interviews The data obtained were then analysed with a Likert scale and descriptive analysis. The results showed that students' interest in Chemo-entrepreneurship oriented green chemistry learning was very high with a percentage of 85% expecting learning methods with experiments to produce useful and economically valuable products. In addition, student readiness is also very high with a percentage of 88% in participating in project-based green chemistry and Chemo-Entrepreneurship oriented learning.

Keywords: Chemo-entrepreneurship; Green chemistry; Student learning interest

Introduction

The preparation of superior human resources is the focus and attention of the current Indonesian government in realizing the ideals towards a golden Indonesia 2045. Superior human resources that show the quality of a country's human resources can be realized through the quality of education. The higher the education of each young generation, the more superior the quality of human resources is expected to be, so that they can get a more prosperous life because their economic life is more established. But in reality, a higher level of education does not guarantee a job. More than half of the labor force in Indonesia are junior high school graduates. In Indonesia, there are 3.5 million young people who have graduated from high school who choose not to pursue higher education, work, or training. This fact is based on calculations from the Indonesian Central Bureau of Statistics conducted until August 2023 (Mashabi et al., 2024). One of the causes of this phenomenon is that not everyone can continue to higher education due to limited financial capacity to fulfil education costs. As a result of this condition, they find it difficult to find or try to get a job, which has the potential to create unemployment.

To prevent unemployment for high school graduates who cannot continue their higher education, one of them according to Kissi et al. (2020) equips them with entrepreneurial skills in their learning (Andrean et al., 2024). This is done to change the thinking of students from job seekers to job creators with the provision of entrepreneurial knowledge they have and have an interest in entrepreneurship. Entrepreneurial knowledge and interest in entrepreneurship are expected to shape their tendency to open new businesses in the future. According to Soemanto (2011), the only

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way or struggle to form humans who have entrepreneurial attitudes, morals, and skills is through education (Hendrawan et al., 2017). Entrepreneurship education, like other disciplines, can be learned and developed through the publication of activities that discuss and study entrepreneurship to improve the knowledge, skills, attitudes, and characters that support student success, especially in dealing with life problems. Providing entrepreneurship education to students can be integrated into certain subjects, not necessarily outside of class hours (Prayitno et al., 2024). One of the subjects that can be integrated with entrepreneurship education is chemistry.

Chemistry is one of the subjects that is close to everyday life so it has the potential to be integrated with entrepreneurship education (Ni'mah et al., 2023). Chemistry learning will be more meaningful if it provides students with direct learning experiences through problem-solving skills that occur in everyday life related to chemical materials (Epinur et al., 2022). A chemistry learning approach that can be applied to student learning integrated with entrepreneurship education is Chemo-entrepreneurship (CEP). CEP learning is an approach used in learning chemistry that is inserted with entrepreneurship and can be applied in everyday life where students are equipped with knowledge and skills to know the process of converting raw materials into economically valuable goods by applying chemical concepts (Fadzil et al., 2019). Thus, learning with this CEP approach can be associated with knowledge, psychomotor, and affective aspects (Wijayati, 2017). Mastery of these three aspects is needed in the competitive world of work, which is also very useful for students who want to be entrepreneurs (Setyaningsih et al., 2021). The number of entrepreneurs created indirectly from the implications of implementing learning with the Chemo-entrepreneurship approach is expected to reduce the number of unemployment that occurs every year in every high school student graduate, especially in Indonesia.

Research on this CEP approach has grown rapidly in the last two decades. The concept of CEP approach in chemistry learning is contextual, which is associated with real objects. In contextual learning, students are guided to explain real-world phenomena and solve everyday problems by mastering concepts that they build themselves, which can result in a comprehensive understanding of concepts (Kosassy et al., 2019). One form of learning innovation with a contextual approach is Chemo-Entrepreneurship (Giri et al., 2020). Chemo-Entrepreneurship (CEP) oriented learning according to Sunarya (2017) teaches students to directly link real objects or phenomena that exist with everyday life, the hope is that students will more easily understand chemical concepts that tend to be abstract (Sunarya, 2017). CEP-oriented learning can not only improve student learning outcomes about the chemical concept itself (Ratnawati, 2023; Sunarya, 2017; Tania et al., 2014) but also improve social and vocational skills because the provision of chemical materials is continued in the form of product manufacturing and marketing (Prayitno et al., 2024), and improve student life skills (Ishak et al., 2021). Thus, in addition to learning important material, the CEP approach can train students in entrepreneurship. However, the essence of the CEP approach is not to mould students into entrepreneurs, but rather to foster interest and inspiration for entrepreneurship through learning (Hendrawan et al., 2017; Wulandari et al., 2018).

The development of digital technology that touches the world of education today affects the CEP approach, especially its application using project-based learning models in chemistry learning. Some recent studies such as Fuldiaratman et al. (2023) showed a significant increase in 4C skills, namely communication, collaboration, critical thinking and creativity after the application of the PjBL model assisted by CEP-oriented learning media in the form of chemoedutainment media. Previous research by Kurniawati et al. (2017) showed that the CEP approach with the PjBL model assisted by e-LKPD can train students' science process skills and entrepreneurial attitudes. However, some of these studies emphasise the application of the CEP approach in PjBL through electronic learning media, not through practicum in the laboratory that produces real products so that students do not get a direct and meaningful learning experience as one of the objectives of implementing CEP-oriented PjBL itself. Therefore, different from the previously mentioned research, the author will apply the CEP-oriented PjBL model with laboratory practicum which is the novelty of this research to produce a product, namely soap from used cooking oil which aims to improve students' creative thinking skills in green chemistry.

