Research Trends and Future Works on Student Creativity in the Context of Sustainability: A Bibliometric Analysis

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Article History:
Received date: August 1, 2023
Received in revised from: October 16, 2023
Accepted date: October 20, 2023
Available online: October 26, 2023


Abstract. Education at the university level must provide learning experiences that facilitate achieving 21st-century skills, one of which is creativity. This study aims to reveal research trends and future work related to creativity at the university level. The method used is a Preferred Reporting Item for Systematic Review and Meta-analysis Protocols (PRISMA-P) and bibliometric analysis of the Scopus database using Vosviewer software. The author selected 778 documents that were considered relevant from English-language journal articles through a selection process. The results show that research topics related to creativity in higher education are still emerging and increasing. The results of the bibliometric analysis using the co-occurrence type of analysis show that there are several dominant keywords outside the search query, including human (36), engineering education (35), critical thinking (31), innovation (28), education for sustainable development (26), and project-based learning (21). Through network visualization analysis, information on the relationship between keywords and the strength of their relationship is obtained. The visualization of overlays shows several topics that are still growing and deserve to be researched, such as entrepreneurs, virtual reality, self-efficacy, etc. Through the help of the OpenRefine software, the author can find several future works related to specific issues. Several new keywords for future research can be determined. This study concludes that bibliometric analysis through Vosviewer has successfully demonstrated trends and future work for creativity in higher education.

Keywords: Bibliometric analysis, creativity, higher education, PRISMA-P, sustainability, Vosviewer

Introduction

Creativity is one of the 21st-century skills that all students must possess at all levels of education, including prospective teachers. All courses must train and provide learning experiences that hone and familiarize students with thinking and acting creatively. Teaching creativity to prospective teacher students at the tertiary level is the capital to develop their content knowledge and skills through investigation, collaboration, connection, integration, and synthesis (Livingston, 2010). Beyond higher education, creativity is needed to survive and prosper in a complex, unpredictable, and constantly changing world.

Higher education often serves as a platform where students can develop and express their creativity. In this context, creativity is defined as the capacity to think outside the box, find innovative solutions to complex problems, and contribute to new knowledge across various fields of study (Beghetto, 2019; Borodina et al., 2019). Creativity has been
recognized as a crucial component of higher education. There is a need to understand how student creativity at this educational level has been researched and what can be learned from existing research trends.

Many studies have been conducted to explore ways to stimulate, support, and assess student creativity in higher education. Some of them through problem-based learning (PBL) (Rahmawati et al., 2018), the design of integrated mobile technology courses (Jahnke & Liebscher, 2020), project-based learning (PjBL) (Zhalalovna et al., 2020), open inquiry (Ramdani & Artayasa, 2020), class debates (Zawawi et al., 2018), knowledge sharing (Lee, 2018), and internships (Tanggaard, 2018), and open-ended experiment module (Lahra et al., 2017). However, a comprehensive overview of how the literature addresses these questions remains unclear. As such, the relevance of existing research findings related to student creativity in higher education requires a systematic evaluation to identify knowledge gaps and potential directions for future research.

In this study, through a bibliometric analysis, we aim to provide a comprehensive overview of how student creativity in higher education has been researched to date. We focus on identifying the main research trends and topics that dominate the discussions in the literature. Consequently, this research unveils novelty by mapping the current research landscape and offering recommendations for future research directions in the context of student creativity in higher education.

