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Analysis of Computer-Based Teaching Materials in Biology Learning Using Bibliometric Tools (Application of the SLNA Method)

Ida Yayu Nurul Hizqiyah[1*], Mia Nurkanti[1], Nia Nurdiani[1], Armansyah Putra[2], Meili Yanti[3], Nurul Syifa[1]

[1]Pendidikan Biologi, FKIP, Universitas Pasundan, Jalan Tamansari No. 6-8 Kota Bandung, Jawa Barat
[2]Pendidikan Biologi Universitas Samawa Sumbawa Besar
[3]Pendidikan IPA, FKIP, Universitas Sulawesi Barat, Jalan Prof Baharudin Lopa, Majene, Sulawesi Barat

[*]Corresponding: hizqiyah.bio.fkip@unpas.ac.id

ABSTRACT

In this study, descriptive qualitative research about computer-based teaching materials in biotechnology was analyzed. The urgency of this research was to analyze the novelty and effectiveness of computer-based teaching materials. The subject of this research was computer teaching materials in biotechnology learning. In this study, researchers also analyzed 25 articles that had been filtered based on the topic of computer teaching materials. The analysis contained several components: title, year, doi, author, method, results, and conclusions. This study used Bibliometrix tools (SLNA method application) as the media used in analyzing these articles. To accomplish the aim and to respond to a recent call for research about learning materials, The findings of this study will help to produce a positive effect that is effective and flexible in biotechnology learning because it can visualize teaching materials in the form of images, videos, sounds, so that gives the impression that no boring when learning activities take place.

ARTICLE INFO

Keywords
Computer Teaching Materials, Biology Learning, SLNA.

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INTRODUCTION

The development of science and technology is categorized as a primary need for all levels of society (Brown, 2019; Clark et al., 2018). Technological developments that occur have resulted in people having the opportunity and being able to take advantage of it (Astuti et al., 2019). Every human needs to be educated anytime to develop his potential and change his behavior for the better, in line with the prevailing values in society (Mulyadi et al., 2020; Prajapati et al., 2017). Learning must be specific to the context and experience that can make students have the desire and be able to carry out learning activities (Almareta & Paidi, 2020). Students' interest in learning can be increased by using

learning technology effectively in the classroom (Fitriyah et al., 2020; Haris, 2015; Parikesit et al., 2021; Unwin, 2019).

Most of the learning processes in an average school environment are still very conventional (Jafar, 2021). Teachers need to invite students to be actively involved in a lesson (Kranzfelder et al., 2019). If students are required to study more actively, then the level of understanding possessed by students will get results of around 90% (Ernawati et al., 2016). Moreover, to study biology, more emphasis is placed on understanding concepts and process skills that are carried out together (Anantyarta & Sholihah, 2020). In addition, scientific language is often used in biology, so that students understand biology learning material, these terms need to be visualized (Maryanti & Kurniawan, 2018). Knowledge of scientific names influences students' knowledge of the genus (Arifah et al., 2020).

Teaching materials in biology learning have been developed considering the various benefits obtained (Halimatussa'diah & Meilinda, 2015; Niemi & Kiilakoski, 2020). Even so, it is necessary to carry out a more in-depth study related to studies that discuss teaching materials, especially computer-based ones. This is done to obtain novelty information and opportunities for developing these teaching materials. This analysis is carried out by conducting theoretical studies through reading sources that develop in a study. This technique aims to be able to reveal various kinds of theories from learning biology which is more emphasized on understanding concepts and process skills that are carried out together as reference material in solving a problem being researched.

METHOD

This research uses data information collection techniques through various literature, books, articles from existing research results so that a new theory is obtained regarding the problem being analyzed which is a literature research (Colicchia et al., 2019; Mohajan, 2018; Sari & Asmendri, 2018). Therefore, library research really needs accurate data from various reliable sources (Khitous et al., 2020). In library research, a qualitative approach is used because according to Fadli (2021) a qualitative approach requires that researchers be able to identify the subject they want to study. So that it becomes a necessity to study the phenomena that are currently developing so that research can produce authentic data.