Green Chemistry material is related to matters to reduce the formation of waste, the use of catalysts, the use of safe solvents or reagents, the use of renewable starting materials, increased energy efficiency, the use of environmentally friendly and recyclable materials (Ratnawati, 2023). Green Chemistry material is one of the new materials in the Merdeka Curriculum. In the context of green chemistry learning, student interest is very important because green chemistry emphasizes the principles of sustainability and the wider environment. If students have a high interest in sustainability and the environment, they are more likely to accept green chemistry concepts and apply these principles in their

daily lives and can provide economic benefits for their life skills. To realize this goal, students do not only read and discuss green chemistry materials but need to apply them to Chemo-Entrepreneurship oriented learning that produces products. Therefore, the purpose of this research is to find out how the tendency of students' interest in Chemo-Entrepreneurship-oriented chemistry learning that produces green chemistry products. This study is expected to provide an in-depth picture of the interests and needs of students in the delivery of green chemistry material in order to bring out the creative thinking skills of students with Chemo-Entrepreneurship oriented learning.

Method

The research method used in this research is quantitative descriptive method. According to Sudjana (2009) descriptive research is research that seeks to describe or explain a symptom, event, incident that occurs in the current condition. Hakim et al. (2018) say that descriptive research is research that describes or describes the results of the object of research in the form of a phenomenon of events or problems that occur at the present time in society to be reported as they are. Quantitative research method according to Sodik et al. (2015) is research that uses a lot of numbers, starting from data collection, interpretation of the data that has been obtained, and the results obtained. It can be concluded that quantitative descriptive research is conducted to describe or describe the object under study based on the numbers obtained, and draw conclusions based on existing phenomena.

The subjects of this study were students of class X-5 at SMA Negeri 19 Surabaya in the academic year 2024/2025 with a total of 34 students. The sample subject was chosen because SMA Negeri Surabaya has a strategic location and is one of the favorite high schools for junior high school graduates around the East Surabaya area. While class X-5 became the research sample because of the diverse occupations of the students' parents, including not only as traders but also as civil servants, teachers, private employees and some who work as fishermen so that it is necessary to explore entrepreneurial interest in students. With the heterogeneous character of students' parents' jobs, not only as self-employed, it is possible to know how much student interest in entrepreneurship-based learning.

The instrument used in this study is the distribution of a questionnaire containing 21 mixed questions, namely questions with answers to yes and no options accompanied by reasons and questions by choosing answers that have been provided according to choosing one or more answers based on individual student self-facts, where the questions aim to determine student interest in green chemistry material with learning models and methods that will be applied in learning. Before the questionnaire instrument is given to students, the instrument has been validated by three validators, then declared valid and feasible to be tested to respondents.

The numbers obtained from the questionnaire containing student responses were then collected and calculated for each statement using the following predetermined formula:

$$P = \frac{number\ of\ numbers\ obtained}{total\ number\ of\ students} \quad (1)$$

Description:
P = Percentage per statement item

Table 1. Criteria for Student Interest in Green Chemistry Learning (Sudijono, 2018)

Percentage (%)	Criteria
81 - 100	Very High
61 – 80	High
41 – 60	Simply
21 – 40	Low
0 – 20	Very Low

Interviews with chemistry teachers were also conducted to validate the answers given by students, as well as to get a more complete picture of school conditions and learning experiences of chemistry materials that have been given to students previously at the school. Some examples of interview questions with chemistry teachers include, whether so far students in class X-5 have often held practicum, the answers have not been obtained until this interview was conducted because they were students who had just entered in this early semester; The learning model that teachers often apply during chemistry learning, the answers are learning through a problem-based approach; whether the teacher has ever implemented Chemo-Entrepreneurship oriented learning in the classroom, if so, what material is taught, the answer is that the teacher has never taught the method at SMA Negeri 19 but has been in other vocational schools. As well as other questions, namely how the impact caused when Chemo-Entrepreneurship-oriented chemistry learning is applied, the answers obtained by students are happy because they learn while making materials that can be sold and make money. From the questionnaire results which are answers from students when confirmed with teacher interviews, the same answers were obtained.

The questionnaire given to respondents consists of 21 items which are statements of student interest in Chemo-Entrepreneurship oriented green chemistry

learning. In measuring student interest in Chemo-Entrepreneurship oriented green chemistry learning there are several objectives of the question, namely: students' interest in learning chemistry in question numbers 1 and 2, the use of media in learning chemistry in question numbers 3 and 4, practical experience in learning chemistry in the laboratory in question numbers 5 and 6, the purpose of learning green chemistry in question numbers 7, 8, 9, 10 and 11, the method students want in learning green chemistry in question numbers 12 and 13, Students' knowledge of the definition of entrepreneurship in question number 14, interest in becoming an entrepreneur in question number 15, students' interest in learning green chemistry products that can be used as entrepreneurial business opportunities in question numbers 16, 17, 18, 19 and 20 and regarding students' readiness to take part in project-based green chemistry learning and Chemo-Entrepreneurship-oriented Chemo-Entrepreneurship in question number 21.

Result and Discussion

Student interest in green chemistry learning is measured by several question objectives consisting of 21 question items, where one statemen objective is obtained from one or more questions. Data analysis was carried out after collecting data through questionnaires. The data that has been obtained is then processed quantitatively descriptively which is then presented in tabular form. The results of data analysis of student interest in green chemistry learning can be seen in Table 2.

