Bibliometric analysis of the term ‘STEM module’

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Abstract. STEM Module is one of the possible solutions in delivering STEM learning to students to improve better understanding. The purpose of this research was to provide a literature review regarding bibliometric analysis of ‘STEM-based module’ term. This research took the collection of articles from the database of Scopus during the period of 2015-2019. This research analysed 1095 articles. To generate a visualization, it employed VOSviewer software. The findings of this research provided a reference about a research that have been conducted related to STEM-based module.

1. Introduction

STEM learning constitutes an approach of learning that integrates Science, Technology, Engineering, and Mathematics (commonly abbreviated as STEM) [1,2]. The current development of Science, Technology, Engineering and Mathematics learning (STEM) these days is significant [3]. The significant development of STEM is due to the rapid progress of technology and the emerging of industrial revolution 4.0. This makes STEM learning is vital to be further developed within an educational setting [4]. On that account, it requires an electronic instructional media as a manifestation of developing STEM learning in the educational setting.

To a certain degree, STEM learning has continually used instructional media. Using instructional media within STEM learning was able to improve student’s motivation in the learning process [5]. A technology-based instructional media is commonly used for STEM learning [6], for instance: e-learning media [7], PhET media [8], sensor media [9], a module-based instructional media [10], virtual laboratories [11], and so forth. To a greater extent, electronic module for STEM learning has been developed [1]. Despite that, bibliometric analysis that evaluate and scrutinize the STEM-based module is minimum. According to the exploration of the researchers, the bibliometric analysis for STEM Module terms has not been found. Therefore, it requires a comprehensive study that can be used for other researchers in observing the development of STEM learning based on module.

The purpose of this research is to observe the development of STEM learning based on module and the trend of research and/or publication in the scientific journal indexed by Scopus database by using bibliometric approach.

2. Methods

In this research, the data collection was obtained from https://www.scopus.com. The researchers took some articles as the relevant samples from the database of Scopus. Scopus is one of the reputable
indexing databases that collects a comprehensive peer-review journal in the world. In addition, Scopus is one of the highly reliable database of scientific and academic information [12].

The research was initiated by performing an online searching during March 2020. The researchers performed an online searching by inputting “STEM Module” on the title, key words, and abstract (field of discipline). It was found 2543 data on the Scopus database to some extent. However, we took the data between 2015-2019 and it found 1095 articles with the following detail: 283 articles from 2019, 234 articles from 2018, 199 articles from 2017, 192 articles from 2016, and 187 articles from 2015. These samples were used to observe the research development thus far.

Then, the samples were downloaded with the extension format of *.ris. It employed VOSviewer to perform further analysis of the obtained samples. VOSviewer was used to visualize and analyse the trend of the data in the form of bibliometric [13]. In addition, VOSviewer is able to generate the publication, authors, and journals map according to the co-citation network or to generate a keywords map according to the identical network simultaneously [14].

3. Results and discussion

The obtained metadata articles that were downloaded from https://www.scopus.com database was analysed by using VOSviewer software. The analysis aimed at identifying the most frequent keywords that occurred. The frequency of the keywords could be arranged based on the preference of the researchers and the less relevant words could be eliminated. Then, VOSviewer was used to generate a visualization of bibliometric map [14,15]. When generating the visualization through VOSviewer, we limited the minimum correlation of the terms to ten terms. After performing the analysis with VOSviewer, it obtained two great clusters. The authors decided to take the second cluster that was related with STEM learning. The software indicated bibliometric mapping on a three different visualization: network visualization (Figure 1); overlay visualization (Figure 2); and density visualization (Figure 3).

![Figure 1. Network visualization.](image-url)
These findings were extracted from the title, keywords, and abstract with full calculation with the minimum number of events set to 10, it obtained 610 item relationships that satisfied the criteria. There were two great clusters, but both had not correlated each other. Therefore, this research took the second cluster since it was correlated with STEM learning. Based on Figure 1, the most frequent keywords that occurred were students, school, curriculum, and stem subject. Based on the obtained data, the novelty of the research related to STEM learning based on module could be discovered. For instance, it discovered a STEM learning based on module that related to big data. It appeared that in the data, the correlation has not yet visible.

Then, the Figure 2 showed the trend from year to year related to this research. Based on the figure, the most recent years was visualized with the yellow colour. According to the figure, one of the attempts to satisfy the novelty of the research could be taken by utilizing game and further, it is possible to correlate it with student’s performance or motivation. Figure 3 showed the density of the research. It further means that the denser the colour, it signifies the more research were conducted. The implication of the findings was used for non-formal educational practice [16] and it was applied.
within a learning based on observation, mathematical modelling, and pedagogy approach based on integrated electronic that is possible for Mathematics and Sciences [17].

The analysis by using bibliometric approach was used to identify the key words on each research or scope of scientific research that have been conducted up to the present. Furthermore, the analysis is promising and beneficial to determine the novelty before conducting a future research on the same discipline/topics.

4. Conclusion
In recent days, STEM learning is significantly developed. To prove how significant the development of the learning, this paper showed a remarkable number of publications related to STEM learning based on module from diverse discipline and specialization. Although it had limited systematic evidence on the subject, this paper attempted to generate a configuration and visualization from various literature systematically and performed an analysis based on bibliometric approach. This paper used the database from https://www.scopus.com. This research eliminated some relevant papers. For the future research, this research suggests taking a greater database and perform comprehensive comparison of bibliometric analysis with different approach.

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