This study aims to determine the results of computer-based analysis of teaching materials in Bibliometric Tools-assisted biology learning (Application of the SLNA Method). This research was only conducted on computer-based teaching materials in biology learning on biotechnology material using the SLNA (Systematic Literature Network Analysis) method which is based on several applications (OpenRefine, Vosviewer, Bibliometrix, and Vosviewer).

This research has produced various information data regarding "Computer-based Learning Materials in Biology learning Biotechnology materials" because the focus of the qualitative approach lies in its importance and inductive nature. Qualitative research has a variety of different approaches, so the results of a qualitative approach can be in the form of descriptive data in written format (Yusanto, 2020). In this study, the instrument for data collection was the journal search engine application on Scopus. The selection of the Scopus data base is carried out to obtain quality-tested

articles so that the validity of the data used can be determined. The steps of the research procedure include:

1. Do a search for journal articles on Scopus by accessing the Scopus website via the link (https://www.scopus.com).
2. Perform data processing using the Open refine application, for the process of filtering data based on CSV data from Scopus.
3. Perform data processing using the Vosviewer application, processing data through the Vosviewer application to obtain visualization of existing keywords.
4. Perform data processing through the Tableau application which aims to alternative visualization of the information obtained.
5. Carry out data processing through the Bibliometrix application which aims to visualize data.
6. Selecting journal articles to be analyzed (20 pieces) based on application processing data.

After the data is obtained, the data in the form of articles is transferred or entered into the applications mentioned then the results in the form of images are analyzed descriptively.

RESULTS AND DISCUSSION

In this study, the analysis of journal articles carried out was as many as 25 articles sourced from Scopus. All of these articles were analyzed based on the characteristics of journal articles, such as title, year, author, DOI, keywords, methods, results of analysis, and conclusions. Each article has the same characteristics, namely its relation to computer-based teaching materials in biology learning on biotechnology material. Following are the results of the analysis of journal articles carried out on Scopus as the main data:

Table 1. Results of Analysis of Journal Articles originating from Scopus

No.	Tittle	Year	Result of Analysis
1.	The impact of using interactive animation in biology education at Moroccan Universities and student attitudes towards animation and ICT in general	2022	Research on the understanding of biology at Moroccan University was considered difficult to learn and understand, so an ICT-based animation teaching material was developed which aims to increase understanding related to biology learning and determine the effectiveness of the media in giving high marks in the student learning process.
2.	Development that wants to become a great biology game as a computer learning media based on the human respiratory system	2021	Research conducted on the use of biology teaching materials using game media aims to understand the quality and formality of a teaching media using games that want to become a biology-based computer.
3.	Interactive learning in programmed teaching of the subject "Based on natural sciences" at the pedagogical faculties of the Republic Macedonia (ICT tools in Biology education)	2020	An article regarding the development of ICT-based biology teaching materials in the Republic of Macedonia which aims as a basis for learning activities that can strengthen communication between teachers and students, manage student learning, and enable students in learning activities to be carried out together as well as to evaluate the learning process.
4.	Effect of three different teaching tools in science education on students' attitudes toward computers	2021	The research was conducted based on a survey of various kinds of instructional media in science subjects to determine the effects of simulations and laboratory implementation activities, and comparisons of the use of teaching media regarding students' attitudes towards computers.

