



The effect of STEM approach e-module -topic of free-range chicken eggs productivity on student learning outcomes in entrepreneurship courses in the era of the industrial revolution 4.0

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Abstract: The use of technology in the form of e-modules in entrepreneurship courses in the chemistry education study program, Universitas Sriwijaya is a challenge for learning in the industrial revolution era 4.0. So this study aims to determine the effect of STEM approach e-module- topic of the productivity of free-range chicken eggs on student learning outcomes in entrepreneurship courses in the era of the industrial revolution 4.0. Respondents of this study were students in the third semester of the chemical education study program at the Sriwijaya University. This research method is a quasi-experimental method, where a limited field test is carried out on previously developed e-modules. Data on student learning outcomes were obtained from the pre-test and post-test scores which were analyzed by N-Gain. The results showed that the N-Gain value was 0.937 which was classified as high category, which means that there was a significant difference in student learning outcomes before and after using the STEM e-module approach. Beside that, respondents have reported examples of creativity in business plan as a result of using STEM approach e-module-topic of free-range chicken egg productivity for the Entrepreneurship Course in Chemistry Education. Thus, it can be concluded that there is an effect of using STEM approach module-topic of free-range chicken eggs productivity on student learning outcomes in entrepreneurship courses in the chemistry education study program, Universitas Sriwijaya.

Keywords: e-module learning chemistry, industrial revolution 4.0, free-range chicken eggs

1. Introduction

Research on needs analysis has been carried out, respondents strongly agree 50% and agree 42%, an e-module for learning chemistry on the topic of free-range chicken egg productivity has been developed. Research on curriculum analysis, respondents strongly agree by 60% and 28% agree to make the e-module (Pakpahan et al. 2021). The research

continued on characteristic analysis and material validation instruments, pedagogical validation, design/practical validation, for the development of STEM-integrated chemistry learning e-modules in the Entrepreneurship course at the Chemistry Education Study Program, Faculty of Teacher Training and Education, Sriwijaya University. This research is specifically about a limited trial "field test" as the end of the research on the development of the ADDIE model of the Tessmer formative test combination.

The development of teaching materials is very important because it is a source of knowledge for students which is very useful for student achievement in learning (Wartika et al. 2021). This is also in line with the research of Edi et al. (2021) which states that students agree that learning materials in the form of modules can help them to improve their competence.

In the current era of the Industrial Revolution 4.0, chemistry learning must develop towards such learning. Globalizing Chemistry learning in the Industrial Revolution 4.0 era forms creative, sustainable students, adapting to the progress of the times. In essence, by providing entrepreneurship education based on digital technology, it is hoped that it can form character building entrepreneurs in the era of the Industrial Revolution 4.0. Prastyaningtyas & Arifin (2019) explained the importance of entrepreneurship education for students by utilizing digital technology as an effort to face the 4.0 revolution. Cholily et al. (2019) explains that learning in the Industrial Revaluation era has entered the fourth generation, where there has been a change from the generation of computers and robots to cyberspace, namely the use of the internet. Students are used to using Android phones, so the internet is a source of material. Students can easily search/browse the material quickly and easily (Astuti et al. 2019).

According to learning experts in the Industrial Revolution 4.0 era, this is a learning competency towards creativity, innovation, communication, collaboration and confidence, in cyberspace using the internet. The E-Module for chemistry learning with the STEM approach for the Entrepreneurship course at the Chemistry Education Study Program, Faculty of Teacher Training and Education, Universitas Sriwijaya, the topic of increasing the productivity of native chicken eggs was developed, to support learning in the Industrial Revolution 4.0 era. Integrating STEM into learning is a good thing to do because it can improve learning outcomes and scientific literacy (Khofifah & Mitarlis, 2021). However, learning chemistry with the Industrial Revolution 4.0 should not lose or erode low self-esteem in a positive sense and blessing from the Almighty (Ifadah & Utomo 2019; Nugroho et al. 2017; Zulfahrin-Uz et al. 2019; Hendarman, 2019).

From the description above, the purpose of this study is to obtain empirical data on the limited test of the effect of learning by using the Online Chemistry Learning Module (Herawati & Muhtadi, 2018; Romayanti et al. 2020), STEM Approach for Entrepreneurship Courses in Chemistry Education Faculty of Teacher Training and Education, Universitas Sriwijaya on learning outcomes. This research was conducted on third semester students of Chemistry Education Faculty of Teacher Training and Education, Universitas Sriwijaya with a quasi-experimental method. This research is useful for 1). to improve student learning outcomes in Entrepreneurship courses and reduce the cumulative study period for Chemical Education students, Faculty of Teacher Training and Education, Universitas Sriwijaya. 2). Besides that, it is also useful to equip students who will be entrepreneurship as a side income besides being a chemistry teacher.

