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A Systematic Review on Chemo-entrepreneurship

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Abstract. Written briefly in English in one paragraph of 150-250 words, containing background, research objectives, methodology, results & important findings of the study.
The purpose of this study is to determine research trends related to Chemo-entrepreneurship, which is beneficial in developing learning models that are in line with the independent learning curriculum. This study is a systematic literature review of Chemo-entrepreneurship from 47 articles indexed by Scopus and Google Scholar published between 2010 – 2022. The findings show that the area where Chemo-entrepreneurship is researched the most is the city of Semarang. The most widely used material in Chemo-entrepreneurship research is colloids. The most common type of research related to Chemo-entrepreneurship is development research. Research related to Chemo-entrepreneurship is mostly done at the Senior High School. The journal that publishes the most articles on Chemo-entrepreneurship is the innovative journal of science education. Most of the research institutions that conduct research on Chemo-entrepreneurship are from Semarang State University. There is no research on Chemo-entrepreneurship associated with 21st century skills, Chemo-entrepreneurship-Education for Sustainable Development (ESD), Chemo-entrepreneurship-environmental education, Chemo-entrepreneurship-STEM, and Chemo-entrepreneurship-green deal. From several analyzes in this literature review, we suggest analyzing topics that are still rarely studied for further study.

Key words: CEP; chemistry; entrepreneurship; review.

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INTRODUCTION

The discourse of curriculum transition from the 2013 curriculum to an independent curriculum is increasingly being carried out. Independent curriculum or previously known as prototype curriculum. The independent curriculum was developed as a foundation for a more flexible curriculum, focusing on basic materials and developing students' character and abilities. The main characteristics of the independent curriculum are: (Kemendikbud, 2022): project-based learning, prioritizing important materials so that they have sufficient time to deliver materials, such as literacy and numeracy, and the flexibility of teachers in carrying out learning tailored to students' abilities and local wisdom. In addition, the independent curriculum is based on a project to strengthen the profile of Pancasila students. This means that students are given in-depth opportunities to explore science, develop skills, and strengthen the development of the six dimensions of the Pancasila student profile. Through the project, students have the opportunity to study important issues, such as tolerance, culture, entrepreneurship, and others.

Project-based learning is a learning model that emphasizes students to do a project and produce a product (Ardianti et al., 2017). Learning by doing will provide a meaningful experience because students are required to develop creative concepts and skills so that they can solve the problems they face by referring to the four pillars of education in general. The four pillars are learning to know, learning by doing, learning to live together, and learning to be themself (Arisanti et al., 2017). Based on this description, project-based activities are expected to train students to take real action on the latest issues in accordance with student learning developments, so that students are inspired to become useful human beings in society.

Project-based learning can be applied to each subject. In project-based learning chemistry, one of them can be applied through Chemo-entrepreneurship learning. Chemo-entrepreneurship-based Chemistry Learning or what is usually abbreviated as CEP is Chemistry learning that is associated with entrepreneurship (Prayitno et al., 2015). Chemo-entrepreneurship-based learning teaches about the manufacture, packaging and marketing of

products related to the topic being taught. So in addition to learning the essential materials, Chemo-entrepreneurship-based learning can train students in entrepreneurship. With the provision of entrepreneurship, it is hoped that after completing their studies students can develop themselves into chemical entrepreneurs.

Chemo-entrepreneurship is one type of project-based learning model development. Chemo-entrepreneurship comes from the words chemistry and entrepreneurship. Based on these two words, chemo-entrepreneurship can be defined as a chemistry learning approach that links the material being studied with entrepreneurship. Marganingsih & Pelipa (2019) defines that chemo-entrepreneurship is an approach that is carried out through learning scenarios that can bring student entrepreneurial ideas to life. Entrepreneurship learning scenario is to apply subject matter by making entrepreneurial projects from starting to making products, packaging and selling these products. Through the CEP approach, students are expected to be more creative, active, and innovative in learning (Lestari, 2019). Chemo-entrepreneurship-based learning can equip students in communicating (Prayitno et al., 2020), collaboration (Pratiwi et al., 2018), creative thinking skills (Rahmazatullaili et al., 2017) (Yustina et al., 2020), creativity (Sari & Angreni, 2018), critical thinking (Insyasiska et al., 2015). This shows that chemo-entrepreneurship-based chemistry learning can support successful learning in the 21st century.