5.	Views of Grade 7 Students on Incorporating Computer Use Simulation and Laboratory Activities in Teaching Science	2019	The research was conducted based on a survey conducted on students to investigate views regarding the effectiveness of the combined use of computer simulations and laboratory activities in science classes in order to attract students' learning desires..
6.	Multimedia tools in teaching and learning: A systematic review	2020	The research was conducted based on a survey regarding the effectiveness of using multi-media tools in the form of text and images that have multimedia components such as audio, video, animation and 3-D in the learning process so that students' learning performance abilities are increasing
7.	Development of a computer-assisted biology teaching media to improve student learning outcomes	2018	Research conducted to develop teaching media using computers produces quality media that is considered suitable for use in biology learning in the classroom.
8.	Conformity of Planning and Implementation ICT-Based Learning by Biology Teachers in High Schools	2018	The research was conducted based on a survey regarding the use of ICT-based learning materials which aims to determine the suitability of lesson plans in ICT-based lesson plans with the implementation of ICT-based learning by biology teachers in Palembang.
9.	Students' ability to apply biotechnology in entrepreneurship	2019	The research was conducted based on a survey regarding the use of integrated learning materials in the contextual learning approach (CTL). This study aims to reveal the causes of students' low ability to apply bio-technology in order to make it relevant to the real world.
10.	The Role of Technology in Dissemination Educational Sciences	2018	The research was conducted based on a survey regarding the use of distance learning materials (ODL) which aims to facilitate learning in the form of providing facilities for students to study so that they are flexible.
11.	A new way of teaching business ethics: Evaluation of reality-based teaching media in cyberspace	2020	The research was conducted based on a survey regarding the evaluation of Virtual Reality-based learning media which aims to create a learning process that can motivate, and increase the effectiveness of learning felt by students.
12.	The effectiveness of animated media for teaching biotechnology material in Indonesian rural elementary schools	2020	The research was conducted based on a survey regarding the use of animated media in biotechnology material in rural elementary schools which aims to attract students' interest so as to increase their interest in learning.
13.	Development and Testing the Effectiveness of Biology Learning Multimedia	2019	In the research that has been carried out based on a survey regarding the development of Adobe Flash-based active multimedia in biology subjects, it produces data in the form of product feasibility levels and the success rate of student learning activities in class XI MAN 1 Central Maluku.
14.	Socioscientific Issues in Science Education: An Opportunity to Include Education on Risk and Risk Analysis?	2021	The research was conducted based on the results of an analysis of Socioscientific Issues in science education which aims to increase content knowledge, the nature of science and to offer them practice in argumentation and decision-making.
15.	Development of Augmented Reality in Bio-technology Processes As Supporting Media for Science Learning Modules	2020	Research conducted regarding the use of augmented reality learning media (augmented reality) in biotechnology lessons which aims to increase student enthusiasm for learning so that students have activeness, creative processes and the ability to innovate
17.	Concept and Application of E-Learning in Biology Learning	2018	The research was carried out utilizing the literature method in providing knowledge concepts related to e-learning concepts and applications in biology learning.
18.	Development of Learning Multimedia on Biotechnology Material	2020	In research conducted on the development of multimedia learning materials that aim to streamline learning for students with the help of the autoplay program

	using the Autoplay Program		
19.	Development of active multi-media in web-based biology learning to prepare for the industrial revolution 4.0	2020	Research on the development of biological interactive multimedia shows that communication between teachers and students requires media that can be accessed anywhere, anytime, and in large quantities.
20.	Development of a Computer-aided Constructivistic Biology Module for High School Level Students in Class XI Even Semester	2018	Research on the development of computer-assisted Biology E-Modules is considered useful in streamlining learning and student learning outcomes
21.	Development of teaching media in the form of Stop Motion Animation Videos for Biology Learning with the Picpac Application	2018	Research that has been carried out in developing learning media containing a set of stop motion animated videos for biology learning with the application of picpac was analyzed using the R&D method
22.	Digital Literacy of Biology Teacher Candidates in the compilation of Audio Visual Aided Teaching Materials	2020	Research conducted develops the concept of digital literacy in creating innovative classes by making small flipcharts and learning films as part of their teaching materials.
23.	Training in Making Teaching Materials based on Information Technology assisted by Camtasia Studio for Teachers at SMK Muhammadiyah 2 Muntilan Magelang	2018	The research carried out develops training in making teaching materials that are ready to be given to students both in the form of flash disks and uploaded to them school e-learning.
24.	Development of Digital Modules as biology learning materials for Students in Class XI IPA	2021	Teaching materials in the form of e-modules in learning activities will make it easier for students to access material and are considered to save paper.
25.	Development of Computer Based Learning Media (PBK) Using the Prezi App	2019	Research that develops computer-assisted learning media makes use of prezi properly in accordance with knowledge development procedures, so as to be able to encourage students to study hard.

