

Development of Basic Chemistry Teaching Material Chemical Education Based on Entrepreneurship

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Received: October 20, 2022

Revised: December 25, 2022

Accepted: December 28, 2022

Published: December 31, 2022

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DOI: [10.29303/jppipa.v8i6.2456](https://doi.org/10.29303/jppipa.v8i6.2456)

Abstract: The current government policy is that scholars do not look for work anymore, but create jobs. Furthermore, the Minister of Education and Culture launched an independent campus policy that carried four policies. The second policy is the right of students to study outside the study program, for example to become entrepreneurs. From the government's policy and the Minister of Education and Culture, entrepreneurship-based basic chemistry teaching materials are needed. The purpose of this research is to develop entrepreneurship-based basic chemistry teaching materials that are feasible theoretically and practically. This teaching material is expected to provide opportunities for students to become entrepreneurs. The development model used is the 4-D model (Four D) developed by Thiagarajan consisting of 4 main stages, namely: Define, Design, Develop and Disseminate. Based on the analysis of student needs, the orientation of the dominant college student is to become an ASN. They are interested in entrepreneurship in the chemical field as a side job. However, they hope that the lecturers in teaching link the course material with the field of business. The teaching materials "Basic Chemistry based on Entrepreneurship" that have been developed obtained a score of 94.8% and 86.6% from material experts and entrepreneurship experts (theoretically). The responses of 2 basic chemistry lecturers were 90.6% and 88%, while the student responses were 93.3% (practically). From the validation data of material experts and entrepreneurship experts, it can be concluded that the teaching materials developed are theoretically feasible. Based on the responses of 2 basic chemistry lecturers and student responses, the teaching materials developed were declared practical

Keywords: teaching materials; basic chemistry; entrepreneurship

Introduction

The current government policy is that university graduates are no longer job seekers, but are creating jobs. Furthermore, the Minister of Education and Culture launched an independent campus policy that carries four policies. The second policy is the right of students to study outside the study program, for example to become entrepreneurs/entrepreneurship (Mustusilo, 2020). According to Abigail et al. (2022) Chemical entrepreneurship is the art of commercializing chemical innovations and ideas to a wider audience, making them go beyond the classroom and assessment. These innovative suggestions when realized with social relevance show prospects for individuals/graduates to become job creators who have the potential to reduce exercise and improve performance. From the policies of

the government and the Minister of Education and Culture, entrepreneurship-based chemistry teaching materials are needed.

The idea of independent learning conveyed by the Minister of Education and Culture that one of them is that learning must be fun, not make students feel pressured, students are free to choose the direction of their own creativity. The role of a teacher is no longer the only source of learning, instead a teacher who can help students find their own talents (Suhartoyo et al., 2020). To create graduates with an entrepreneurial spirit, study programs/lecturers must prepare teaching materials/courses based on entrepreneurship. The existing basic chemistry teaching materials in Indonesian and English (text books) describe material in the form of subject matter without relating it to opportunities to become businesses and create jobs. For

How to Cite:

Epinur, E., 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>

example the subject of Electrochemistry which studies the working principle of accumulators (accumulators) and metal plating with other metals (electropolating). So far, the teaching materials only explain the reactions that occur, without explaining the opportunity to be made into a business.

In theory, the battery will never be damaged (soaked) and the battery water will never decrease. Because the reaction of discharging the battery and charging (charging) is an alternating reaction, namely: $\text{Pb} + \text{PbO}_2 + \text{H}_2\text{SO}_4 \rightleftharpoons \text{PbSO}_4 + \text{H}_2\text{O}$ (Chang, 2005). But in reality the battery water is reduced, the battery is soaked and can't be charged again. There are two kinds of battery water, the terms on the market are soft battery water and hard battery water. Soft battery water (blue) is distilled water, hard battery water (red) contains about 30% sulfuric acid (Petrucci et al., 2007). If the battery water is reduced, the blue battery water (aquades) will decrease. Aquades is mineral-free water made by distillation, but you can also collect rainwater in a plastic or glass container after it has rained for about 20 minutes.

