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STEM-Based Entrepreneurship Learning Design Using Textile Circuit Clothing Decoration for Vocational Education Students

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***Abstract*: This study aims to determine the STEM-Based Entrepreneurial Learning Design Using Textile Circuit Clothing Decoration for Vocational Education students. The method used in this research is research and development research and development (R&D) methods; the object of research is lecturers who teach entrepreneurship courses and vocational education students who take technopreneurship courses. Expert validation is obtained through the validator's response by providing a validation sheet. The technopreneurship learning device in this study was declared very feasible based on the average percentage of media and material aspects. The stages of developing technopreneurship learning tools are obtained through an integrated systematic STEM which is carried out through the use of Clothing Decoration Textile Circuit for Vocational Education students as the primary form of activity.**

***Keywords*: entrepreneurship, STEM, Vocational, Technology Entrepreneurship, Textile Circuit**

I.INTRODUCTION

Students studying in higher education must be prepared to become real learners who are skilled, flexible, and tenacious [1]. Along with this, a generation that is ready and cultured must be prepared. For this reason, the Ministry of Education and Culture launched a policy related to the learning process in universities. The policy is MBKM which is a framework to make students become strong scholars, relevant to the needs of the times, and ready to become leaders with a high national spirit [2].

Makassar State University UNM, as an integral part of the Ministry of Education and Culture, responds and takes part in implementing the MBKM program (8 programs). Quality people are not only ready to work but also have the potential to become entrepreneurs who will create jobs and contribute to increasing the number of entrepreneurs ratio [3].

We need a way of learning skills that can be integrated with other sciences through STEM learning (scoot, 2012). STEM is an approach that is shown in the learning process that integrates 4 (four) domains, namely science, technology, engineering and mathematics [4]. STEM is an elemental design or design of learning activities that are directly applied to real-life solving problems as done by scientists and engineers through an interdisciplinary approach [5] [6].

The idea of integrating stems into learning in higher education is one of the efforts to increase interest and work skills in the 21st Century and to be involved in stem fields, especially those related to technopreneurship [7]; [8]. One of the lessons that can integrate 21stCentury Skills is STEM - Science, Technology, Engineering, and Mathematics [9].

Based on survey activities and initial analysis conducted in vocational study programs at FT UNM [10], no one has used STEM-based technopreneurship learning. Based on the results of the survey conducted, it is necessary to have learning that is able to prepare vocational students to face the challenges of the 21st Century.

One effort that can be made is to provide student learning experiences in the field of technopreneurship through STEM-based learning. STEM-based learning is carried out by integrating technology entrepreneurship through textile circuits. The industrial revolution 4.0 is an indicator of the strengthening role of information technology that can be used to build digital entrepreneurship [11]. business adjustments to changes that occur in the global market must apply elements of digital entrepreneurship in business [12].

The practice of digital transformation is usually used in a business context. The introduction of digital technology has sparked the creation of new business models and revenue streams. Emerging technologies such as artificial intelligence (AI), cloud computing and the Internet of Things (IoT) are accelerating transformation, while underlying technologies such as data management and analytics are required to analyze the vast amounts of data generated by digital transformation. Table 1 shows the transformation of technology in the field of entrepreneurship.

Table 1. Alternative forms of technology and technopreneurship [13].

Typology	Technology Behind the Opportunity	Key Activities in the Process	Access to Resources and Funding
Technology Entrepreneurship	New products based on breakthroughs in research; science-based advances through specific knowledge in an academic field Example: Graphene	Technology proof of concept: first customer validation; activate a global but niche market (Clarysse et al., 2011)	Public research grants and other soft money sources Venture capital attracted by promising intellectual property (Audretsch et al., 2012; Giones & Miralles, 2015)

Entrepreneurship is meant to achieve the target. Students are able to analyze the budget for investment costs and operational costs, profits, and constraints and are able to predict challenges and opportunities and predict community responses. For this reason, it is necessary to have a learning design that forms the basis for student activities. Learning devices are designed to assist lecturers or teaching staff in providing learning experiences involving mental and physical processes produced from interactions between students and environmental lecturers and other learning resources in order to fulfil competency achievement [14]. Therefore, in choosing the content of entrepreneurship teaching materials, content that contains aspects of technology entrepreneurship must be considered

II. LITERATURE REVIEW

Technopreneurship Learning

The staff of the Directorate General of Higher Education, Ministry of Education of the Republic of Indonesia, Directorate General of Higher Education means that learning is the core of the educational process in educational institutions. In a broader context, entrepreneurship learning is education that teaches humans to be able to develop their own business activities, as expressed by [15].

