



Development of TikTok-based Chemo-entrepreneurship e-Worksheet to Fostering Students' Entrepreneurial Spirit

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Abstract: This research aims to develop an e-worksheet and analyze its quality based on the assessment of material experts, media experts, and chemistry teachers, as well as knowing students' responses to TikTok-based chemo-entrepreneurship e-worksheet products. The method used a 4D model consisting of define, design, development, and disseminate stages, but was limited to the developing stage. Data collection techniques in this research were interviews, validation sheets, and student response questionnaires. The data obtained was analyzed qualitatively and quantitatively. The result of this study indicated that the e-worksheet product was rated very good (with an ideal percentage of 90%) by material experts, very good (with an ideal percentage of 97% by media experts, and very good (with an ideal percentage 96%) by the reviewer. Students responded very well to the e-worksheet product (with an ideal percentage of 96%). Thus, the TikTok-based Chemo-entrepreneurship e-worksheet can be used as an alternative chemistry learning medium while developing the participants' entrepreneurial spirit.

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Introduction

Chemistry is a science that develops based on observations and experiments to form a scientific attitude, gaining experience in applying a scientific approach, and studying chemical concepts to solve problems in the surrounding environment (Dewi, 2021). Therefore, chemistry learning can directly align with various objects or phenomena around human life (Wibowo, 2018). One of the chemical materials studied by students and closely related to everyday life is the Colligative Properties of Solutions.

The topic of colligative properties of solutions is closely associated with daily life activities, for example, making syrup, refining petroleum, refining sugar, and making ice cream. In making traditional ice cream, there is a process of adding salt, which is one application of the colligative properties of the solution, namely decreasing the solution's freezing point. The teacher needs to connect the material on Colligative Properties of Solutions and its application in life through entrepreneurship education. One approach that links material with natural objects around human life is the Chemo-entrepreneurship (CEP) approach.

The CEP approach is a contextual chemistry learning approach, namely a chemistry approach that connects the material studied with natural objects (Wibowo, 2018). The CEP approach is aimed at motivating students to have an entrepreneurial spirit. The CEP approach can also train students to process materials into products we often encounter in real life, have economic value, and foster students' entrepreneurial interests (Milaningsih, 2023). Through



the CEP approach, students are expected to be more creative in producing products that have economic value because, in reality, not all students continue their higher education after graduating from school (Ruliyanti, 2020).

Providing entrepreneurship education at the high school level is essential, considering there is still a high level of open unemployment among educated people, including high school graduates (Pupasari, 2020). Entrepreneurship education is a tool that can be used to reduce unemployment and poverty and can also be used as a means to create a financially independent society so that it is able to achieve prosperity for individuals and the surrounding environment towards a prosperous society (Alstra, 2023). It is hoped that entrepreneurship education will reduce the high unemployment rate, especially among the educated (Nleonu EC, 2020). Schools need to provide students with real-world experience in business as part of entrepreneurship education to gain the necessary knowledge, attitudes, and abilities (Hidayat, 2021). Information and communication technology in the digital era has experienced significant growth (Marti'ah, 2022). This condition is an opportunity to create entrepreneurship, especially in the education sector, which demands a creative, competitive, and innovative generation (Yogi, 2021).

Sustainable education in the 21st Century has four pillars of the learning process: "learning to know, learning to do, learning to be, and learning to live together" (Marryono Jamun, 2019). To realize these four pillars of education, teachers, as learning agents, need to study and apply technological developments in the learning process. Based on this, education should use technology to support learning, access information, and support learning activities and assignments (Novita, 2023). Apart from utilizing technology for learning, teachers need to prepare teaching materials for teaching related to the material to help students learn and deepen the material. One of the teaching materials that can be used is Student Worksheets.

Student worksheets are a learning tool containing material summaries, practice questions, and instructions for implementing learning tasks that students must complete to build basic abilities according to achievement indicators of the learning outcomes (Mairani, 2022). However, these worksheets are considered less effective in supporting the learning process in the current era of increasingly rapid technology. Student worksheets still have shortcomings, including incomplete presentation of incomplete material, the cover appearance does not stimulate students' learning motivation, and the questions provided are less varied (Rosa, 2020). To optimize Student Worksheets both in terms of appearance and quality of learning, a transformation is needed to increase innovation and student creativity by replacing the function of short student worksheets with electronic versions or e-worksheets (Khotami, 2023).