2. Methods

This research is a field test stage of research on the development of e-modules for chemistry learning with a STEM approach for the Chemistry Education Entrepreneurship course, Faculty of Teacher Training and Education, Universitas Sriwijaya, the topic of Feed for Increasing the Productivity of Free-range Chicken Eggs in the Industrial Revolution Era 4.0. This research method is a quasi-experimental, limited trial of prototype II, the results of the ADDIE development model and Tessmer's formative evaluation. This research was conducted in the odd semester of 2021/2022 at the Chemistry Education Study Program, Faculty of Teacher Training and Education, Universitas Sriwijaya. The research field test procedures from Tessmer's formative evaluation tests are in the form of a pretest/pretest and a final test/posttest.

2.1 Pre-Test

At this stage, the initial test/pretest to students of the Chemistry Education Study Program, Faculty of Teacher Training and Education, Universitas Sriwijaya, is the implementation stage where limited trials are carried out to one class of students.

2.2 Final Test

At this stage the researcher conducted a final test /posttest to students of the Chemical Education Study Program, Faculty of Teacher Training and Education, Sriwijaya University, is the implementation stage where a test is carried out on a class of students.

2.3 Calculation of Test Results

At this stage the researchers performed calculations using the N-scoreGain to the answers of the pretest and posttest as a limited trial field test of the e-module chemistry learning -STEM approach for the Entrepreneurship course at the Chemistry Education Faculty of Teacher Training and Education, Universitas Sriwijaya. The calculation of the increase in learning outcomes as a limited test field test from Hake (1998) on the results of the initial test and final test of learning using the Normalized Gain formula (N-Gain) such as $\langle g \rangle = \frac{s - s_0}{s_0}$ pretest is the mean score of the pretest. "s" posttest is the posttest mean score. $\langle g \rangle$ is the calculated score of the increase/difference between the pretest and posttest mean scores. The calculated results are compared with the Gain Index Criteria. If $\langle g \rangle$ the calculated result is greater than 0.700 then it is significantly different from the "high" criteria before and after learning. If $\langle g \rangle$ the result of the calculation is between 0.300 to 0.700 then it is in the "moderate" significance criteria before and after learning. If $\langle g \rangle$ the result is less than 0.300 then it is in the "low" significance criteria before and after learning

2.4 Take Home Work

At this stage, students as respondents prepare entrepreneurial plans. This arrangement was carried out in their respective homes with different feed titles between respondents and this plan was collected 2 days later.

3. Results and Discussion

The product resulting from this research is the result of a limited trial field test from development research e-module for chemistry learning with STEM approach for Chemistry

Education Entrepreneurship course, Faculty of Teacher Training and Education, Universitas Sriwijaya, the topic of Feed for Increasing the Productivity of Free-range Chicken Eggs.

3.1 Pre-Test

At this stage, an initial test is carried out or pretest to 52 Chemistry Education students, Faculty of Teacher Training and Education, Universitas Sriwijaya in the third semester of 2021. At first the students were given test questions related to the e-module chemistry learning with the STEM approach for the Chemistry Education Entrepreneurship course, Faculty of Teacher Training and Education, Universitas Sriwijaya. The student answer sheets were collected. The results of the initial test that all students could not answer the initial test questions. The average score of the initial test results was 10.0 from the maximum score of 100.0. The initial test was carried out for 15 minutes. The pre-test results are summarized in the [Table 1](#).

Table 1

Pre-test result of limited field test

Pretest	Respondent	Range Score	Mean
	52	0-100	10

3.2 Post-Test

The final test stage of this research was obtained by means of the 52 students reading and studying the chemistry learning e-module, then the students reviewed, reviewed the e-module and at the end of the e-module activity the students answered the final test questions. The final test questions are the same as the initial test questions, namely the description test questions. The average final test score was 100.0. The Post-test takes 15 minutes. The post-test results are summarized in the [Table 2](#).