The purpose of learning entrepreneurship at the tertiary level is none other than to create employment opportunities. For this reason, universities provide a very large contribution and have an important role in developing entrepreneurship education. Universities have human resources with competence and analytical skills so that they are able to create high-value Small and Medium Enterprises [16].

Entrepreneurs are people who want to live freely and independently, not depending on the mercy of others [15]. They want to make their own money. Money earned by your own strength and effort. They have to create something new or add value to something worth selling or giving away. In business activities, His independent behaviour and attitude are able to combine innovation, creativity, problem-solving, and opportunity-seeking. At the same time, Technopreneurship is a person's ability to develop an entrepreneurial spirit by utilizing technology both in the manufacturing and marketing processes in accordance with their respective expertise competencies [17]. Technopreneurship comes from the combination of two words, namely technology and entrepreneur. Technology is the use of progress in business development, while entrepreneurship is a person's ability to provide economic added value for the goods and services he sells. Thus, Technopreneurship is an aspect of technical integration where the entrepreneur is the main object supported by established technology to create new jobs [18].

STEM is defined as an approach to teaching and learning between two or more STEM components or between one STEM component and other disciplines [19]. The STEM learning approach in this study refers to the definition given by [19], which integrates the concept of entrepreneurship in teaching and learning science education in schools.

STEM

Although STEM concepts and entrepreneurship are linked, students develop entrepreneurial skills and support STEM through science and engineering-based activities from the STEM disciplines of the science curriculum that examine the impact of STEM activities. You are expected to have a positive attitude. Students have a very limited entrepreneurial spirit and skills. For example, [20] study explored the impact of her STEM activities based on the 6E learning model on fifth graders' entrepreneurial skills, attitudes towards STEM, and career interests. Additionally, the literature review points to a need for research and activities that provide teachers with examples of how to use entrepreneurial skills in STEM activities. This study investigates the impact of an entrepreneur's STEM activities on entrepreneurial skills and perceptions of her 7th-grade students. By blending entrepreneurial skills with her STEM-based activities in the National Science Curriculum, she aims to help individuals adapt to educational change in the 21st Century.

Technology Entrepreneurship

Technology is a way or method to process something, so that cost and time efficiency occurs so that it can produce a higher quality product. The basics of creating technology are market needs, solutions to problems, application of various scientific fields, improvement of production effectiveness and efficiency, and modernization. Technology is part of the solution needed to meet opportunities [21]. So technology is only one of the five necessary aspects of entrepreneurship. Technology is not everything in technopreneurship. research and commercialization must be considered two important things in defining technopreneurship (technology entrepreneurship)[21]. Research is discovery and addition to science. Commercialization can be defined as the transfer of research results or technology from the laboratory to the market in a profitable way. There are several ways to commercialize a technology: licensing, partnering, or selling it to other parties who will commercialize it. The basics of creating technology are market needs, solutions to problems, application of various scientific fields, improvement of production effectiveness and

efficiency, and modernization. There is a difference between ordinary entrepreneurship and technopreneurship (technology entrepreneurship). Technology entrepreneurship must be successful in two main tasks: ensuring that the technology functions according to the target customer's needs and that the technology can be sold at a profit. Ordinary entrepreneurship generally only deals with the second part, selling for a profit.

Thus Technopreneurship or technology entrepreneurship is a series of combined innovation and technology activities, the dynamics of the development of science and technology with entrepreneurship. Technology entrepreneurship combines software systems, hardware, and network technology (referred to as intelligent computing technology) to enhance entrepreneurial services. The importance of sensors, networks, algorithms, and other technological advances in entrepreneurship is to design, build and maintain the business environment and infrastructure [22]. The entrepreneurial process emphasizing technology starts from limited resources to bring profits through business processes. Entrepreneurial creation is closely related to technological innovation or technology-oriented entrepreneurship.

III. METHODS

The method used in this research is the research and development research and development (R&D) method of the subject, and this researcher is a lecturer in the subject and vocational education students at the Faculty of Engineering, UNM, who have taken technopreneurship courses. Expert validation is obtained through the validator's response by providing a validation sheet. The validation sheet used aims to determine the response and validity of the STEM-Based Entrepreneurial Learning Design Using Textile Circuit Clothing Decoration for Vocational Education students. The device's validity was obtained through the content and construct validity results. Content validity was obtained from the suitability of the STEM-based learning tools developed with Competency Standards, Indicators, and entrepreneurship course materials studied by students. For construct validity, it was obtained from the opinion of experts regarding the purpose of the STEM-Based Entrepreneurial Learning Design Using Textile Circuit Clothing Decoration for Vocational Education students, which was developed. Meanwhile, the product practicality criteria are assessed based on student interest questionnaire data, and the response of the course tutors to the learning tools developed.