E-worksheet is a student work guide to help students understand learning material in electronic form, which is implemented using desktop computers, notebooks, smartphones, and tabs (Firma Kholifahtus, 2021). E-worksheet can display videos, images, text, and questions that can be assessed automatically (Utami, 2022). Using e-worksheets for learning makes student activities more fun, makes learning interactive, and provides opportunities for students to continue to try and motivate themselves while learning (Indahsari, 2020). Apart from that, research by Milaningsih (2023) noted that e-worksheet chemo-entrepreneurship is feasible and effective for cultivating students' entrepreneurial spirit. The existence of e-worksheets also increases teachers' creativity so that e-worksheets are more interactive and fun and attract students' interest in learning (Costadena, 2022).

Students in the 4.0 era mostly use the internet to complete assignments, one of which is the use of social media. Pardianti (2022) stated that social media can be used as a learning



medium. TikTok is a Chinese social network and music video platform launched in September 2016 (Apriyani, 2022). Syarifuddin (2022) research states that TikTok, together with the right use and methods, can be used as an engaging, interactive, and innovative learning media. Research conducted by Putri (2021) states that with the TikTok application, students can quickly create a learning process that attracts their attention.

This research aims to produce innovative new teaching materials in the form of chemo-entrepreneurship e-worksheets that are feasible and effective in fostering students' entrepreneurial spirit and to determine the response of students and teachers after conducting chemistry lessons using the developed e-worksheet. The e-worksheet is intended to help teachers deliver the materials, improve student learning outcomes, and foster students' entrepreneurial spirit.

Research Method

The Research and Development (R & D) method was applied in this study. R & D is a research method used to create a particular product and test the practicality and effectiveness of the product. The product developed in this research was learning media as an e-worksheet containing chemo-entrepreneurship linked to the social media TikTok. In this study, a 4-D research model was used, which consisted of 4 stage, namely: Define, Design, Develop, and Disseminate (Sugiyono, 2019), but was limited to the developing stage.

The define stage defines the requirements needed to develop the product. The activities carried out were needs analysis, student analysis, task analysis, material concept analysis, and formulation of learning objectives. The define stage was obtained through interviews and observation of chemistry teachers and high school students. The design stage is the stage of designing the media to be developed. The design phase is implemented by selecting media, selecting formats, collecting references, making instruments, and making initial designs. The development stage is the stage for testing and improving the product. Products are assessed by experts so that quality products are produced.

Data collection techniques in this research were interviews, validation sheets, and student response questionnaires. The e-worksheet being developed was validated by experts (material and media) to determine its feasibility. Product quality was validated and assessed using a Likert scale questionnaire, while student responses were obtained using a Guttman scale questionnaire. The data analysis technique was carried out by changing assessment data from media experts, material experts, and reviewers into qualitative assessment data based on a Likert scale with answer choices Excellent (E), Good (G), Fair (F), Poor (P), Bad (B) where each option has a score of 5, 4, 3, 2, 1 (see Table 1). Next, the average value of each and the overall assessment aspects of the scores obtained were calculated. The average value was calculated using the formula:

$$\bar{X} = \frac{\sum X}{n}$$

\bar{X} = average score

$\sum X$ = total score

n = number of experts

Score obtained then altered to qualitative with classification total assessment, such as seen in Table 1.



Table 1. Criteria Evaluation (Sugiyono, 2019)

No.	Score range (i) quantitative	Qualitative category
1	$x_i + 1.80 S_{Bi} < \bar{x}$	Excellent
2	$x_i + 0.60 S_{Bi} < \bar{x} \leq x_i + 1.80 S_{Bi}$	Good
3	$x_i - 0.60 S_{Bi} < \bar{x} \leq x_i + 0.60 S_{Bi}$	Fair
4	$x_i - 1.80 S_{Bi} < \bar{x} \leq x_i - 0.60 S_{Bi}$	Poor
5	$\bar{x} \leq x_i - 1.80 S_{Bi}$	Bad

Data from students were converted into quantitative data using the Guttman scale, which were converted into scores. Then, the percentage of product ideality was calculated for each aspect. The ideal percentage (%) was calculated using this formula:

$$\text{Percentage ideal} = \frac{\text{obtained-score}}{\text{maximum ideal score}} \times 100\%$$

Results and Discussion

In this study, a 4-D research model was used, which consisted of four stages, namely: Define, Design, Develop, and Disseminate (Sugiyono, 2019). The development process begins with the Define Stage. The Define stage includes five steps: needs analysis, student analysis, task analysis, material concept analysis, and formulation of learning objectives. This stage was carried out to identify and determine learning needs and collect information related to the Chemo-Entrepreneurship-oriented e-worksheet. From the results of the needs analysis carried out by distributing questionnaires to students, it was found that most students said that the colligative properties of solutions were only explained using the lecture method, so students needed help understanding the concept of chemo-entrepreneurship in the material. Using the lecture method causes students to be less active in the learning process, so students could be more optimal in developing their potential (Wulandari, 2022). Meanwhile, the interview with the teacher concluded that the colligative properties of solutions were carried out using textbooks, student worksheets, and discussions. It needs analysis showed that a teaching material product was required to foster students' entrepreneurial spirit and help them understand the concept of colligative properties of solutions.