Table 2. Results of Student Interest Questionnaire in Learning Chemo-Entrepreneurship Oriented Green Chemistry

Question Purpose	Answer	percentage	Category
Interest in studying chemistry	yes	100	Very high
	no	0	very low
The use of media that students want in learning chemistry	chemistry textbook	62	high
	internet	20	very low
	virtual laboratory	3	very low
	media tools	3	very low
	books and internet	6	very low
	no answer	6	very low
Experience practicing chemistry in the laboratory	ever	5	
	never	85	
Purpose of studying green chemistry	protecting the environment	29	
	developing new products	9	
	more	62	
Desirable methods for delivering green chemistry materials	experiment	83	very high
	the teacher explains	9	very low
	don't know	6	
Knowing about Entrepreneur	yes	85	
	no	15	
Interest in becoming an Entrepreneur	yes	74	high
	no	26	
Students interest in learning about green chemistry products	yes	91	very high
that can be turned into entrepreneurial business opportunities	no	9	
Students readiness to follow project-based green chemistry	ready	88	very high
learning and Chemo-Entrepreneurship orientation	less prepared	9	
	not ready	3	

Based on Table 2, it can be seen that overall students in one class with a total of 34 students who were asked to fill out a questionnaire expressed interest in learning chemistry. With an interest in learning chemistry of 100%, it can be said that students in one class are in a very high interest category. The reasons stated by them why they are interested in learning chemistry vary, including chemistry is a lesson that not only provides calculation questions like mathematics but also has a practicum. According to Ozgelen (2012) chemistry is a science that was originally obtained and developed based on experiments but in later developments chemistry was also obtained and developed based on theory (Giri et al., 2020). The reason students are interested in further chemistry is because learning chemistry is fun and easy to learn, learning chemistry can study the surrounding environment, chemistry is useful in everyday life, with chemistry can make new products or substances. This is corroborated by the opinion of Amalia et al. (2024) in the experimental class, learning becomes fun because the activities are student-centered so that students are the ones who plan and find

concepts in their papers as a result of student group projects. Chemistry learning will be more meaningful if it can be applied in real life (Jannat et al., 2020). In line with what was conveyed by Ishak et al. (2021) that in learning chemistry what must be emphasized is the connection of material with problems that exist in real life, by studying chemistry, various symptoms or phenomena in everyday life can be understood. To confirm the suitability of the statements made by students in accordance with existing facts, the researchers conducted an interview with their subject teacher, from the teacher said that they really liked chemistry lessons, as evidenced by the students' formative grades, which on average exceeded the KKM score in chemistry, which is above 75. One of the factors that causes the achievement of material completeness in students is the success of learning strategies, one of which is the application of the right learning model by the teacher. This is reinforced by the opinion of Tania et al. (2014) that teachers need to master and be able to apply various learning models in order to achieve the expected learning objectives so as to get the completeness of material provision in students.

To create chemistry learning that is fun for students, in addition to requiring students' interest in chemistry itself, learning must also be given in accordance with the wishes of students directly, including the use of learning media. In the questionnaire question about the media that students expect in learning chemistry, information was obtained, more than half of the students around 62% of students wanted learning media in the form of textbooks or better known as textbooks. Meanwhile, the use of internet media, which has become a medium that has become a daily consumption in today's digital era, is even less desirable than the use of textbook media, at 20%. The lower desire of students to use learning media compared to textbooks is of course a question in itself because currently the era of rapid development of digitalized media, one of the reasons put forward by students is because the use of the internet requires a stable network/signal while their home environment is in an area with a less supportive internet signal, and some argue that information in textbooks in the form of printed media is often considered easier to understand because it provides structured, complete information, and does not depend on access to technology. Furthermore, the questionnaire data shows that students expect media such as virtual laboratories as much as 3%, media tools 3%, a combination of books and the internet is expected by students around 6%, who did not answer as much as 6%. With the high interest of students in the use of textbooks as learning media, of course there is an underlying reason. Based on interviews conducted by students regarding this, the reasons include because the explanation in the book is easy to understand; in the package book there is complete material and practice questions; from the package book, the material is easier to memories; and the reason most stated by students is because the questions and answers are directly integrated according to the learning material. According to Epinur et al. (2022) students have difficulty in adjusting to learning if they are not equipped with teaching materials, especially in conditions where educators teach quickly and less clearly. Reinforced by the opinion of Giri et al. (2020), one of the supports in contextual learning is the provision of relevant teaching materials.

Talking about the use of media in learning chemistry, of course, cannot be separated from learning methods. Chemistry, which mostly explains natural phenomena, is mostly abstract, and one way to concretize abstract chemical concepts according to Suja (2015) is through practicum, so researchers asked students whether they had done practicum during chemistry learning. Practicum is an activity that aims to equip students to be able to understand theory and practice (Nisa, 2017) and according to Tania et al. (2014) said practicum is a method in learning that is closely related to chemistry subjects. From the questionnaire given, information was obtained that only 14.71% of students or it can be said that only 5 out of 34 students in class X-5 have done chemistry practicum where the practicum was carried out at the previous school level, namely in junior high school, because when this survey was conducted they still did not get practicum at the high school based on information obtained from interviews with chemistry teachers. While those who have never done practicum activities exceed half the number of students in the class, namely 24 students or 85.29%. Learning by implementing practicum can be used as an alternative learning that can encourage students to learn actively to reconstruct their conceptual understanding (Astuti et al., 2019).