This review is focused on articles that discuss chemo-entrepreneurship or chemoentrepreneurship. The purpose of this study is to find out the considerations made by researchers in choosing a theme about chemo-entrepreneurship from 2010 - 2022. In addition, this study also aims to answer questions about: 1) where is the location of research on Chemo-entrepreneurship most often conducted? 2) what topics or materials are used the most in Chemo-entrepreneurship research?; 3) what types of research/independent variables are most often used in Chemo-entrepreneurship research?; 4) what level of education is the most widely used for Chemo-entrepreneurship research; 5) Which journals publish the most articles related to Chemo-entrepreneurship?; and 6) Which agency conducts the most research on Chemo-entrepreneurship?

Based on the initial analysis related to Chemo-entrepreneurship using the software vos viewer, it is obtained an illustration that research on Chemo-entrepreneurship has been carried out, both on the development of teaching materials and the effectiveness of Chemo-entrepreneurship-based chemistry learning, it's just that there are many studies on the development of teaching materials or the effectiveness of learning. Chemo-entrepreneurship-based chemistry, research sites, research or development materials, research variables, research levels, published journals, and research institutions cannot be analyzed in detail. For this reason, it is necessary to review articles related to Chemo-entrepreneurship further in order to be able to answer some of the questions above. The results of the initial analysis using the vos viewer software are presented in Figure 1.

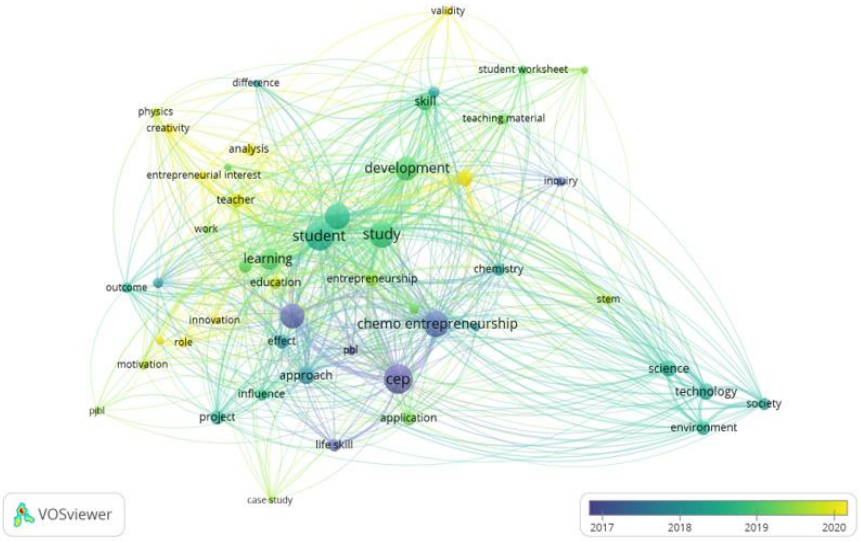

Figure 1. Results of Chemo-entrepreneurship Analysis with Vos Viewer

The vos viewer software was chosen because this software can see the topic maps that appear based on categories, and see the strength of the lines that connect between topics, based on the number of repetitions of topics that have been studied previously (Marwantika, 2015). Based on the description above, the benefits of this research are to provide information to the public about 1) the locations of research on Chemo-entrepreneurship that are most often carried out, 2) topics or materials that are most widely used in Chemo-entrepreneurship research, 3) types of research/variables independent most frequently used in Chemo-entrepreneurship research, 4) the most widely used educational level for Chemo-entrepreneurship research, 5) the journal that publishes the most articles related to Chemo-entrepreneurship, and 6) the institution that conducts the most research on Chemo-entrepreneurship. Entrepreneurship.

METHODS

Research Strategy

This research is a literature study on Chemo-entrepreneurship. This research begins by searching for articles related to Chemo-entrepreneurship through the publish or perish software developed by Harzing. Publish or Perish software has the ability to quickly find articles with the same theme, making it easier for researchers to find hundreds to thousands of articles to be analyzed. The keywords used in the article search are Chemo-entrepreneurship or Chemo-entrepreneurship by selecting the publication time range between 2010 – 2022. The article search was carried out on March 24, 2022.