IV. RESULTS AND DISCUSSION

Research procedure

The research procedure is a step-by-step activity taken in research. The activity steps in this research include three stages, namely 1) The preparation stage to make observations, study literature on the material that is the topic of research, determine course learning outcomes, prepare semester learning implementation plans (RPS), prepare teaching materials, and develop assessment instruments. Understanding concepts and making answer keys; 2) The implementation stage, where the researcher goes directly to the field where the research and sampling are done, give a pretest, carries out learning using scenarios or STEM learning designs on topics using textile circuit decorations; 3) The reporting stage is for analyzing and processing research data and reporting research results. Initial observations that have been made are that the condition of entrepreneurship courses in the department of electronic engineering education, Faculty of Engineering, Makassar State University, is that there are no STEM-based entrepreneurship learning tools.

Design Stage

The design stage is intended to produce an initial draft related to the product before it is developed. The designed device is in the form of syllabi, lesson plans, and test instruments integrated with STEM systematics and arranged as a means for students to develop problem-solving skills through Textile Circuit Decorations. Technology entrepreneurship creates prerequisites that enable efficient digital technology transformation by implementing various technological innovations.

Learning activities apply entrepreneurship learning using Textile Circuit Clothing Decoration with a STEM approach. Learning activities apply the STEM learning model. The steps for developing STEM-based learning tools become a reference for the learning steps in the RPS. This is in line with [23] that learning activities refer to the syntax of the learning model selected based on students' characteristics and the appropriate material's suitability. Learning activities refer to the disciplines of science, technology, engineering, mathematics, and science entrepreneurship. STEM steps become a reference for learning steps in RPS. This stage point produces a STEM learning plan. The stages of developing entrepreneurship learning tools are obtained by determining the systematic determination of STEM integrated entrepreneurship which is carried out through modification of textile circuits through 3D printing as the primary activity is to market products using smartphone applications. This is done as an Apperception step in learning that is used to increase interest in learning [24].

Figure 1. Modification of the textile circuit which is used to carry out entrepreneurial product activities

The following is the process of integrating STEM-based entrepreneurship learning.