**Methods**

This research is a literature study. There are two methods employed in this research, namely the PRISMA-P procedure for data collection (Moher et al., 2009) and bibliometric for data analysis. It is a recommended framework to be used when planning and reporting protocols for systematic reviews and meta-analyses. Its purpose is to enhance the quality and transparency in the reporting of systematic review protocols. Sources of information obtained from the Scopus database. The research steps shown in Figure 1.
Document search process using TITLE-ABS-KEY (creativit* OR creativeness OR "creative thinking") AND TITLE-ABS-KEY (education OR curriculum* OR teaching OR learning) AND TITLE-ABS-KEY (universit* OR college OR " higher education") AND TITLE-ABS-KEY (student)). The search for documents was carried out in June 2022. At the initial search stage, 4,869 documents were obtained. Then the initial sorting process is carried out. Only papers in the 2017-2021 range are retrieved. Not including 2022 in the search process is because the number of document publications is still ongoing. Only social science, environmental science, and energy articles are taken at the screening stage. This process generates 1,297 documents.

The following process is bibliometric analysis. Seven hundred seventy-eight documents downloaded from the Scopus database were processed and analyzed with the help of VOSviewer software for further interpretation. The type of analysis chosen is co-occurrence. This type of analysis aims to map the relationship between keywords and the strength of each keyword. The unit of analysis determined is all keywords (author and index keywords). The selected counting method is full counting. To avoid having keywords that have the same meaning as singular or plural forms, or different ways of writing, the researcher made a thesaurus to show several combined keywords. Thesaurus in this phase is shown in Table 1.

**Table 1.** Thesaurus

<table>
<thead>
<tr>
<th>No</th>
<th>Label</th>
<th>Replaced by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>cross-sectional studies</td>
<td>cross-sectional study</td>
</tr>
<tr>
<td>2</td>
<td>curricula</td>
<td>curriculum</td>
</tr>
<tr>
<td>3</td>
<td>education, nursing, baccalaureate</td>
<td>education</td>
</tr>
<tr>
<td>4</td>
<td>higher education</td>
<td>university</td>
</tr>
<tr>
<td>5</td>
<td>higher education institutions</td>
<td>university</td>
</tr>
<tr>
<td>6</td>
<td>humans</td>
<td>human</td>
</tr>
<tr>
<td>7</td>
<td>problem based learning</td>
<td>problem-based learning</td>
</tr>
<tr>
<td>8</td>
<td>problem solving</td>
<td>problem-solving</td>
</tr>
<tr>
<td>9</td>
<td>project based learning</td>
<td>project-based learning</td>
</tr>
<tr>
<td>10</td>
<td>questionnaire survey</td>
<td>questionnaire</td>
</tr>
<tr>
<td>11</td>
<td>self efficacy</td>
<td>self-efficacy</td>
</tr>
<tr>
<td>12</td>
<td>skill</td>
<td>skills</td>
</tr>
<tr>
<td>13</td>
<td>steam</td>
<td>stem</td>
</tr>
<tr>
<td>14</td>
<td>students</td>
<td>student</td>
</tr>
<tr>
<td>15</td>
<td>students, nursing</td>
<td>student</td>
</tr>
<tr>
<td>16</td>
<td>survey and questionnaires</td>
<td>survey</td>
</tr>
<tr>
<td>17</td>
<td>universities</td>
<td>university</td>
</tr>
<tr>
<td>18</td>
<td>university students</td>
<td>student</td>
</tr>
</tbody>
</table>

**Results and Discussion**

**Research Trends of Creativity in Higher Education**

The mapping of research trends of the latest research on creativity aims to look at the number of annual publications. This information can be used as a reference to the extent of the interest of researchers and practitioners in the field of creativity. Publication productivity profiling reflects research productivity in that area. This information can also be a reference for future researchers and assess the feasibility of developing research in that area. Trends in research publications on creativity in universities were obtained from Scopus. Figure 2 shows the research trend. Figure 2 shows that articles on creativity have
been around since 1946. Research on creativity in universities shows a positive trend, increasing from year to year. That is, this topic is still worthy of further study.

Figure 2. Scopus documents on creativity in higher education

Relationship between Topics

One of the features of the vosviewer is co-occurrence analysis. Using the unit of analysis of all keywords with the full counting method and the minimum number of occurrences of a keyword is 5, from 3148 keywords obtained, 118 meet the threshold. By setting the number of keywords in one cluster is 20, resulting in 4 clusters (Table 2).