Article Selection

The article search results using the publish or perish software obtained as many as 494 articles indexed by Google Scholar and 5 articles indexed by Scopus. Of the 499 articles obtained, not all of them are related to Chemo-entrepreneurship, so a sorting process is needed. The results of sorting titles related to Chemo-entrepreneurship obtained 57 articles. Of the 57 articles that were sorted by title, they were then re-sorted based on articles about Chemo-entrepreneurship published in national, international or procedural journals. Based on the results of the sorting, 47 articles were obtained about Chemo-entrepreneurship. Furthermore, from the 47 selected articles, further analysis was carried out regarding the place/location of research implementation, research topics/materials, types of research/independent variables studied, educational level where research on Chemo-entrepreneurship is often carried out, as well as journals that most frequently publish articles on chemo-entrepreneurship.

The stages of selecting articles to be analyzed are based on: 1) articles published in national, international or procedural journals. article type. Scientific works in the form of a thesis or repository are not included in further analysis. 2) articles that discuss Chemo-entrepreneurship or Chemo-entrepreneurship; and 3) articles are accessible or downloadable. If there are articles that cannot be downloaded or opened, they are not included in the analysis. The steps in searching for articles through publish or perish software are presented in Figure 2.

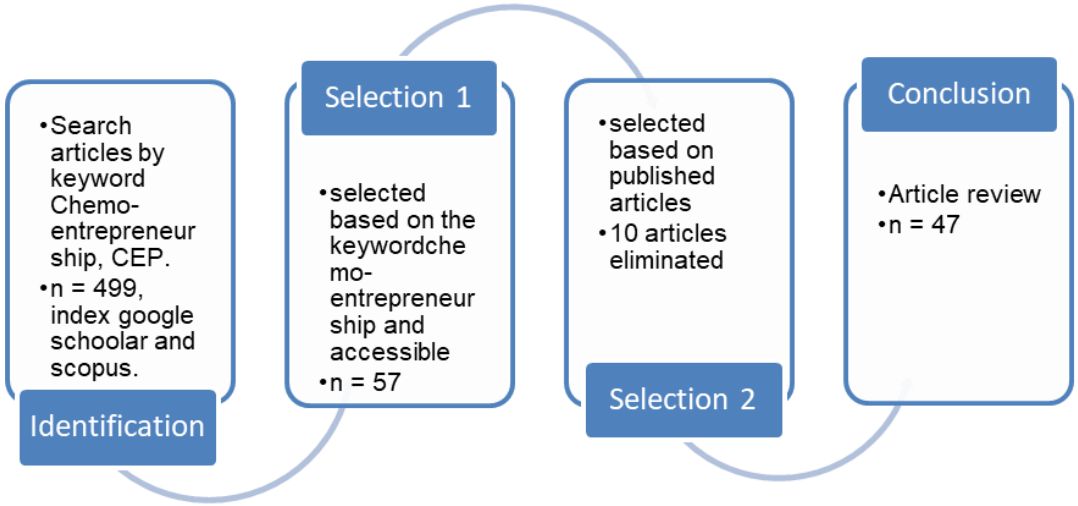

Figure 2. Article Search Illustration

RESULTS AND DISCUSSION

Research Site Analysis

Based on the 47 articles analyzed, there were 7 articles that did not mention where the research was carried out. Articles that do not mention the place of research are articles of research and development. Based on 40 articles that mention the place where research on Chemo-entrepreneurship is carried out, the city of Semarang is the most widely carried out place. There are 7 studies conducted in the city of Semarang, 4 studies in the city of Padang and 4 studies conducted in the Regency of Rembang. The results of research related to Chemo-entrepreneurship based on the research location can be seen in Figure 3.