The battery is soaked (damaged) or can't be charged anymore, because the reverse reaction isn't perfect, PbSO_4 (brown in color) doesn't completely turn into Pb and PbO_2 , so it accumulates like brown mud. By knowing the nature of PbSO_4 , which dissolves in hot water, we can remove PbSO_4 . After all the PbSO_4 is removed, then the battery is filled with zuur and charged with a charger. To charge the battery you don't have to use a charger, we can fill it with a jumper technique.

The business opportunity is that we can repair a bad battery into a new battery. For motorbike batteries, the profit can reach 400%, buying used motorbike batteries is Rp. 30,000 and 1 bottle of hard battery water Rp. 7,500 (capital Rp. 37,500), the price for a new motorcycle battery is around Rp. 200,000,- Likewise with car batteries, buying a used car battery is Rp. 80,000 and 3 bottles of hard battery water Rp. 22,500 (capital Rp. 102,500), the price for a new car battery is around Rp. 800,000. For a car battery, you can get a profit of around 680%. Other basic chemical materials, for example acid-base indicators which are very much needed by chemistry teachers, can be made from plant extracts. Production tofu with various flavors, activated charcoal production (export opportunity), soap making, water purification.

Some of the results of research related to entrepreneurship in the field of chemistry are Wahyuni and Widiarti (2010) which concluded that Chemo-Entrepreneurship oriented problem-based learning methods can increase student learning activities and quantitatively student learning outcomes show an increase from 65 to 81.2 and learning completeness also increases from 34% to. Kusuma and Siadi (2010) state

that student learning outcomes and life skills can be increased through the application of Chemo-Entrepreneurship oriented teaching materials. According to Novalinda et al. (2020) there is an effect of entrepreneurship-based learning on optical management learning outcomes; learning discipline influences the learning outcomes of Optical Management; and there is the influence of entrepreneurship-based learning and learning discipline together on the learning outcomes of Optical Management.

Entrepreneurship is a dynamic behavior, dare to take risks, reactive, and always growing. Some of the characteristics of an entrepreneur, namely work-oriented, confident, tolerant, and the motivation to excel. Another term entrepreneur is entrepreneur. The following are the various definitions of entrepreneur put forward by experts (Hafizh, 2018):

1. According to Thomas W Zimmerer, the definition of entrepreneur is the application of creativity and innovation to solve problems and efforts to take advantage of the opportunities that people face every day.
2. Peter F Drucker defines the notion of entrepreneur as the ability to create something new and different, the cool language is the ability to create the new and different.
3. According to Kasmir, the definition of an entrepreneur is a person who has the courage to take risks to open a business on various occasions.
4. Meanwhile, according to Zimmerer the notion of entrepreneurship is a process of applying creativity and innovation in solving problems and finding opportunities to improve life.
5. Finally, according to Soeparman, the definition of entrepreneur is an ability to think creatively and behave innovatively which is used as a basis, resource, driving force for goals, strategies and processes in facing life's challenges.

According to Hafizh (2018) the next stage is the mindset that needs to be built by an entrepreneur so that in the future it remains consistent. It should be noted, material about entrepreneurship is not only a matter of theory but what is very important is practice, practice, and practice. The correct mindset stage of an entrepreneur needs to be instilled from the start, this is very important. Even though it looks trivial, successful people start with their initial mindset, the initial mindset of a true entrepreneur for success, is:

1. Don't think instantly
In any business, don't ever want to succeed instantly, whether it's an online or offline business, all of that requires a process to get there and it takes time to reach its peak.
2. Don't think for free

One of the obstacles in doing business is the mindset of wanting something for free, meaning that it is very calculated to invest in knowledge, such as attending seminars, training, e-courses, courses.

3. Be ready and dare to fail
4. If you want to start plunging into the world of entrepreneurship, don't be afraid to fail, do your best, good results will come. One way to minimize failure is to learn from people who have been successful and don't follow their failures, that's the best way to minimize them.

Teaching materials are all forms of materials in the form of a set of materials that are arranged systematically to assist lecturers/teachers/instructors in carrying out learning activities and enable students to learn. At the present time learning resources are not only lecturers, various information can be obtained from various mass media and the environment. Learning is defined as the activity of compiling information and structuring the environment to support scientific discoveries. The environment does not only mean a place to study, but includes learning methods, and learning media, learning equipment needed to convey information and guide students in learning.

The teaching and learning process includes "the process of structuring, selecting, and delivering information in an appropriate environment and the way students process information sources to convey a message. Messages can be in the form of descriptions about certain topics, lecturer directions to students about steps to study a particular topic (Belawati, 2007).