Before learning green chemistry material before being given to students so that learning objectives can be achieved properly, the author asked several questions through a questionnaire to students as a preparation before the actual learning. Before the author implements what methods he wants to apply to learning later, the author first asks students whether they know the purpose of learning green chemistry material. The data obtained provides information that students need to learn green chemistry material to protect the environment, 29% of the total number of students in the class, 9% to develop new products, while 62% of students chose three reasons at once, namely learning green chemistry material to pass the exam, protect the environment and to develop new products. When

viewed as a whole, all students gave the main answer choice of learning green chemistry is to protect the environment. In line with what Setyaningsih et al. (2021) conveyed, the concept of green chemistry approach can be the right choice to be integrated into chemistry learning today which is expected to be meaningful and relevant to environmental conditions. The concept of green chemistry is the actualization of a sustainable chemical science education process (Saptorini et al., 2014) in practice, the application of the green chemistry approach is based on the 12 principles of green chemistry proposed by Anastas et al. (1998). Afriyanti et al. (2014) stated that green chemistry learning in students brings students directly involved with the environment in a learning activity. The concept of green chemistry is a chemical approach that deals with how to design chemical products and processes to reduce or eliminate the use of chemicals that are harmful to humans, animals and the environment (Joshi et al., 2019).

The purpose of learning green chemistry to students can be carried out well, then the learning that takes place to students must be right on target so that the implementation of learning is carried out effectively. One of the learning methods that can be effective is that the learning method must be really expected by students. Therefore, as a preparation before implementing green chemistry learning, researchers asked questions through a questionnaire regarding the learning methods that students want in learning green chemistry material so that the learning objectives of green chemistry to students can be achieved. From the questionnaire data obtained information from 34 students about 29 students want learning methods with experiments that show very high interest with a percentage of 85%, while those who want direct explanation methods from teachers are only 9% or 3 students only. For the rest with the number of students 2 people stated that they did not know. With very high student interest in wanting experimental methods in learning green chemistry, this is the basis for making decisions for researchers to carry out green chemistry learning in the class with experimental methods. The application of experimental methods in chemistry learning according to Amalia et al. (2024) will train students to develop communication skills and provide experience in making time allocations to complete tasks. The implementation of experiments in chemistry learning according to Winarti et al. (2015) will provide opportunities for students to build their own knowledge, convey creative ideas that they get from observations and discussions so that they can better understand the concepts taught. This is reinforced by research by Amalia et al. (2024) which proves that experiments conducted by students, namely by making soap with kefir milk additives in lipid material chemistry lessons can improve students' creative thinking skills and entrepreneurial interests.

Related to the need for researchers to implement green chemistry learning with an entrepreneurial approach, researchers must know whether students know the definition of entrepreneurship or not and how students' interest in entrepreneurship itself, so that learning will be carried out effectively according to the expected goals. From the table above, the questionnaire results show that students who know the term entrepreneur and mention the definition of entrepreneurship according to their respective views show a percentage of 85% with a total of 29 students. Of these 29 students who are interested in entrepreneurship, 25 people show a high interest with a percentage of 74%, the rest who are not interested in becoming entrepreneurs are only 7 students with a percentage of 26%. Based on the results of the interviews described in writing on the questionnaire sheet, the reasons why they are interested in becoming entrepreneurs are conveyed, obtained a variety of answers including wanting to gain life experience, wanting to make an item that can be resold, can make their own money so as not to trouble their parents or in other words can educate an independent spirit. In addition, one of the interesting reasons conveyed is that a business can be achieved and produced by a smart person so that the person concerned is very enthusiastic about becoming an entrepreneur, and the reason that is often conveyed is more principled is that they want to work alone and not be ordered by others. Regarding the definition of entrepreneurship in general, which is conveyed by most students, it aims to produce products, so researchers asked whether or not they were interested in learning to make or process green chemical products that are useful and have economic value (can be sold), it is known that students are very enthusiastic or have a very high interest with a percentage of 91%, otherwise students who are not interested show a very small percentage of 9%. According to Purnama et al. (2020) entrepreneurship is the creation of something in the form of services or new products that involve time, effort, risk, finance and psychological and social development. The previous opinion regarding the definition of entrepreneurship put forward by Schumpter (1939) is a person who is able to break down the existing economic system by introducing new goods and services by creating new forms or processing or modifying raw materials (Hendrawan et al., 2017).

In the final question to find out high student interest in green chemistry learning is linear with student readiness to receive the learning, then students

are asked to answer the question of how their readiness to follow project-based green chemistry learning to produce Chemo-Entrepreneurship-oriented green chemistry products, obtained data that student interest is very high with a percentage of 88% meaning that students are really ready to follow the learning. While students who are less ready are only 3 students with a percentage of 9% which is the reason they have never previously known or received chemistry learning other materials with a chemo-entrepreneurship approach. From the questionnaire, only 1 student stated that he was not ready for the learning without including specific reasons. It is expected that after participating in the learning, the student will experience a change in thinking because they already know the real purpose of CEP learning. The CEP approach is one of the contextual learning which helps teachers to link the material taught with everyday life while for students it helps gain skills and knowledge that are very important to develop an entrepreneurial mindset because entrepreneurship can increase economic growth (La Guardia et al., 2014; Sadraei et al., 2018).