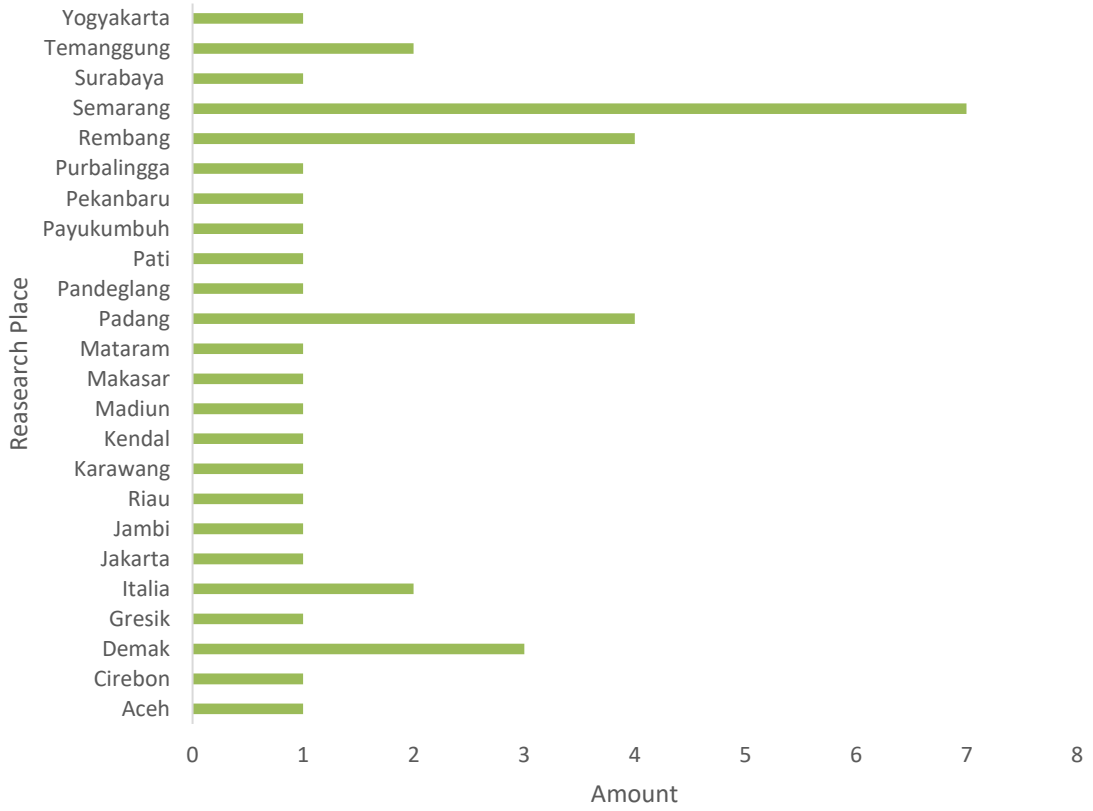

Figure 3. The Most Dominant Research Locations

The choice of a place to conduct research is very important, because each region has different characteristics. The different characteristics of each area can affect the type or model of learning that will be carried out in schools or madrasas. The background of research on Chemo-entrepreneurship from various research results both in the city of Semarang, Padang city, and Rembang Regency is low student learning outcomes. (Wildana et al., 2022; Rulianty et al., 2018), there is no combination of Chemistry lessons or Chemistry practicum with entrepreneurship (Sumarti, et al., 2018; (Rabialdi & Dj, 2019)Rosyadi & Gazali, 2019; Prayitno et al., 2017), textbooks are limited and damaged, and learning has not equipped students' soft skills (Ruliyanti et al., 2020; Farkhati & Sumarti, 2019; Sumarti et al., 2018). Based on some of the things above, it is concluded that the selection of research sites is basically done by looking at the condition of students in a particular class or school. The school used for Chemo-entrepreneurship research is a school that has fairly good facilities, but there are other things that cause research to be carried out at the school. There are currently no “flagship” or “peripheral” schools, as student recruitment is based on zoning. It's just that the facilities of each school are still much different, especially public and private schools.

The Most Dominant Subjects

The subject or subject matter of Chemistry which is most often used in Chemo-entrepreneurship research is colloids. Based on the analysis, it can be identified that there are 9 studies on the topic of colloids, 4 studies on the topic of acids and bases, and 4 studies on the topic of colligative properties of solutions. Some of the topics that have been studied in Chemo-entrepreneurship-based Chemistry learning can be seen in Figure 4.