The results of the analysis of teaching materials carried out on Scopus journal articles as the main data source with the help of the SLNA method application which consists of using the OpenRefine, Vosviewer, Tableu, and Bibliometrix applications as supporting data sources. The following are the results of journal analysis conducted on Scopus. The main data was collected by reviewing a number of previously determined journal articles related to "Computer Teaching Materials in Biology Learning".

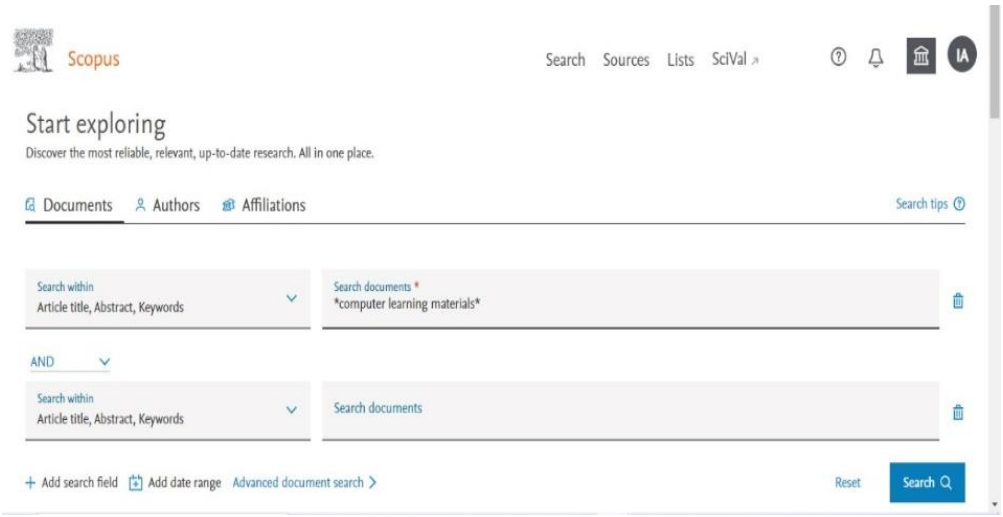

Figure 1. Searching for Journal Articles on Scopus with Keywords

The articles to be analyzed are filtered in advance according to the topic to be analyzed, in this study the topic taken is based on computer-based teaching materials.