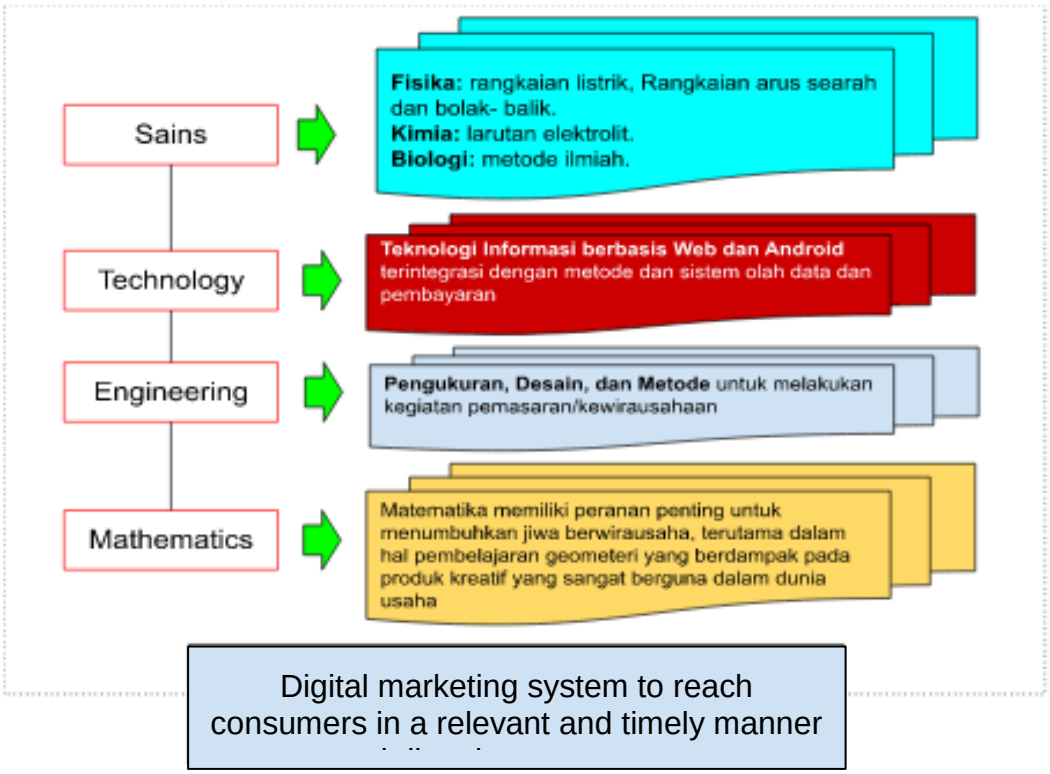

Figure 2. STEM Integration Process with Technopreneurship courses

Development Stage

The development of learning tools is based on several stages according to the development framework of this stage. Initial information in problem identification is analyzed and then developed through STEM-based entrepreneurial learning device design.

This stage is the stage of making a product based on the design result, and then a feasibility test is carried out so that an assessment is obtained from an expert validator. Expert validators consist of lecturers in the field of vocational and vocational education, lecturers in the field of entrepreneurship, and lecturers in the field of multimedia design. The final stage of the development process is evaluation. The results will be the basis for making decisions about two things: how valid the textbooks developed are and which parts are still weak and need to be revised.

Design expert validation data

Aspects assessed by design experts include book size, cover design, and book content design. In this study, the appointed expert was a lecturer from the Department of Electronic Engineering Education. Based on the results of the design expert's evaluation seen in the aspect of book size obtained a percentage of 75% in the good category, the book cover design aspect obtained a percentage of 92.5% in the very good category, and the design aspect of the book content obtained a percentage of 95.5 % in the very good category. The results of the design expert's evaluation of the total percentage obtained 87.6% in the "very good" category. The results of the study in the form of a bar chart are shown as follows (Fig.3):

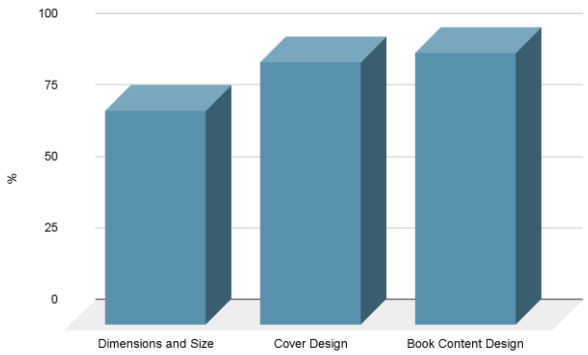

Figure 3. Diagram of Design expert validation results

Content Expert Validation Data

In this study, the expert appointed as the validator was a lecturer from the Department of Electronic Engineering Education. The data from the evaluation of content experts seen in the content validity aspect obtained a percentage of 80.9% in the very good category; the presentation feasibility aspect obtained a percentage of 91.6% in the very good category. The language assessment aspect obtained a 75%. in the good category. The content expert's evaluation of the total percentage obtained 82.5% in the very good category. The results of the study in the form of a bar chart are shown as follows (Fig.4):

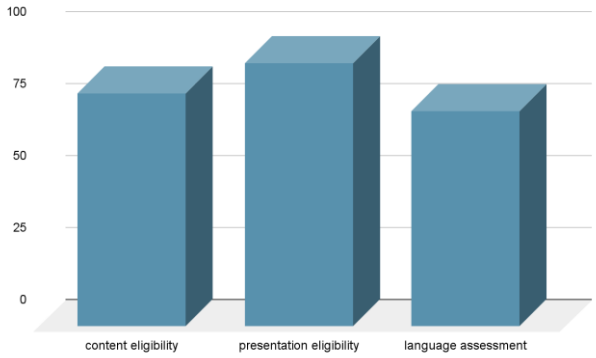

Figure 4. Diagram of Content Expert Validation Results

Student Response Questionnaire Results Data

Based on research conducted on students, responses to problem-based entrepreneurship textbooks reached 79.3% in the good category. It can be interpreted that students stated that the entrepreneurship textbook in the good category was used as teaching material for entrepreneurship courses. Aspects assessed by students include aspects of appearance, presentation of material, and benefits. In this study, 25 Electronic Engineering Education Department students were tested. The data obtained from the student responses obtained from the display aspect obtained a percentage value of 85.4% in the very good category, the presentation aspect of the material obtained a percentage value of 75% in the good category, and the aspect of benefits with teaching materials obtained a percentage value of 77.2% in the good category, the results of student responses from the total percentage obtained 79.3% in the good category. The results of the study in the form of a bar chart are shown as follows (Fig.5):