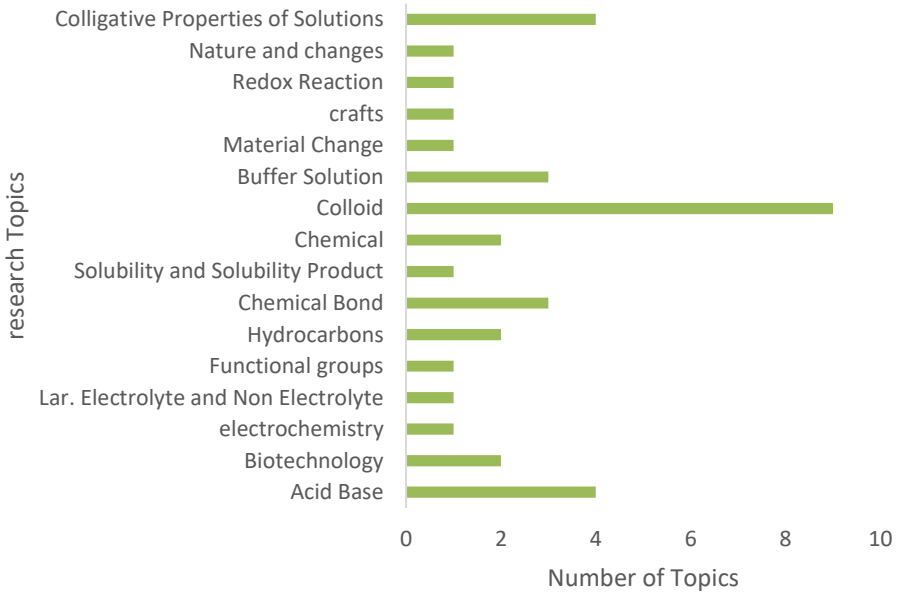

Figure 4. Lesson Materials in Chemo-entrepreneurship Learning

The selection of chemistry topics/materials in research is generally based on the timing of the research and the retrieval of material that is relatively easy to relate to contextual science. Colloids are the last material in Chemistry class 11 semester 2, so that researchers have special readiness in conducting research on colloid topics. Besides that, colloidal material is a very contextual material in studying phenomena from changes in natural material in everyday life (Setyaningsih et al., 2021). Like colloids, acid-base materials and colligative properties of solutions are two relatively easy materials when it comes to contextual learning. For example, during the acid-base learning, an entrepreneurial example of making "nata" is given by utilizing coconut water waste, soybean soaking water waste (Prayitno et al., 2015). At the time of learning the colligative properties of solutions, entrepreneurship-based Chemistry practicums were carried out such as making ice cream, syrup, and salted eggs. (Lestari, 2019). Chemo-entrepreneurship-based Chemistry lessons can also be taught on other subjects by considering the connection with nature such as making decorative candles, shoe polishing, and others. Chemo-entrepreneurship-based Chemistry learning is not only about making a product based on the topic of Chemistry, but up to the packaging and marketing or sales stages.

Dominant Research Variable

The most studied variable in research on Chemo-entrepreneurship is the development of teaching materials. Of the 47 articles analyzed, there were 14 studies developing Chemo-entrepreneurship-based teaching materials. The next most research variable is about learning outcomes as many as 10 studies, and the effectiveness of chemo-entrepreneurship learning on entrepreneurial interest as many as 10 studies. In full, the independent variables studied in the Chemo-entrepreneurship research can be seen in Figure 5.

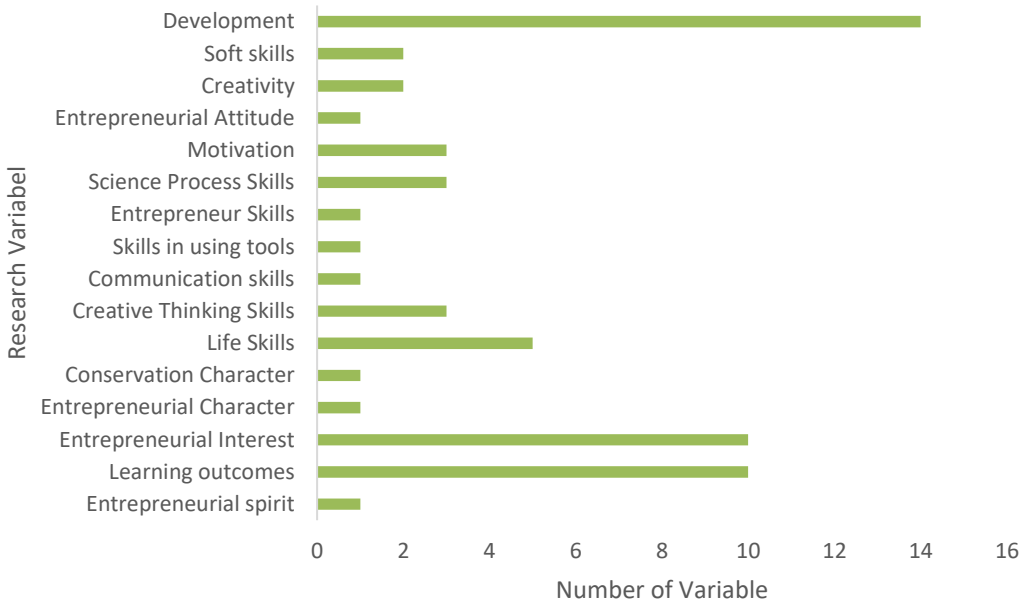

Figure 5. Research Variables in Chemo-entrepreneurship Research

Most of the variables studied in Chemo-entrepreneurship research are development. The development research carried out consists of developing learning modules (Giri et al., 2020; Lestari, 2019; Annisa & Sari, 2021; Andrean et al., 2019; Safriani & Lazulva, 2021), student handbook development (Puspasari & Kamaludin, 2020; Nirwana & Yenti, 2021; Jamilah & Agus Kamaludin, 2019), teaching materials (Wildana et al., 2022), and Chemo-entrepreneurship-based practical instructions (Ainun Najib & Misrochah, 2020; Wijayanti et al., 2020; Pinta et al., 2018).