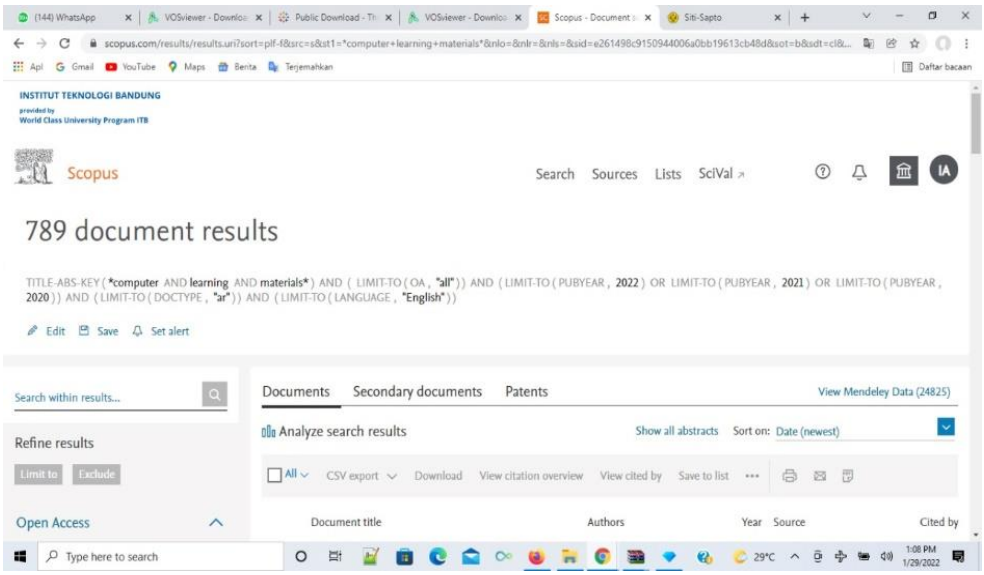

Figure 2. Screening Results of Articles on Scopus with the Keyword "Computer Teaching Materials"

On the keywords that were searched, 789 articles that were directly related to computer teaching materials were netted. Furthermore, the overall results of the data were collected and analyzed using supporting data in the form of the SLNA method application consisting of Open Refine, Vosviewer, Tableu, and Bibliometrix. Then a screening was carried out related to articles related to computer teaching materials in biology learning biotechnology material.