Table 2. Mapping research topics

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Keywords (occurrence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1 (red colour) 41 items</td>
<td>21 century skills (5), academic achievement (6), academic performance (8), architecture (6), china (13), art (7), collaboration (13), collaborative learning (17), communication skills (6), computer aided instruction (6), creative pedagogy (5), creativity (230), curriculum (47), design (13), design education (11), design thinking (11), diversity (7), engineering (9), engineering education (35), engineering students (5), entrepreneurship education (12), identity (6), imagination (5), interdisciplinary (8), leadership (11), learning (52), makerspace (6), pedagogy (17), personal training (7), product design (8), project-based learning (21), soft skills (9), stem (12), teacher education (8), teaching (61), teaching and learning (5), technology (8), united kingdom (5), united states (7), university education (5), university sector (20), active learning (17), artificial intelligence (6), assessment (14), blended learning (10), covid-19 (14), creative self-efficacy (6), creative thinking (48), critical thinking (31), digital technologies (5), divergent thinking (7), e-learning (18), economics (5), education computing (10), educational innovation (5), experiential learning (9), flexibility (5), flipped classroom (8), fluency (6), gamification (6), gender (10), learning systems (12), nursing (6), originality (5), pandemic (6), problem-based learning (16), problem-solving (20), qualitative research (6), social media (5), student (147), student engagement (6), surveys (7), teacher training (9), university (137), virtual reality (5), writing (5), adult (15), article (21), controlled study (11), cross-sectional study (5), educational measurement (5), female (17), human (36), human experiment (17), male (15), nursing education (12), nursing student (12), procedures (7), psychology (15), qualitative analysis (6), satisfaction (5), self concept (5), self efficacy (9), skills (21), survey and questionnaire (5), taiwan (7), teamwork (11), thinking (8).</td>
</tr>
<tr>
<td>Cluster 2 (green colour) 35 items</td>
<td></td>
</tr>
<tr>
<td>Cluster 3 (blue colour) 22 items</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 shows several keywords with a relatively dominant number of repetitions apart from the keywords that appear in the search query. In cluster 1, there are five dominant keywords, namely engineering education (35), PjBL (21), pedagogy (17), collaborative learning (17), and collaboration (13). In the same way, in cluster 2, we get critical thinking (31), problem-solving (20), e-learning (18), active learning (17), and assessment (14). In cluster 3, we get the keywords human (36), skills (21), human experiment (17), female (17), and adult (15). In cluster 4, we get the keywords innovation (28), education for sustainable development (26), entrepreneurship (18), questionnaire (17), and sustainability (16). In general, the keywords that are considered the most dominant in the context of creativity in universities are human (36), engineering education (35), critical thinking (31), innovation (28), education for sustainable development (26), and PjBL (21). To see the relationship between keywords within one cluster and between clusters, Figure 3 shows it.

**Figure 3. Relationship between concepts**

Figure 3 shows that the nodes for each keyword are different. The size of the node indicates the number of repetitions or not. Large nodes show a lot of repetition of keywords and vice versa. The distance between keywords also shows the size of the relationship between keywords (van Eck & Waltman, 2020). For example, suppose we hover the mouse over the keyword creative thinking. In that case, we will find that this keyword is surrounded by three surrounding keywords: teacher education, soft skills, and entrepreneurship education. These four keywords have a very close relationship.