The second and third most frequently used variables are entrepreneurial interest and learning outcomes. Interest is a person's desire to like something based on the events he experiences. The existence of Chemistry education that is associated with entrepreneurship has an impact on students to like chemical entrepreneurship. Students who think that chemistry is only a subject that relates scientific concepts can actually be associated with very interesting entrepreneurship. Students' interest in the Chemo-entrepreneurship-based learning model will indirectly foster student learning motivation, which in turn can improve student learning outcomes. Chemo-entrepreneurship research related to entrepreneurial interests has been carried out by Ulhaq et al., (2021); Triawan et al., (2017); Ismulyati & Ikhwani, (2018); and Setyaningsih et al., (2021), while research on learning outcomes was carried out by Arfin et al., (2018); Artani et al., (2021); Rosyadi & Gazali, (2019) with research results that Chemo-entrepreneurship learning is effective in improving student learning outcomes.

Educational Levels in Chemo-entrepreneurship Research

Educational level is the level or level of education in Indonesia, starting from Elementary School (ES), Junior High School (JHS), Vocational High School (VHS), Senior High School (SHS), and Universities. Based on the results of the analysis, the most research on Chemo-entrepreneurship is carried out at the SHS level, which is 35 studies, then at VHS there are 2 studies, and 1 research is carried out at Universities. The percentage of research on Chemo-entrepreneurship at the education level can be seen in Figure 6.

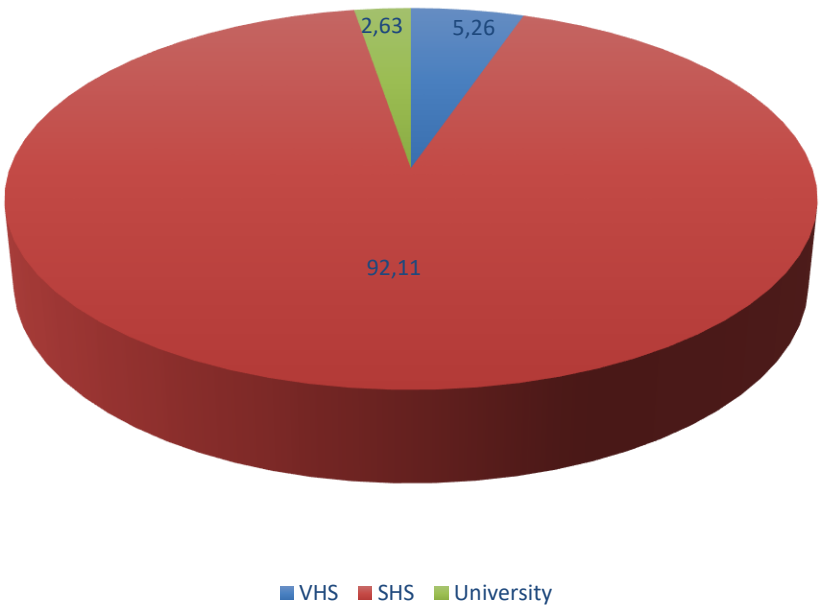

Figure 6. Percentage of Chemo-entrepreneurship Research Levels

Research on Chemo-entrepreneurship is mostly done in high school because chemistry in high school is a compulsory subject and has relatively many material concepts compared to vocational schools. In VHS, chemistry is a supporting subject with relatively few hours or subject matter, except for SMK majoring in pharmacy and health. In general, Chemo-entrepreneurship-based chemistry lessons are appropriate to apply at the SHS or VHS level because most of the SHS/VHS graduates do not continue on to university, so lessons by equipping students with soft skills or life skills are indispensable for students to compete in the world of competition. working world.