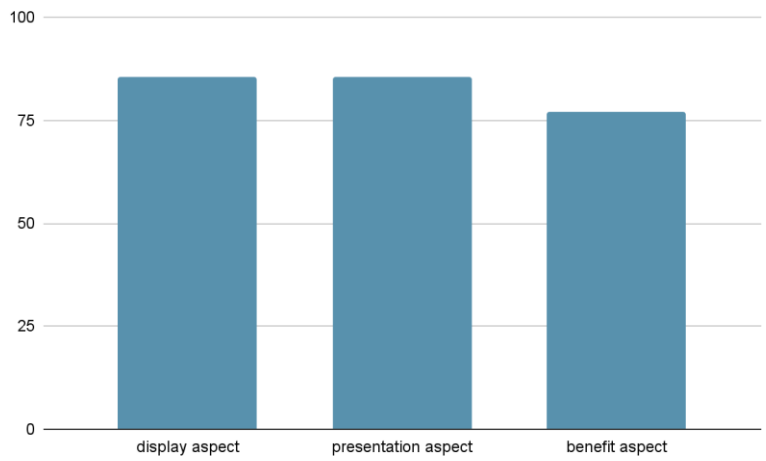

Figure 5. Diagram of Student Response Results

The Results of Entrepreneurial Lecturers' Responses to the Development of Learning Devices in Vocational Education Through the STEM Approach Using Textile Circuit Clothing Decoration

The course lecturers consist of 2 people who assess the feasibility of the developed model by providing instruments to fill out. Based on the lecturer's responses, a very good assessment was obtained, especially regarding stem integration in entrepreneurship learning (Fig.6). For aspects of the formulation of learning objectives obtained a score of 4 or criteria Good; for aspects of quality obtained a score of 4.66 or very good criteria; for aspects of effectiveness obtained a score of 4.33 or criteria Very Good; for aspects of presentation (STEM Approach) obtained a score of 4.33 or very good criteria, entrepreneurial Technology Integration Aspect obtained a score of 4.66 or with very good criteria. Thus, the average total score of Entrepreneurship Lecturers' responses to the development of learning tools in Vocational Education through the STEM Approach Using Textile Circuit Clothing has obtained score of 4.39 (very good criteria).

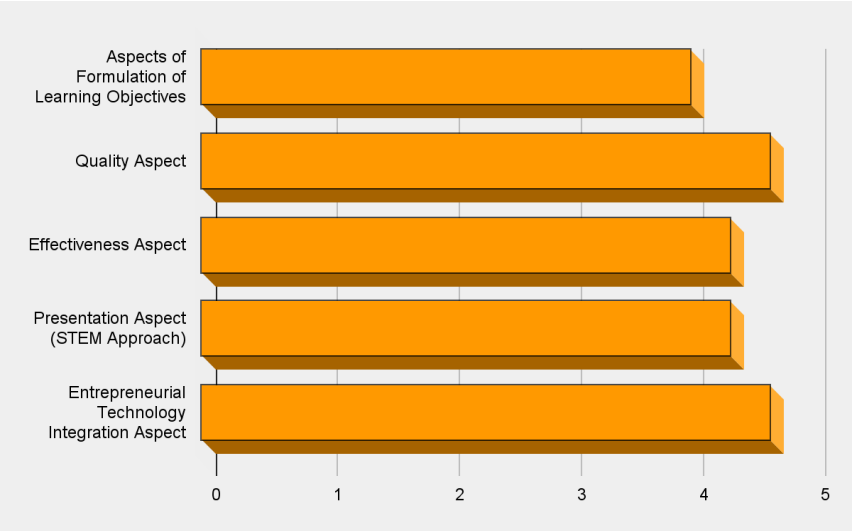

Figure 6. Assessment results of course lecturers on the development of STEM-based Technopreneurship Learning Tools

V. CONCLUSION

STEM-Based Entrepreneurial Learning Design Using Textile Circuit Clothing Decoration For Vocational Education students, it is stated that it is very feasible based on the average percentage of media and material aspects. The stages of developing technopreneurship learning tools are obtained through the determination of STEM systematics that integrates entrepreneurship which is carried out through the manufacture of circuit textile technology as the main activity. The results of the design expert's evaluation of the total percentage obtained 87.6% in the "very good" category. The content expert's evaluation of the total percentage obtained 82.5% in the very good category. The results of student responses from the total percentage obtained 79.3% in the good category. Furthermore, the Entrepreneurial Lecturer's Response to the Development of Learning Devices in Vocational Education through the STEM Approach Using Textile Circuit Clothing Decoration obtained a score of 4.39 (very good criteria).

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