Based on the results of analyzing student questionnaire data in this study, it can be obtained information that class X-5 students as the object of the author's research expect green chemistry learning or it can be said that students have a high interest in green chemistry learning carried out with an entrepreneurial-oriented experimental method to produce green chemistry products that have economic value or have opportunities as an entrepreneurial business. Because this green chemistry learning is directed to produce products at the end of learning, the author will apply the PjBL or Project Based Learning model with a Chemo-Entrepreneurship (CEP) oriented approach. With the application of the PjBL or Project Based model, it is expected to create direct involvement of students in learning activities that aim to carry out and produce a meaningful project product, so as to provide learning experiences in solving problems related to everyday life. (Apriany et al., 2020; Suradika et al., 2023; Umar, 2016). The use of PjBL is oriented towards authentic problems so that students can relate chemical concepts to phenomena that exist around (Ratnawati, 2023), so that the PjBL model makes students more creative in understanding the material combined with real situations (Abidin, 2014). The above opinion about the advantages of the PjBL model is corroborated by (Krajcik et al. (2014) stating in PjBlL significant problem solving, focus on achieving learning objectives, student involvement in every learning activity, collaboration between students, teacher and student feedback, and accompanied by the use of technology to create real products or results. Chemo-Entrepreneurship (CEP) is an approach/method used in learning chemistry by inserting entrepreneurship related to chemical materials that are applied in everyday life (Marwah et al., 2016; Ulhaq et al., 2021). The spirit of entrepreneurship is important for students because it can improve self-quality, strengthen students' potential because they get skills, provide motivation for independent living, create jobs in society and student curiosity (Arfin et al., 2018; Kamaludin, 2018; Sumarti et al., 2018). The implementation of the PjBL model integrated with the CEP approach can provide the potential for students to learn the production process of a material into a useful product that has economic value (Sumarti et al., 2014).

The government's effort to improve the competence of high school graduates is to equip 21st century skills. 21st century skills are skills that must be possessed by students to prepare themselves to face the changes and demands of the times (Ekaputra et al., 2023). One of the 21st century skills that are needed today is creative thinking skills. Vincent-Lancrin et al. (2019) put forward a definition of creativity as the ability to produce work that is new (unexpectedly original) and appropriate (useful, adaptive regarding task constraints). Another opinion about creative thinking is a new breakthrough in using knowledge, approaches, perspectives, and abilities to find solutions to problems (Santofani et al., 2016). Students' creative thinking skills can be developed through education so that students can improve their competence to face 21st century competition. One effective alternative to improve students' creative thinking skills is CEP-orientated learning. This has been proven through the research of Sutarto et al. (2021), Dewi et al. (2019), and Wibowo et al. (2018) where some of these studies applied CEP-oriented learning to improve creative thinking skills in students who were the object of their research. In supporting learners' creativity according to Kovalyova et al. (2016) PjBL is a dynamic learning approach to teach students to explore real-world problems and challenges to plan, manage and complete projects through content knowledge and language skills. Based on the results of these studies, the authors will apply the Chemo-Entrepreneurship approach to provide green chemistry learning integrated in the PjBL model because it will create a green chemical product, namely bar soap from processing used cooking oil. Green chemistry learning carried out with the PjBL model and oriented to CEP through experimental methods based on the results of questionnaires distributed to students showed a very high interest of 85% in the desire to conduct green chemistry learning experiments.

The main result of this study which shows high student interest in learning green chemistry with experimental methods is consistent with the results of

research by Al Idrus et al. (2020) who concluded that the ability of green chemistry concepts needs to be given in the form of practicum to increase student creativity. In line with what was conveyed by Nurbaity (2011) that the concept of green chemistry has 12 principles that can be applied in chemistry teaching, especially in practical activities in the laboratory by reducing/replacing hazardous chemicals used in a chemical reaction or synthesis of a compound that produces hazardous waste that causes environmental problems. So that the results of the research conducted by the author can help teachers to apply the experimental method for learning green chemistry with a chemo entrepreneurship-oriented project-based learning model to encourage high interest and fondness for learning chemistry so as to improve students' creative thinking skills.

Conclusion

In general, the purpose of this study was to determine students' interest in Chemo-entrepreneurship oriented green chemistry learning to improve creative thinking skills. The results showed that students have a very high interest with a percentage of 85% wanting to learn with experimental methods by producing products. Furthermore, the results also showed that students' readiness was very high with a percentage of 88% in participating in project-based green chemistry learning and Chemo-Entrepreneurship oriented. Chemo-Entrepreneurship oriented chemistry learning is one of the interesting learning approaches that can be done in schools to bring up entrepreneurial interests in students so that they have the potential to create their own jobs which of course can help the government reduce the problem of unemployment of high school graduates. This research is only limited to a limited population and the application of learning models and methods but does not integrate the use of learning media due to time constraints so that there are still obstacles that occur. The obstacle in this study is that not all students have an entrepreneurial interest in themselves so that it will affect the expected learning objectives Recommendations from this study are that educators can integrate chemo entrepreneurship-oriented PjBL models with the use of digital application-based learning media so that learning is more interesting in its implementation. It is also hoped that policy makers in the world of education, especially in high schools, will apply the design of the entrepreneurship learning approach in natural science subjects, especially chemistry, so that its use for students is even more widespread.

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References

Abidin, Y. (2014). *Desain Sistem Pembelajaran dalam Konteks Kurikulum 2013*. PT Refika Aditama.