Journal with the Most Publishing Chemo-entrepreneurship

Journals are magazines that specifically contain scientific articles in certain fields of science which are published regularly. Based on the results of the analysis of articles, the three national journals that publish the most about Chemo-entrepreneurship are the journal of innovative science education, chemistry in education, and the journal of chemical education innovation, respectively. The journals that have published research results on Chemo-entrepreneurship in the last 12 years can be seen in Figure 7. The journal of innovative scene education has a focus and scope on learning, current issues and trends, learning science in everyday life, teacher education science, science education policy, and science education and studies.

Chemistry in Education is a journal that aims to provide the latest information, ideas, and opinions about the progress of chemistry education research which includes curriculum development policies, the latest research results in chemistry learning, media and evaluation, as well as related conceptual analysis of philosophy and chemistry education theory. The chemistry education innovation journal is the third journal that most often raises the theme of Chemo-entrepreneurship. The purpose of the chemistry education innovation journal is to increase the knowledge of lecturers and the academic community from various institutions in producing works on scientific literature, research results, conceptual results, and book reviews in the field of chemical technology. The three journals described above are journals that are under the responsibility of the State University of Semarang.

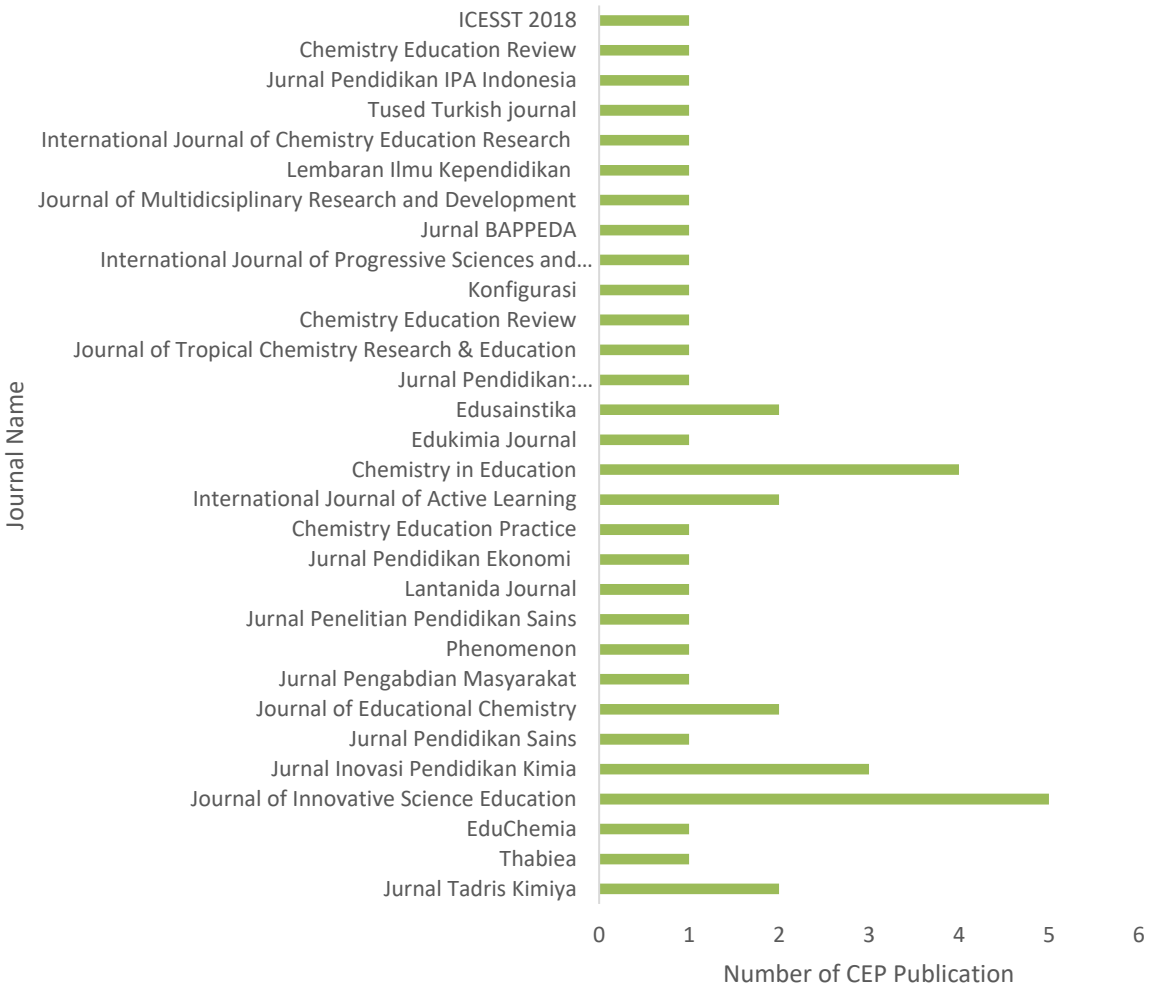

Figure 7. Journals that Publish Chemo-entrepreneurship Articles

The many results of Chemo-entrepreneurship research published in the above journals show that research on chemistry-entrepreneurship (Chemo-entrepreneurship) is an interesting research for students, both undergraduate and postgraduate students at the State University of Semarang. The impressive result is that there are still very few educational journals that publish the integration of chemistry with entrepreneurship (Chemo-entrepreneurship).

Research Agency in Chemo-entrepreneurship