The role of teaching materials as learning media is very significant in increasing the effectiveness of learning. The benefits of a teaching material in the learning process are strongly influenced by the ability of a lecturer to develop and utilize it. "Teaching materials are materials or subject matter that are arranged systematically, which will be used by lecturers and students in the learning process (Belawati, 2007). In the learning process the function of teaching materials is very important for lecturers and students. If there are no teaching materials, the lecturer will have difficulty increasing the effectiveness of the teaching and learning process. As for students, if teaching materials are not available, students will have difficulty adjusting to learning, especially if the lecturer teaches quickly and is not clear. They have difficulty retracing what the lecturer has taught, in other terms, they lose track (Belawati, 2007).

Furthermore, Belawati (2007) states the role of teaching materials for lecturers are: (1) saving lecturer time in teaching, (2) lecturers changing roles from a teacher to a facilitator, (3) increasing learning to be more effective and interactive. Teaching materials for students have the following roles: (1) students can learn on their

own without having to have a lecturer or other student friends, (2) students can study anywhere they want, and anytime, (3) students can learn according to their own pace, (4) students can study according to the order they choose, (5) help potential students to become independent.

Method

This development research uses the 4-D development model (Four D) which is a model for developing learning tools, including teaching materials. This model was developed by Thiagarajan et al. (1974). Consists of 4 main stages, namely: Define, Design, Develop and Disseminate.

Defining stage

The defining stage is useful for determining and defining needs in the learning process and gathering various information related to the product to be developed.

Design Stage

After getting the problem from the definition stage, then the design stage is carried out. This design stage aims to design teaching materials that will be developed. This design stage includes:

- a. Preparation of basic chemical materials
- b. Selection of basic chemistry titles/topics
- c. Selection of Format (format selection)
- d. Initial design (initial design)

Development Stage

At this stage the ready design is developed into a product in the form of a "basic chemistry teaching material draft based on entrepreneurship". To see theoretical feasibility, there are two validators (entrepreneurship expert and subject matter expert). Then repaired according to the validator's suggestions. To see practical feasibility is to ask for the assessment of 2 basic chemistry lecturers and the responses of 25 students through a limited trial.

Stage of Dissemination

After limited trials and teaching materials have been revised, the next stage is the dissemination stage. The purpose of this stage is to disseminate the developed teaching materials. Dissemination is carried out by publishing teaching materials with ISBNs, making videos on YouTube. The teaching materials developed will be used in the next basic chemistry lesson.

The data needed is an analysis of student needs for basic chemistry teaching materials based on entrepreneurship. Furthermore, data validation of entrepreneurship experts, materials experts and teaching materials (theoretical feasibility). Data for

practical feasibility was obtained from the assessment of 2 lecturers and the responses of 25 students. Validation is done by asking the validator to examine the product and provide ratings and comments on a questionnaire with a scale of 1-5 (Likert scale). Lecturer assessments and student responses were also obtained from a questionnaire with a scale of 1-5.

Table 1. Likert Scale Statement Format

Attitude Statement	VW	W	D	NF	VU
Positive Statement	5	4	3	2	1

(adaptation Sugiyono, 2013)

Description:

VW = Very Worth it

NF = Not Feasible

W = Worthy

VU = Very Unworthy

D = Doubtful

Table 2. Product Qualification Rating Scale

Percentage of Eligibility Value Scale	Eligibility Level
81-100	Very Worth it
61-80	Worthy
41-60	Decent Enough
21-40	Less Eligible
0-20	Not feasible

Result and Discussion

Needs analysis was carried out by distributing questionnaires to 25 students who had contracted basic chemistry courses. After they filled out the questionnaire, they were told to watch a battery repair video, and were asked to fill in the questionnaire again. From the needs analysis it was found that most students did not understand Entrepreneurship. They think Entrepreneurship requires large capital and digital skills. The findings of Singh and Dwivedi (2022) state that digital entrepreneurship competence (DEC) has a significant impact on digital entrepreneurial intentions (DEI) and entrepreneurial motivation (EM) mediating the relationship between DEC and DEI. Besides that the lecturers who teach do not relate the course material to everyday life and prospects as a business field. In addition, lecturers who teach do not relate their lecture material to everyday life (contextual) and their prospects as a business field. Several researchers have reported that contextual learning can increase student learning activities and outcomes (Vermunt, 2005; Chotimah, 2007; Pursitasari, 2009; Mulyani, 2013; Manalu et al., 2016; Istijabatun et al., 2016; Hartoyo, 2009; Sinaga and Silaban, 2020). Most students when they have graduated are very interested in becoming ASN. After being given an example of a business prospect in the chemical field, namely "battery repair" and showing the video, they changed. Students who are interested in starting a business, if the lecturer explains the business prospects