Afiyanti, N. A., Cahyono, E., & Soeprodjo. (2014). Keefektifan Inkuiri Terbimbing Berorientasi Green Chemistry Terhadap Keterampilan Proses Sains. *Jurnal Inovasi Pendidikan Kimia*, *8*(1), 1281–1288. https://doi.org/10.15294/jipk.v8i1.4433

Al Idrus, S. W., Purwoko, A. A., Hadisaputra, S., & Junaedi, E. (2020). Analisis Kemampuan Awal Konsep Green Chemistry Sebagai Upaya Meningkatkan Kreatifitas Mahasiswa Dalam Praktikum Kimia Lingkungan. *Jurnal Pijar Mipa*, *15*(3), 305–311. https://doi.org/10.29303/jpm.v15i3.1977

Amalia, M., Adlim, M., Khaldun, I., Winarni, S., & Hasan, M. (2024). Application of the PjBL Model to Chemical Materials to Improve Students' Creative Thinking Skills and Entrepreneurial Interests. *Jurnal Penelitian Pendidikan IPA*, *10*(5), 2572–2580. https://doi.org/10.29303/jppipa.v10i5.7132

Anastas, P. T., & Warner, J. C. (1998). Principles of green chemistry. *Green Chemistry: Theory and Practice*, *9*, 14821–14842. Retrieved from http://masrurichemistry.lecture.ub.ac.id/files/2013/09/3-Prinsip-Green-Chemistry.pdf

Andrean, M. D., Zainul, R., Nizar, U. K., & Kurniawati, D. (2024). Development of The E-Module on Colloid System with Contextual Teaching and Learning (CTL) Oriented Toward Chemo-Entrepreneurship (CEP) to Enhance Students' Critical Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, *10*(9), 6638–6646. https://doi.org/10.29303/jppipa.v10i9.8546

Apriany, W. A., Winarni, E. W., & Muktadir, A. M. (2020). Pengaruh Penerapan Model Pembelajaran

Project Based Learning (PJBL) terhadap Hasil Belajar Kognitif Siswa pada Mata Pelajaran IPA di Kelas V SD Negeri 5 Kota Bengkulu. *Jurnal Pembelajaran Dan Pengajaran Pendidikan Dasar*, *3*(2), 88–97. https://doi.org/10.33369/dikdas.v3i2.12308

Arfin, W., Latisma, L., & Oktavia, B. (2018). A development module of chemistry learning based on chemo-entrepreneurship oriented. *Proceedings of the International Conferences on Educational, Social Sciences and Technology - ICESST 2018*, *1*, 394–400. https://doi.org/10.29210/2018157

Astuti, S. W., Andayani, Y., Al-Idrus, S. W., & Purwoko, A. A. (2019). Penerapan Metode Praktikum Berbasis Kehidupan Sehari-hari Terhadap Keterampilan Proses Sains Siswa Kelas XI MIA MAN 1 Mataram. *Chemistry Education Practice*, *1*(2), 20. https://doi.org/10.29303/cep.v1i2.952

Ekaputra, F., & Widarwati, S. (2023). Discovery Learning Based Practicum Learning in Improving Critical Thinking Skill and Student Creativity. *Tarbiyah: Jurnal Ilmiah Kependidikan*, *12*(1), 47–56. https://doi.org/10.18592/tarbiyah.9183

Epinur, Yusnidar, Y., & Minarni, M. (2022). Development of Basic Chemistry Teaching Material Chemical Education Based on Entrepreneurship. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 2909–2916. https://doi.org/10.29303/jppipa.v8i6.2456

Fadzil, H. M., & Saat, R. M. (2019). The Development of a Resource Guıde in Assessıng Students' Scıence Manıpulatıve Skılls at Secondary Schools. *Journal of Turkish Science Education*, *16*(2), 240–252. https://doi.org/10.12973/tused

Fuldiaratman, F., & Ekaputra, F. (2023). Analysis of Students' 4C Skills Based on Project Based Learning through Chemo Entrepreneurship Media. *EduLine: Journal of Education and Learning Innovation*, *3*(3), 454–459. https://doi.org/10.35877/454ri.eduline2057

Giri, B. B., Ibnu, S., & Sutrisno, S. (2020). Pengembangan Modul Elektrokimia dengan Pendekatan Kontekstual Chemoentrepreneurship untuk SMA. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(8), 1183. https://doi.org/10.17977/jptpp.v5i8.13959

Hakim, L., & Fatmaryanti, D. (2018). Studi Pendahuluan Pengembangan Media Pembelajaran Berbasis Booklet Etnosains Fotografi Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. In *The 7th University Research Colloqium 2018* (Issue 2015, pp. 223–227). Retrieved from https://shorturl.at/E0fgt

Hendrawan, J. S., & Sirine, H. (2017). Pengaruh Sikap Mandiri, Motivasi, Pengetahuan Kewirausahaan Terhadap Minat Berwirausaha (Studi Kasus pada Mahasiswa FEB UKSW Konsentrasi Kewirausahaan). *AJIE-Asian Journal of Innovation and Entrepreneurship*, *02*(03), 2477–3824. Retrieved from https://journal.uii.ac.id/ajie/article/view/8971

Ishak, M. P., Harizon, & Muhaimin. (2021). Penggunaan Model Pembelajaran Project based Learning Terintegrasi Chemo-Entrepreneurship Dan Hubungannya Dengan Life Skill Siswa Dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Kimia*, *15*(1), 2745–2753. https://doi.org/10.15294/jipk.v15i1.26142

Jannat, N., Hussien, A., Abdullah, B., & Cotgrave, A. (2020). A Comparative Simulation Study of the Thermal Performances of the Building Envelope Wall Materials in the Tropics. *Sustainability*, *12*(12), 4892. https://doi.org/10.3390/su12124892

Joshi, D. R., & Adhikari, N. (2019). Green Chemistry: Beginning, Recent Progress, and Future Challenges. *World Journal of Pharmacy and Pharmaceutical Sciences*, *8*(7), 280. https://doi.org/10.20959/wjpps20197-14208