This study also analyzes the origin of the research institution. The top three research institutions from Chemo-entrepreneurship research are Semarang State University, Padang State University, and Sunan Kalijaga State Islamic University, Yogyakarta. The results of the analysis of research institutions can be seen in Figure 8. The number of researchers from Semarang State University shows that research related to Chemo-entrepreneurship is quite attractive to the academic community of Semarang State University. Research on Chemo-entrepreneurship can be found in Supartono (2006) which was later developed into several further educational studies to date.

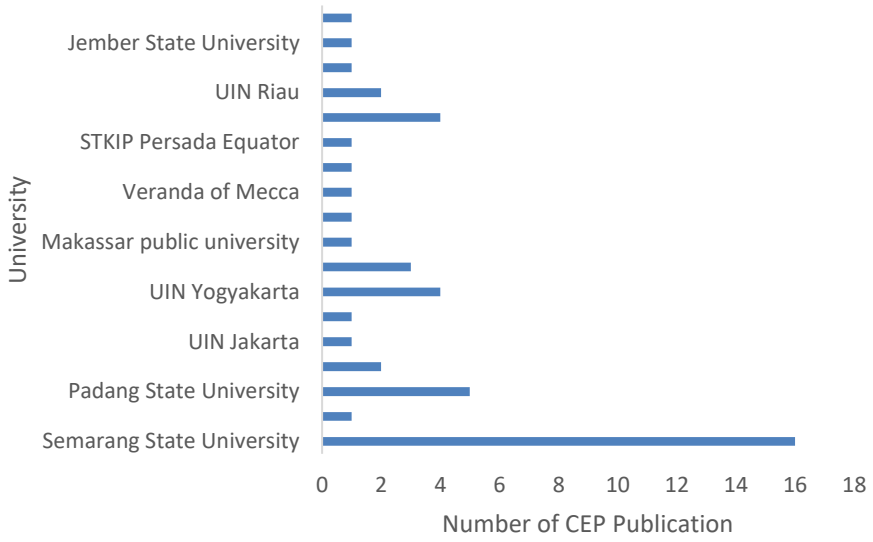

Figure 8. Origin of the Agency that Publishes Chemo-entrepreneurship Articles

Research related to Chemo-entrepreneurship is still relevant to be carried out to support the goals of 21st century education, as well as one of the learning models that can be used to support educational goals, especially in the independent learning curriculum.

CONCLUSION

There are many studies related to Chemo-entrepreneurship for the period 2010-2022. It's just that most research is still around development research. Research related to the effectiveness of Chemo-entrepreneurship learning is still limited. The effectiveness of Chemo-entrepreneurship based learning still tends to be on the assessment of interest and learning outcomes. There is still little that discusses the effectiveness of Chemo-entrepreneurship learning related to 21st century skills, namely creative thinking skills, critical thinking and problem solving, communication, and collaboration. Other studies related to Chemo-entrepreneurship that have not been studied include Chemo-entrepreneurship - Education for Sustainable Development (ESD), Chemo-entrepreneurship - environmental education, Chemo-entrepreneurship - STEM, and Chemo-entrepreneurship-green deal.

In addition, research on Chemo-entrepreneurship has not been spread evenly in Indonesia. Most research related to chemo-entrepreneurship is carried out in the city of Semarang with the most basic material being colloids. The most common type of research related to Chemo-entrepreneurship is development research. Research related to Chemo-entrepreneurship is mostly done at the Senior High School level. The journal that publishes the most articles on Chemo-entrepreneurship is the innovative journal of science education. Most of the research institutions that conduct research on Chemo-entrepreneurship are from Semarang State University.

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