of a topic, are as much as 72%. They will do this business after finishing college they cannot get a job (20%), after finishing college even though they have got a job (40%), if the course load is reduced (20%), as soon as possible (20%).

From these data it is illustrated that students focus on their lectures first and will make this business a side job. Only 20% of students who declare as soon as possible, and becoming ASN (State Civil Apparatus) are still students' priority (80%), this shows that the Entrepreneurship spirit is very low. According to Nurseto (2010) teachers must teach the spirit of entrepreneurship to their students, society must be more active and intensive in monitoring the development of entrepreneurship education if the nation wants to progress. A country that is rich in natural resources, if supported by resources that have a high entrepreneurial spirit, will become a prosperous country so that poverty will naturally decrease. The cause of the low entrepreneurial spirit of students is because they have only studied for one semester. According to Muliadi (a) (2020) there is a significant relationship between students' semester level and entrepreneurial attitudes. In another study, Muliadi (b) (2020) found that there were no significant differences in entrepreneurial attitudes between male and female students. A literature review of social entrepreneurship journals was conducted Smith et al. (2022), resulting in identifying four key dimensions in social entrepreneurship which are social, economic, behaviour and governance. These four dimensions have been categorised to have an effect on social entrepreneurship and sustainability.

Students choose to open a business in the field of chemistry (100%), the reason is because they have studied the theory so it is easier to do it and the risk of failure is low. According to Lee et al. (2022) found the stigma of business failure to be positively related to the likelihood that individuals will invest their entrepreneurial talents into social enterprises. Of the several business opportunities given (choose 3), those who chose making tofu with various flavors 98%, making soap 88%, battery repair 84%. 80% charcoal mask making. These four business fields are not too difficult to do and the profits are decent. This is in line with their plan to become entrepreneurs as a side job. This student's opinion is not quite right, because entrepreneurs have to be managed seriously. According to Kamaludin et al. (2021) the four main dimensions of social entrepreneurship are social, economic, behavior and governance. These four dimensions have been categorized as having an influence on social entrepreneurship and sustainability.

For the business of coating metal, water purification and making charcoal briquettes that choose successively 24, 20, and 20%. These three business units do require large capital and rather troublesome work.

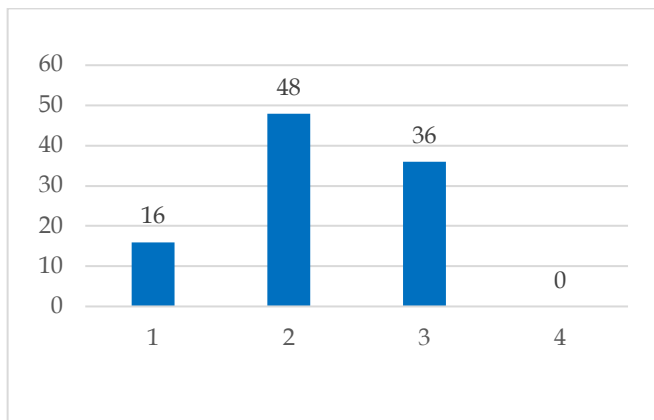


Figure 1. Percentage of Connecting Lecturers, Lecture Materials with Business Prospects

Description:

- 1. Never
- 2. Sometimes
- 3. Partly
- 4. Always

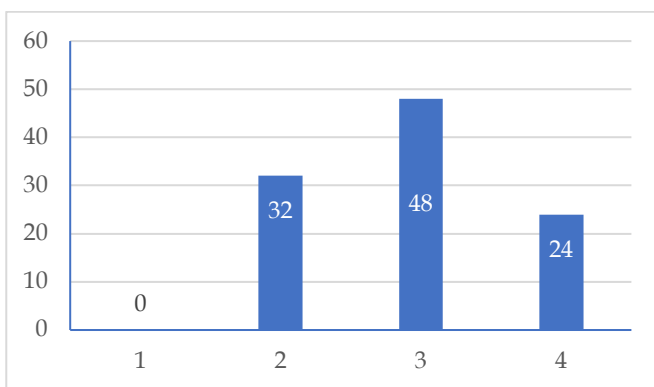


Figure 2. Percentage of Interested Students Battery Repair Business

Information:

- 1. No
- 2. Thinking
- 3. Interested
- 4. Very interested

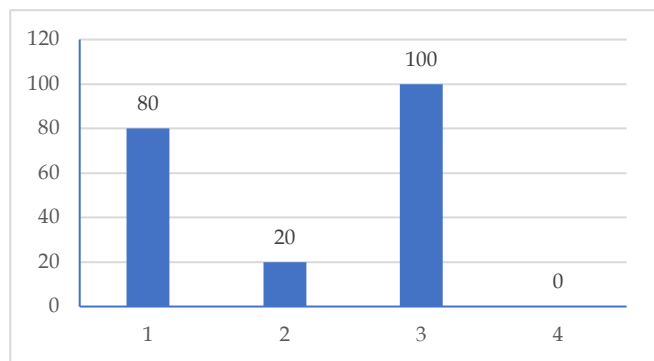


Figure 3. Percentage of Student Choices After Graduating College

Information:

- 1. Register to be an ASN
- 2. Applying to Private Companies
- 3. Opening Your Own Business in the Chemical Sector
- 4. Opening Your Own Business Outside the Chemical Field

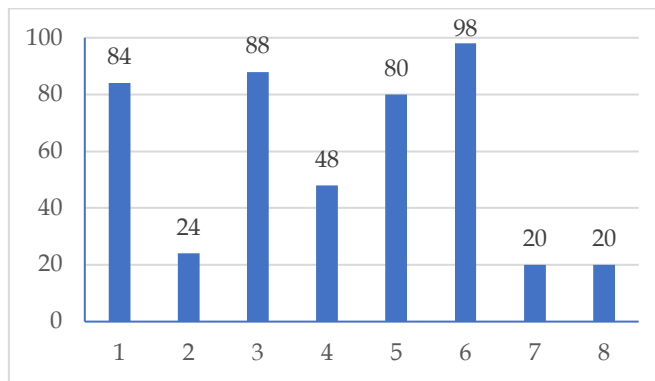


Figure 4. Percentage of Business Choices in Chemistry Information:

- 1. Battery Repair
- 2. Metal Coating
- 3. Soap Making
- 4. Making Shampo
- 5. Making Mask/Charcoar Masks
- 6. Making Various Flavored Tofu
- 7. Water Purifier
- 8. Making Coconutt Shell Briquetts

The results of the analysis of the basic chemical material in the curriculum and the relationship between this material and business opportunities resulted in 8 types of businesses, namely: (1) Battery Repair; (2) Metal Coating; (3) Soap Making; (4) Making Shampoo; (5) Making Masks/Charcoar Masks; (6) Making Various Flavored Tofu; (7) Water Purification and (8) Coconut Shell Briquette Making. At this Difine stage, the resulting product is branded as Cap KUE (Kimia Unja Entrepreneurship). For example Soft Battery Water with KUE stamp, KUE stamp accu zuur, tofu various flavors of KUE stamp, KUE stamp soap.



Figure 5. Soft Battery and Water Products Hard Battery Water

At the Design stage, a concept map of entrepreneurship-based teaching materials is obtained which will be developed (figure 6). In the Develop stage, material is collected from relevant literature and drawings and developed into an Entrepreneurship-based Basic Chemistry Teaching Material Draft.

Furthermore, the draft Entrepreneurship based Basic Chemistry Teaching Materials was validated by entrepreneurship experts, material experts and teaching materials. Based on the suggestions from experts, improvements were made.