The incorporation of creative thinking, soft skills, and entrepreneurship education into the framework of teacher training programs will have a transformative impact on future
educators, equipping them with the ability to inspire and drive change and innovation within the field of education and the wider community. The application of creative thinking will give rise to a cohort of inventive teacher candidates who possess the courage to deviate from conventional approaches, thereby refraining from perceiving teaching as a routine endeavor (Paek & Sumners, 2019). Prospective teachers are faced with the task of effectively utilizing their interpersonal abilities, sometimes referred to as soft skills, in order to develop adaptable relationships with individuals from diverse backgrounds (Xie and Derakhshan, 2021). Moreover, the inclusion of entrepreneurship education inside the teacher training curriculum has the potential to initiate a fundamental transformation in educational approaches. By adopting this methodology, aspiring educators are provided with an entrepreneurial attitude that empowers them to instruct in manners that foster imaginative cognition, therefore preparing their pupils to assume leadership roles and drive innovation in the forthcoming era (Lv et al., 2021; Wardana et al., 2020).

Emerging Topics

In addition to showing the strength between topics, vosviewer can also show emerging and old issues (Figure 4).

The blue color shows old topics. For example, engineering education, personnel training, psychology, etc. On the other hand, the yellow indicates a developing research topic, for instance, entrepreneur, virtual reality, self-efficacy, etc. Choosing the yellow topic as the central issue is a sage choice. For instance, a study that connects entrepreneurship and creativity can be found in other research (Diawati, et al., 2023). Research on entrepreneurship and virtual learning can be found in studies related to the metaverse (Inder, 2023), and research related to creativity and self-efficacy can also be found in another study (Raihan & Uddin, 2023).
Future Works

The results of the vosviewer study on creativity in universities show that several pieces of research are worth doing in the future by searching for and selecting the desired issue. One of the intriguing issues to discuss, especially in science education related to creativity, is sustainability. Figure 5 below shows some future work that can be chosen regarding creativity in universities related to sustainability.

**Figure 5.** Future work of creativity in higher education

To get future work related to sustainability related to Creativity in Higher Education, it is through the help of the openrefine software on the output (excel) obtained from the scopus database (Kusumasari, 2016). After typing the word “sustainability,” the researcher was directed to several articles that were considered relevant, as shown in Table 3.

**Table 3.** Several alternative future works related to creativity in Higher Education

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Authors</th>
<th>Keywords</th>
<th>Future Works</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knowledge management in entrepreneurship education as the basis for creative business development</td>
<td>Yuliya Frolova, Suad A. Alwaely and Olga Nikishina</td>
<td>business competitiveness; creativity; entrepreneurship education; knowledge management; sustainable development</td>
<td>There is a need for quantitative research to measure the effectiveness of the proposed motivational model, showing the limits of the effectiveness of this model and its comparative effectiveness with similar approaches (Frolova et al., 2021)</td>
</tr>
</tbody>
</table>
Table 3 shows that several alternative research topics can be taken related to the issue of creativity in universities. There are three options for researchers, namely (1) continuing each of the existing studies, (2) trying to combine two or more studies, and (3) opening a new research space based on existing research results. From the four articles, several new keywords can be combined into new topics in the future, including sustainability, ESD, design thinking, entrepreneurship, entrepreneurial creativity, knowledge management, and teacher training. For instance, in 2023, research that combines the keywords design thinking, ESD, and teacher training is research owned by (Calavia et al., 2023), and research that combines the keywords sustainability, knowledge management, and teacher training can be found in the study of (Adhikari & Shrestha, 2023).
Conclusion

This research has succeeded in showing that research on creativity in higher education is still emerging. Through bibliometric analysis using vosviewer on the type of co-occurrence analysis, the relationship between research topics, research novelty, and future work in the field of creativity in universities can be mapped. The results of this analysis can be used as a reference for researchers to continue existing research topics while opening up space for the following research area. For developers of lecture programs at the faculty of education, the results of this research can be used as a consideration to include content, pedagogy, and learning technology that facilitates students to train, familiarize and implement their creative ideas and actions through lectures.

Acknowledgement

The authors express their gratitude to the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for providing financial assistance through the Doctoral Dissertation Research (PDD) plan in the year 2023, under Contract Number: 051/E5/PG.02.00.PL/2023.

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