The second stage was the Design Stage, resulting in the e-worksheet being designed with the Canva application and converted into PDF. The Canva application is an online design program that provides various tools such as presentations, brochures, posters, resumes, pamphlets, banners, and so on provided in the Canva application (Junaedi, 2021). The Canva application has advantages, including having a variety of attractive designs and increasing the creativity of teachers and students in designing learning media. In addition, the Canva application provides various features and templates, saving time in making learning media (Admelia et al., 2022). In this e-worksheet, learning videos were created via the TikTok application and then inserted into the e-worksheet as a link that can be watched by clicking to ensure the learning variation. The software used in this research includes Canva, TikTok, Kinemaster, Flip PDF Professional, and Google Form applications.

The e-worksheet design began with preparing and analyzing material on the colligative properties of solutions. Material analysis aims to determine the material's characteristics and depth to be presented. The material on colligative properties that will be presented includes 1) Understanding the colligative properties of solutions, 2) Types of colligative properties of solutions, 3) Understanding freezing point depression of solutions, 4)



Application of freezing point depression of solutions in everyday life related to entrepreneurship. The following process was designing the e-worksheet using the Canva application. The templates and animations used in the e-worksheet were adapted to the material. The process of creating an e-worksheet via the Canva Premium application can be seen in Figure 1.



Figure 1. Process of creating e-worksheet via the Canva application

The components in the e-worksheet included a foreword, table of contents, instructions for use, introduction, concept map, summary of material on colligative properties of solutions, product planning design, preparation of project schedules, implementation and monitoring related to making rotary ice, evaluation of questions, and references. The next process was making a video using the Kinemaster application and making evaluation questions using Google Forms.

The video editing process was carried out with the help of the Kinemaster application. The Kinemaster application allows users to edit videos easily and quickly. Many features are available in the Kinemaster application, such as effects, filters, music, and much more. Videos that had been edited were then downloaded in high quality to obtain more apparent and exciting results. Videos edited using the Kinemaster application were then uploaded to the TikTok application. After the video had been successfully uploaded to the TikTok application, the next step was to insert the TikTok video link into Canva to access the video on the e-worksheet. The content of the video is an explanation of the material on the colligative properties of solutions starting with apperception (Astiani et al., 2018). Apperception in the video is related to daily life events, so it can reduce boredom from studying in line with (Kamila, 2022), who stated that apperception activities are beneficial in providing an initial overview when delivering material and can increase students' understanding and motivation in learning. Some of the apperception scenes presented in the video include the process of dissolving salt in each solution and then the role of adding salt to ice cubes in making rotating ice. Salt added to ice cubes helps lower the freezing point of ice cubes or solutions. Salt has hydrophilic properties or can bind with water molecules so that salt can make ice (Agung et al., 2022). The learning video in the TikTok application can be seen in Figure 3.

The video contains the definition of colligative properties of solutions, various colligative properties of solutions, and questions for practice and discussions. The video can be viewed on the e-worksheet by clicking the button provided to make it easier for students to



access the videos presented. Question evaluation is useful for measuring students' understanding of the material presented. The questions for practices were made using Google Forms, where the links to these forms were included in the e-worksheet. After completing the questions, students can submit them and check the scores they obtained.



Figure 2. TikTok Video

The third stage was Development, which was carried out by developing the e-worksheet product as a link created using the Flip PDF Professional application, as seen in Figure 4. After downloading the e-worksheet, it was uploaded to the Flip PDF Professional application. After successfully uploading to the Flip PDF Professional application, the file that had become a flipbook was published online so that a link appeared. Files were published online using high quality for a more attractive appearance and more explicit images. The link was then copied, and after that, it can be distributed online. The e-worksheet was distributed via a link so that e-worksheet can be easily accessed. After the product was finalized, the next step was a review by one material expert, one media expert, four reviewers (high school chemistry teachers), and students (see Table 2). The review results of these experts were then used as a consideration to determine the product's suitability.