Kamaludin, A. (2018). Chemo-entrepreneurship Modelling on Chemical Bonding Materials as an Effort to Grow Entrepreneurial Spirit of Students with Hearing Impairment in (Islamic) Senior High School. *IJCER (International Journal of Chemistry Education Research)*, *2*(1), 34–44. https://doi.org/10.20885/ijcer.vol2.iss1.art6

Kissi, E., Ahadzie, D. K., Debrah, C., & Adjei-Kumi, T. (2020). Underlying strategies for improving entrepreneurial skills development of technical and vocational students in developing countries: using Ghana as a case study. *Education + Training*, *62*(5), 599–614. https://doi.org/10.1108/ET-11-2019-0264

Kosassy, S. O., Gistituati, N., & Montesori, M. (2019). The Effect of Contextual Learning Approach (CTL) to Improve Students' Critical Thinking Ability in Organization and Management Subject. *Proceedings of the 1st International Conference on Innovation in Education (ICoIE 2018)*, 141–145. https://doi.org/10.2991/icoie-18.2019.33

Kovalyova, Y. Y., Soboleva, A. V., & Kerimkulov, A. (2016). Project Based Learning in Teaching Communication Skills in English as a Foreign Language to Engineering Students. *International Journal of Emerging Technologies in Learning (IJET)*, *11*(04), 153. https://doi.org/10.3991/ijet.v11i04.5416

Krajcik, J. S., & Shin, N. (2014). Project-Based Learning. In Sawyer (Ed.), *The Cambridge Handbook of the*

Learning Sciences (2nd ed., pp. 275–297). Cambridge University Press. https://doi.org/10.1017/CBO9781139519526.018

Kurniawati, E. E., Sumarti, S. S., & Nuswowati, M. (2017). Pengaruh Project Based Learning Berorientasi Chemoentrepreneurship berbantuan E-LKPD terhadap Keterampilan Proses Sains dan Sikap Wirausaha. *Chemistry in Education*, *10*(2252), 315–321. https://doi.org/10.15294/chemined.v10i1.41102

La Guardia, D., Gentile, M., Dal Grande, V., Ottaviano, S., & Allegra, M. (2014). A Game based Learning Model for Entrepreneurship Education. *Procedia - Social and Behavioral Sciences*, *141*, 195–199. https://doi.org/10.1016/j.sbspro.2014.05.034

Marwah, M., Dewi, C. A., & Mashami, R. A. (2016). Pengaruh Pembelajaran Kooperatif Tipe Tai Berbasis Chemoentrepreneurship Terhadap Motivasi Berwirausaha Dan Penguasaan Konsep Siswa Padamateri Koloid. *Hydrogen: Jurnal Kependidikan Kimia*, *4*(2), 80. https://doi.org/10.33394/hjkk.v4i2.89

Mashabi, S., & Prastiwi, M. (2024). Data BPS. *Kompas.Com*. Retrieved from https://www.kompas.com/edu/read/2024/05/27/072700371/data-bps-3-5-juta-lulusan-sma-tidak-lanjut-kuliah-atau-bekerja?.

Ni'mah, A., & Kamaludin, A. (2023). Development of a Chemo-Entrepreneurship Practicum Video to Improve Material Understanding of Colligative Properties for Senior High School. *Jurnal Penelitian Pendidikan IPA*, *9*(2), 666–675. https://doi.org/10.29303/jppipa.v9i2.1512

Nurbaity, N. (2011). Pendekatan Green Chemistry Suatu Inovasi Dalam Pembelajaran Kimia Berwawasan Lingkungan. *JRPK: Jurnal Riset Pendidikan Kimia*, *1*(1), 13–21. https://doi.org/10.21009/JRPK.011.02

Prayitno, M. A., Haryani, S., Wardani, S., & Wijayati, N. (2024). Chemoentrepreneurship-based learning: Influence on social and vocational skills. *Lumat*, *12*(2), 1–17. https://doi.org/10.31129/LUMAT.12.2.2067

Purnama, N., Hasan, M., & Syukri, M. (2020). Implementing Chemo-entrepreneurship-based inquiry learning on the acid-base concept to increase science process skills and students' interest in entrepreneurship. *Journal of Physics: Conference Series*, *1460*(1), 012098. https://doi.org/10.1088/1742-6596/1460/1/012098

Ratnawati, E. (2023). Penerapan Pembelajaran Materi Kimia Hijau Melalui Project Based Learning (PjBL). *UNESA Journal of Chemical Education*, *12*(2), 141–147. https://doi.org/10.26740/ujced.v12n2.p141-147

Sadraei, R., Sadeghi, V. J., & Sadraei, M. (2018). Biotechnology revolution from academic entrepreneurship to industrial: chemo-entrepreneurship. *Biometrics & Biostatistics International Journal*, *7*(6), 546–550. https://doi.org/10.15406/bbij.2018.07.00257

Santofani, A., & Rosana, D. (2016). Pengembangan tes kreativitas pada pembelajaran fisika dengan pendekatan inkuiri pada materi teori kinetik gas. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 134. https://doi.org/10.21831/jipi.v2i2.6373

Saptorini, Widodo, A. T., & Susatyo, E. B. (2014). Green Chemistry Dalam Desain Pembelajaran Project-Based Learning Berbasis Karakter Di Madrasah Aliyah Se-Kabupaten Demak. *Rekayasa*, *12*(1), 57–68. https://doi.org/10.15294/rekayasa.v12i1.5588

Setyaningsih, U., Sumarti, S. S., & Sudarmin, S. (2021). Development of Chemo-Entrepreneurship Oriented Learning Design Based on Green Chemistry. *Journal of Innovative Science Education*, *9*(3), 28–34. https://doi.org/10.15294/jise.v9i1.37491

Sodik, M., & Siyoto, S. (2015). *Dasar Metodologi Penelitian*. Yogyakarta: Literasi Media Publishing.