Table 2

Post-test result of limited field test

Post-test	Respondent	Range Score	Mean
	52	0-100	100

Furthermore, as the implementation of the task in the e-module, the student worked on another task as atake home work to work on at another time. These other assignments are collected the next day. The other tasks are: 1).download the video of laying native chickens and record the URL address of the video, each student has a different video. 2). download the type of feed to increase the productivity of native chicken eggs and record the URL address of this type of feed, each student has a different type of feed. 3) arrange the title of the substance or material or supplement as feed to increase the productivity of native chicken eggs, each student has a different title or a certain feed topic. 4) download videos and or practicum procedures, funds or chemical analysis journals for types of feed or supplements, or other substances (note the URL address as well). 5). designing sketches/drawings/plans of the place and the cage for the cultivation of laying hens, each student has a different design. 6) prepare a plan for the address where the plan for laying native chickens is to be cultivated, each student has a different address. 7). prepare an initial cost/funding plan (for chicken coops, feed, free-range laying hens, wages for domestic

chicken maintenance officers, etc.), each student has a different funding plan. 8). write a bibliography as a reference source. 9). communicating/reporting the results of activities 3 to 9 typed the report with the word program, submitted to the Whatsapp group (note for points 1, 2, 4, just write the URL address). 10). upload each student's assignment to youtube. This kind of learning creativity is a hallmark of the STEM approach and learning in the Industrial Revolution 4.0 era that involves cyber. submitted to the wa group (note for items 1, 2, 4, just write the URL address). 10). upload each student's assignment to youtube. This kind of learning creativity is a hallmark of the STEM approach and learning in the Industrial Revolution 4.0 era that involves cyber. submitted to the wa group (note for items 1, 2, 4, just write the URL address). 10). upload each student's assignment to youtube. This kind of learning creativity is a hallmark of the STEM approach and learning in the Industrial Revolution 4.0 era that involves cyber.

3.3 Data Analysis

The pre-test and post-test data from 52 students can be seen in Fig 1. The pre-test and post-test data from the limited field test activity were carried out using the formula from Hake (1998) N-Gain. The result of the calculated score $\langle g \rangle$ from the pretest and posttest data is 0.937. This means a limited trial of the learning e-module chemistry STEM approach for the Chemistry Education Entrepreneurship course, Faculty of Teacher Training and Education, Universitas Sriwijaya is very high, because the score $\langle g \rangle$ is bigger than the N-Gain-table Index which is 0.700.

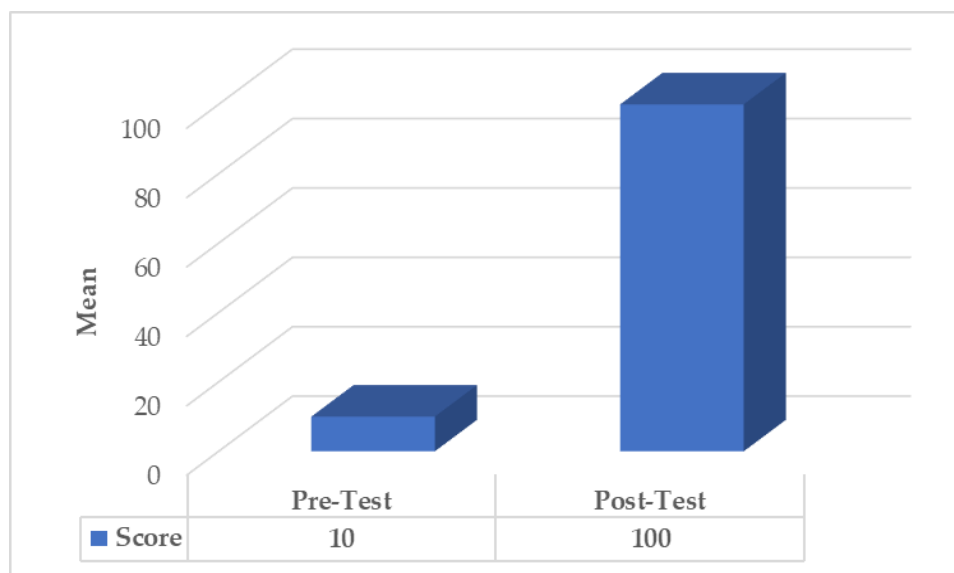


Fig 1. Pre-test and post-tests results of limited field test

Fig 1 shows that the mean score of 10.0 (scale 0–100) from the initial test results (pretest) from students before reading and using the e-module learning chemistry with the STEM approach to the Entrepreneurship course in Chemistry Education, Teacher Training and Education Faculty, Universitas Sriwijaya in the Industrial Revolution Era 4.0. The average score of 100.0 from the results of the final test (posttest) from students before reading and using the e-module chemistry learning STEM approach for the Entrepreneurship course in Chemistry Education, Faculty of Teacher Training and Education, Universitas Sriwijaya, in the

Industrial Revolution Era 4.0. The results of the calculation of the significance of the initial test and the final test obtained an N-Gain of 0.937 which means that the high category of differences in learning outcomes is a limited.