Figure 3. Process of changing the e-worksheet in the form a PDF file into a link



Table 2. Review quality of product and response of students

Response	Review aspect	Score	Max Ideal score	Ideal percentage	Category
Materials Expert	Contents	12	15	90%	Excellent
	Presentation	14	15		
	Language	15	15		
	Chemo-Entrepreneurship	9	10		
Media Expert	Presentation	15	15	97%	Excellent
	Graphics	14	15		
	Language	15	15		
	TikTok Videos	24	25		
Reviewers	Presentation	14.75	15	96%	Excellent
	Graphics	14.5	15		
	Contents	14.25	15		
	Language	14.75	15		
	Chemo-Entrepreneurship	9.25	10		
	TikTok Videos	24.25	25		
Students' Response	Material	1,93	2	96%	Excellent
	Language	1,9	2		
	Presentation	2	2		
	Chemo-Entrepreneurship	3,8	4		

Validation by material experts was carried out twice. In the first stage of material expert validation, a score of 80% was obtained, stating the “good” category so that the e-worksheet that was being developed needed to be improved and revalidated. In the material validation process, material experts suggested enhancing aspects of the material content, namely by explaining the application of the colligative properties of solutions in everyday life apart from the process of making traditional ice cream, even though what was presented in the e-worksheet was only the process of making traditional ice cream. After revision, the second stage of material expert validation was continued, where a score of 90% was obtained, which stated the “excellent” category. Therefore, based on experts’ suggestions and comments, the media developed is feasible and can be tested for small-group research.

The media expert’s assessment obtained a result of 97% in the “excellent” category. These results state that e-worksheets include outstanding aspects of presentation, graphics, language, and TikTok videos. Media experts also provided advice regarding errors in writing and choosing font size. The choice of font size was intended to make the e-worksheet easy and exciting to read (Sari et al., 2023). Media experts also provided input regarding using the formula for lowering the freezing point of solutions found on page 10 of the e-worksheet. Assessment by the reviewers (four chemistry teachers) obtained an ideal percentage of 96% in the excellent category. Reviewers also provide suggestions and input, such as selecting animations that can be adapted to the current material; in the question evaluation, there should be questions related to making ice cream, completeness of the material, use of the freezing point depression formula, and suitability of the concept map to the material presented. Based on the assessment results by material experts, media experts, and reviewers,



data was obtained that the Chemo-Entrepreneurship e-worksheet developed was in the excellent category.

The developed Chemo-Entrepreneurship e-worksheet was tested to 30 students from three schools. They had delivered their comments and responses through a distributed questionnaire. Based on the student questionnaire, the ideal percentage was 96% in the “excellent” category. The results of student responses stated that the e-worksheet Chemo-entrepreneurship that was developed made learning more enjoyable and fostered students’ entrepreneurial spirit through the Chemo-entrepreneurship approach.

The Chemo-Entrepreneurship approach in the e-worksheet can be seen in the primary material presented, work steps, and product planning tasks. A brief description of the primary material and additional information relating to the products produced. Experimental work steps explain the process of processing material into a functional product with economic value. Experiments are not only related to chemistry but also have entrepreneurial characteristics in them. The CEP approach makes chemistry learning exciting and allows students to optimize their product production potential (Wibowo & Ariyatun, 2018). E-worksheet is equipped with product planning tasks to foster an entrepreneurial spirit in students.

Based on research that has been conducted, the E-LKPD Chemo-Entrepreneurship that has been developed has received a very good assessment from teachers and is very feasible to be used as teaching material to foster the entrepreneurial spirit of students. E-LKPD Chemo-Entrepreneurship makes learning more enjoyable and helps students understand the learning material.

Conclusion

The conclusions obtained from the results of this study that the developed e-worksheet Chemo-Entrepreneurship obtained an ideal percentage of 90% from material experts in the excellent category, 97% from media experts in the excellent category, 96% from reviewers in the excellent category, and 96% of the test Student responses were in the excellent category. Thus, the developed Chemo-Entrepreneurship e-worksheet is of excellent quality and is suitable as an alternative learning medium for material on the collaborative properties of solutions in classroom learning to foster students’ entrepreneurial spirit.

Recommendation

Some recommendations given for future researchers are as follows: (1) Research using the R&D method only reaches the development stage, it is hoped that further research can reach the dissemination stage to perfect this research. (2) Complement the chemo-entrepreneurship e-worksheet developed with practical videos other than making ice cream so that students understand it more easily.

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