Soemanto, S. (2011). Eksperimen Model Pembelajaran Pendidikan Agama Islam di SMP. *EDUKASI: Jurnal Penelitian Pendidikan Agama Dan Keagamaan*, *9*(2). https://doi.org/10.32729/edukasi.v9i2.290

Sudijono, A. (2018). *Pengantar Statitistik Pendidikan*. Indonesia: Rajawali Press.

Suja, I. W. (2015). Penggunaan Analogi dalam Pembelajaran Kimia. *JPI (Jurnal Pendidikan Indonesia)*, *3*(2), 397–410. https://doi.org/10.23887/jpi-undiksha.v3i2.4457

Sumarti, S. S., Aris, S. R. S., & Aini, R. N. (2018). Chemoentrepreneurship with Cooperative Integrated Process Inquiry Strategy to Increase Students' Entrepreneurial Interest and Learning Motivation. *Jurnal Pendidikan IPA Indonesia*, *7*(2), 172–180. https://doi.org/10.15294/jpii.v7i2.12206

Sumarti, S. S., Supartono, & Diniy, H. H. (2014). Material Module Development of Colloid Orienting on Local-Advantage-Based Chemo- Entrepreneurship to Improve Students' Soft Skill. *International Humanities and Management Science*, *2*(1), 42–46. Retrieved from http://lib.unnes.ac.id/id/eprint/33225

Sunarya, R. A. (2017). Analisis Hasil Belajar Dan Minat Wirausaha Siswa SMA Kelas XI Pada Materi Buffer-Hidrolisis Menggunakan Bahan Ajar Berorientasi Chemoentrepreneurship. *Jurnal Inovasi Pendidikan Kimia*, *12*(1), 2065–2074. https://doi.org/10.15294/jipk.v12i1.13298

Suradika, A., Dewi, H. I., & Nasution, M. I. (2023). Project-Based Learning and Problem-Based Learning Models in Critical and Creative Students. *Jurnal Pendidikan IPA Indonesia*, *12*(1), 153–167. https://doi.org/10.15294/jpii.v12i1.39713

Sutarto, Nuriman, Budiarso, A. S., & Hasanah, N. (2021). Application of STMCpE-Based chemistry books with chemo-entrepreneurship orientation in the learning of acid-base solutions to improve students' creative thinking skills. *Journal of Physics: Conference Series*, *1832*(1). https://doi.org/10.1088/1742-6596/1832/1/012034

Tania, V. M., & Azizah, U. (2014). Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw Dengan Pendekatan Chemo-Entrepreneurship Pada Materi Pokok Hidrokarbon Untuk Meningkatkan Hasil Belajar Siswa Di Sma Muhammadiyah 4 Surabaya Implementation of Cooperative Learning Model Type Jigsaw With. *UNESA Journal of Chemical Education*, *3*(02), 15–22. https://doi.org/10.26740/ujced.v3n2.p%25p

Ulhaq, M. Z., Wijayati, N., & Sumarni, W. (2021). Implementation of the CTL Model with the CEP approach to improve student learning outcomes and entrepreneurial interest in Matter–Properties and Changes in SMK. *Journal of Innovative Science Education*, *9*(3), 35–42. https://doi.org/10.15294/jise.v9i1.37986

Umar, M. A. (2016). Penerapan Pendekatan Saintifik dengan Metode Pembelajaran Berbasis Proyek (Project-Based Learning) pada Mata Pelajaran Kimia. *Jurnal Entropi*, *11*(2), 132–138. Retrieved from https://ejournal.stkipbbm.ac.id/index.php/bio/article/view/194

Vincent-Lancrin, S., González-Sancho, C., Bouckaert, M., de Luca, F., Fernández-Barrerra, M., Jacotin, G., Urgel, J., & Vidal, Q. (2019). *Fostering Students' Creativity and Critical Thinking*. Paris: OECD. https://doi.org/10.1787/62212c37-en

Wibowo, T., & Ariyatun, A. (2018). Penerapan Pembelajaran Berorientasi Chemoentrepreneurship (CEP) Terhadap Kreativitas Siswa Sma Modern Pondok Selamat Pada Materi Kelarutan Dan KSP. *JTK (Jurnal Tadris Kimiya)*, *3*(1), 62–72. https://doi.org/10.15575/jtk.v3i1.2030

Wijayati, N. (2017). Application of Project Based Learning (PBL) Model for Materials of Salt Hydrolysis to Encourage Students' Entrepreneurship Behaviour. *International Journal of Active Learning*, *50*(1), 50–58. Retrieved from http://journal.unnes.ac.id/nju/index.php/ijal

Winarti, T., & Nurhayati, S. (2015). Pembelajaran Praktikum Berorientasi Proyek Untuk Meningkatkan Keterampilan Proses Sains Dan Pemahaman Konsep. *Jurnal Inovasi Pendidikan Kimia*, *8*(2), 1409–1419. https://doi.org/10.15294/jipk.v8i2.4446

Wulandari, I. M., Anwar, Y., & Savalas, R. (2018). Penerapan Model POE (Predict-Observe-Explain) dengan Pendekatan Chemoentrepreneurship pada Materi Pokok Hidrokarbon terhadap Hasil Belajar dan Keterampilan Proses Sains Siswa Kelas XI MIA di MAN 2 Mataram. *Chemistry Education Practice*, *1*(1), 34. https://doi.org/10.29303/cep.v1i1.1628