3.4 Take Home Work

At this stage, the respondent or the student designs a free-range chicken egg productivity business. One example is reported by the following respondent. 50 respondents making business plans with different types of feed for laying hens. Respondent LM numbered 14 from the attendance list for the Academic Year 2021/2022. LM wrote the title "Profit 14.7 Million From 70 Hens". LM refers to the link <https://youtu.be/jF5mexXSV1s>. The feed used in entrepreneurship or cultivation of laying hens is rice snail, where my father himself was once a breeder of chickens and also laying ducks, to get good egg results and many of my fathers often feed chickens and ducks using bran mixed with rice snails. From 10 chickens can produce 20-25 eggs per day, plus 10 ducks every morning can produce 18-25 eggs (Fig 2). The number of eggs produced not only depends on the feed given, but according to my father's personal experience the temperature, care, diet, and also the environment greatly affect the quality of the eggs that will be produced by the chickens and ducks. The chicken feed link: <https://youtu.be/XJ4sgy2VpAk>.

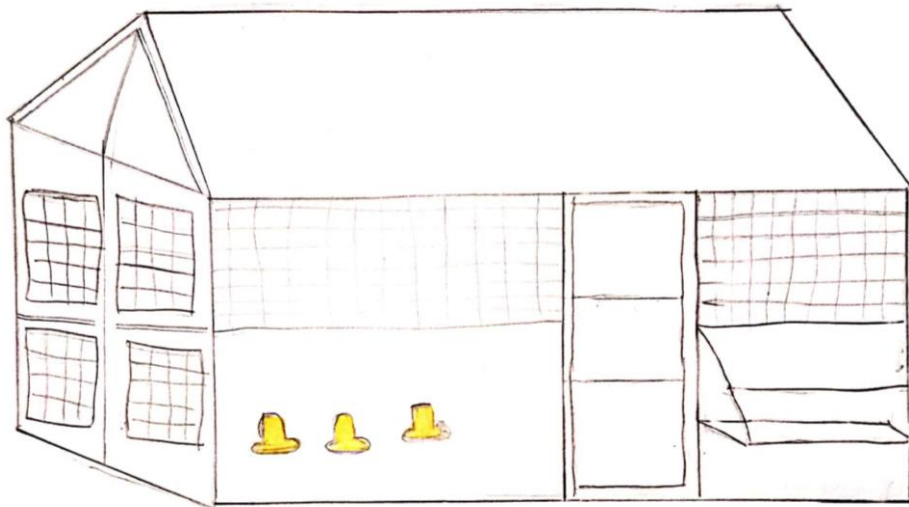


Fig 2. Design / floor plan of the free-range chicken coop

For the plan to make the chicken coop, I plan to build it on the side land not far from my house, the reason I chose this place is because the area of land that will be made of the chicken coop is quite large and also not far from the waters / ponds that are used to place ducks or chickens. The temperature of the place that is not too hot and also not too cold in my opinion is suitable if raising chickens there. Moreover, for the chicken feed itself in my place, it is quite easy to get, for example, a lot of bran usually sells it at the factory at a cheap price, there are also many rice snails there. The planned address for this laying hens entrepreneur is at: Kampai Village, Kedaton Peninjauan Raya District, Ogan Komering Ulu Regency. The creativity is the hallmark of learning with this approach STEM. These respondents or students take data and upload the results of their creativity to internet source. This is a feature of learning in the Industrial Revolution Era 4.0. The link for

the free-range chicken practicum or sample video directly can be obtained from the following link: <https://youtu.be/w11SVsm-cto>; <https://www.ayamjoper.id/size-kandang-ayam-petelur/>; <https://temonggo.com/kandang-ayam/>; <https://youtu.be/jF5mexXSV1s>; <https://youtu.be/XJ4sgy2VpAk>.

The estimated cost of laying free-range chickens is in the form of a cage with a size of 10 m² (for 50 chickens) consists of: wood/bamboo for Rp. 1,000,000; zinc for Rp. 900,000; wire for Rp. 300,000; electricity bill costs as much as Rp. 200,000/month; a place to eat chicken Rp. 100,000; chicken drinking place for 100,000; a place to lay eggs in the amount of Rp. 100,000; laying hens of Rp. 1.500.000; bran of Rp. 30.000/week; milled corn for Rp. 40,000/week; rice field snails of Rp. 10,000/week, so the total cost required is Rp. 4.680.000,-. That said, three million six hundred and eighty thousand rupiah. After selling the product, the profit is Rp. 5,195,000/month.

4. Conclusion

This research has produced N-Gain data of 0.937, it can be interpreted that there is an effect in student learning outcomes after using free-range chicken egg productivity topic-STEM approach e-module for the Chemistry Education Entrepreneurship Course, Faculty of Teacher Training and Education, Universitas Sriwijaya. LM students as respondents have reported examples of creativity in business plan as a result of using free-range chicken egg productivity topic-STEM approach e-module for the Chemistry Education Entrepreneurship Course.

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