CONCEPT MAPS

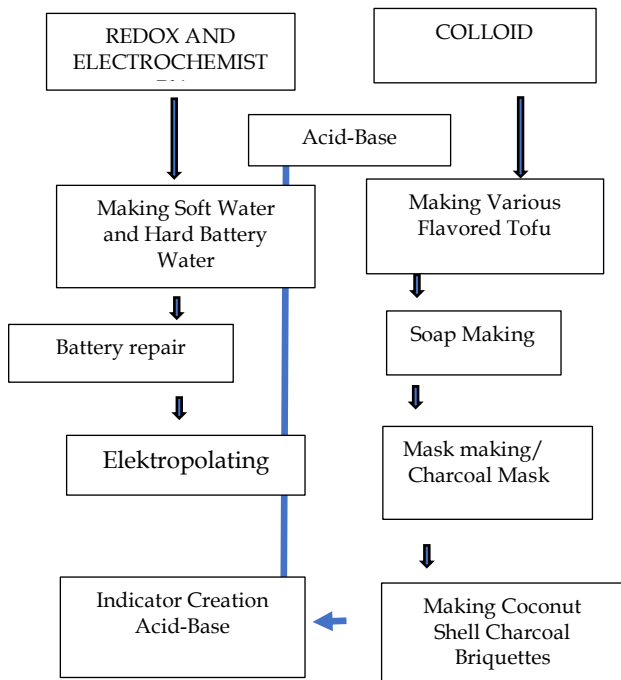


Figure 6. Concept Map of Chemistry Teaching Materials Basic Based Entrepreneurship

In the first validation, a total score of 90 was obtained, the maximum score was 23 items x 5 = 115. The percentage was 78.3% based on table 2 including the "decent" category. Based on the validator's suggestion, a revision was made. The revised components are: (1) listing image sources; (2) include water quality standards according to the Minister of Health of the Republic of Indonesia; (3) The theory of acids and bases is sufficient for an introduction, in accordance with the basic chemistry syllabus (4) to make a synopsis. The second validation obtained a score of 109, the percentage is 94.8% based on table 2 including the "very feasible" category.

From the entrepreneurship field validator, in the first validation a score of 65 was obtained, the maximum score was 15 items x 5 = 75. The percentage was 86.6% based on table 2 including the "very feasible" category. The validator's suggestions: (1) narrative explanations should increase the font size of important words and display them in BLOCK; (2) the pictures need to be laid out so that they look more attractive; (3) the layout needs to be set so that it is easier to understand and important information is easy to find. Improvements were made based on the validator's suggestions, when asked for

validation the two validators stated, "if it has been corrected according to the suggestions it is enough".

After being declared very feasible by the validator, they were then asked for the responses of two basic chemistry lecturers. From the first lecturer a score of 68 (90.6%) was obtained, the second lecturer was 66 (88%) based on table 4 in the "very decent" category. Input from the two lecturers is: (1) description of business prospects in Entrepreneurship-based Basic Chemistry Teaching Materials is more clarified; (2) emphasizing the things that are important in how the product works; (3) add pictures on electropolating. Improvements from the suggestions of two basic chemistry lecturers have been made. After this teaching material was declared feasible by the validator and received a positive response from the lecturers who teach basic courses, students' responses were asked. Students who were asked to respond were students who filled out a need's questionnaire.

Teaching materials were distributed to students and given 3 days to study, then together with researchers conducted experiments. Then they were asked to fill out a student response questionnaire, a score of 70 was obtained from a maximum score of 75. The percentage of student responses was 93.3%, based on table 2, it was included in the "very decent" category. The dissemination of these teaching materials is done through YouTube and books with ISBNs. The youtube link is <https://www.youtube.com/watch?v=eGzOEMXsmss>, for 3 weeks it has been viewed 416 times, 202 likes and 30 comments. Teaching materials with ISBN are being processed by CV publishers. Sarnu Untung, IKAPI member No. 146/JTE/2015.



Figure 7. Book cover of teaching material chemistry based on entrepreneurship

Conclusion

Based on the validation of entrepreneur experts (86.6%), material experts and teaching materials (94.8%), the entrepreneurship-based basic chemistry teaching

materials developed are very feasible to use. Based on the responses of 2 basic chemistry lecturers (90.6% and 88%), the student responses (93.3%) of the entrepreneurship-based basic chemistry teaching materials that were developed were very feasible to use. According to entrepreneur experts, materials and teaching material experts, lecturer responses and student responses, basic chemistry teaching materials developed on an entrepreneurial basis provide opportunities for students to become successful.

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