	A	B	C	D	E	F	G
1							
2	Paper	Title	DOI	Year	LCS	GCS	
3	COOK GJR, 2018, INT J RADIAT ONCOL BIOL PHYS	CHALLENGES AND PROMISES OF PET RADIOMICS	10.1016/j.ijrobp.2017.12.268	2018	0	62	
4	ZWOLAK JP, 2018, PLOS ONE	QFLOW LITE DATASET: A MACHINE-LEARNING APPROACH TO THE	10.1371/journal.pone.0205844	2018	0	7	
5	COURNEYA J-P, 2018, J MED LIBR ASSOC	HIGH-PERFORMANCE COMPUTING SERVICE FOR BIOINFORMATIC	10.5195/jmla.2018.512	2018	0	2	
6	ROONEY MK, 2018, INT J RADIAT ONCOL BIOL PHYS	SIMULATION AS MORE THAN A TREATMENT-PLANNING TOOL: A S	10.1016/j.ijrobp.2018.05.064	2018	0	18	
7	TU S, 2018, BIOCHEM MOL BIOL EDUC	WECHAT: AN APPLICABLE AND FLEXIBLE SOCIAL APP SOFTWARE F	10.1002/bmb.21170	2018	0	16	
8	HASSANZADEH H, 2018, J BIOMED INFORMATICS	TRANSFERABILITY OF ARTIFICIAL NEURAL NETWORKS FOR CLINIC	10.1016/j.jbi.2018.07.017	2018	1	8	
9	DEW KN, 2018, J BIOMED INFORMATICS	DEVELOPMENT OF MACHINE TRANSLATION TECHNOLOGY FOR AS	10.1016/j.jbi.2018.07.018	2018	0	28	
10	HAM T, 2018, J BIOMECH ENG	USING HANDS-ON PHYSICAL COMPUTING PROJECTS TO TEACH CC	10.1115/1.4040226	2018	0	1	
11	PARONG J, 2018, J EDUC PSYCHOL	LEARNING SCIENCE IN IMMERSIVE VIRTUAL REALITY	10.1037/edu0000241	2018	0	200	
12	WAHBY M, 2018, GECCO - PROC GENET EVOL COMPUT CONF	A ROBOT TO SHAPE YOUR NATURAL PLANT: THE MACHINE LEARN	10.1145/3205455.3205516	2018	0	6	
13	WALLON RC, 2018, J SCI EDUC TECHNOL	IMPLEMENTATION OF A CURRICULUM-INTEGRATED COMPUTER	10.1007/s10956-017-9720-2	2018	0	7	
14	SPINA TV, 2018, IEEE COMPUT SOC CONF COMPUT VIS PATTERN F	SEGMENT3D: A WEB-BASED APPLICATION FOR COLLABORATIVE S	10.1109/ISBI.2018.8363600	2018	0	6	
15	SARKAR D, 2018, ACS NANO	MIMICKING BIOLOGICAL SYNAPTIC FUNCTIONALITY WITH AN INC	10.1021/acsnano.7b08272	2018	0	61	
16	MOEDJIONO S, 2018, PROC INT CONF INF COMPUT, ICIC	MEDIA INTERACTIVE LEARNING AND BIOLOGY SUBJECTS IMPLEM	10.1109/IAC.2017.8280626	2018	0	3	
17	LORE KG, 2018, NEURAL NETW	A DEEP LEARNING FRAMEWORK FOR CAUSAL SHAPE TRANSFORM	10.1016/j.neunet.2017.12.003	2018	0	14	
18	GENOVIA JA, 2018, AIP CONF PROC	DEVELOPMENT OF A WEBQUEST AS INSTRUCTIONAL MATERIAL IF	10.1063/1.5019510	2018	0	1	
19	ZHETPISBAYEVA BA, 2018, J ADV PHARM EDUC RES	ASSESSMENT ISSUES IN CONTENT AND LANGUAGE INTEGRATED LEARNING (CLIL)		2018	0	1	
20	MALLAWAARACHCHI V, 2018, INT J EMERG TECHNOL LEARN	EXPERIENTIAL LEARNING IN BIOINFORMATICS - LEARNER SUPPOI	10.3991/ijet.v13i12.8608	2018	0	7	
21	XIA D, 2018, INT J EMERG TECHNOL LEARN	DESIGN OF VISUAL EDUCATION RESOURCE LIBRARY BASED ON 3D	10.3991/ijet.v13i11.9609	2018	0	3	
22	ARRASATE S, 2018, CURR TOP MED CHEM	PERTURBATION THEORY MACHINE LEARNING MODELS: THEORY,	10.2174/1568026618666180810124031	2018	0	6	
23	TEKKUMRU-KISA M, 2018, PROC INT CONF LEARN SCI, ICLS	DESIGNING AN EDUCATIVE CURRICULUM EMBEDDED WITHIN AN	INTERACTIVE WEB-BASED PLATFORM TO FACILITATE TEACHER LE	2018	0	0	
24	BISHOP SM, 2018, ACTA NEUROCHIR SUPPL	MULTI-SCALE PEAK AND TROUGH DETECTION OPTIMISED FOR PE	10.1007/978-3-319-65798-1_39	2018	0	4	
25	AHLSTRAND E, 2018, BIOCHEM MOL BIOL EDUC	AN INTERACTIVE COMPUTER LAB OF THE GALVANIC CELL FOR STU	10.1002/bmb.21091	2018	0	0	
26	ARIFIN Y, 2019, TALE - IEEE INT CONF ENG, TECHNOL EDUC	TAXONDROID: DESIGN INTERACTIVE APPLICATION FOR ANIMAL T	10.1109/TALE48000.2019.9225967	2019	0	0	
27	SMITH JS, 2019, NAT COMMUN	APPROACHING COUPLED CLUSTER ACCURACY WITH A GENERAL-F	10.1038/s41467-019-10827-4	2019	0	168	
28	HALDER AK, 2019, IEEE/ACM TRANS COMPUT BIOL BIOINF	3GCLUST: HUMAN PROTEIN CLUSTER ANALYSIS	10.1109/TCBB.2018.2840996	2019	0	2	
29	BEUNZA J-J, 2019, J BIOMED INFORMATICS	COMPARISON OF MACHINE LEARNING ALGORITHMS FOR CLINICA	10.1016/j.jbi.2019.103257	2019	0	28	

Sheet1

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1							
2	Paper	Title	DOI	Year	LCS	GCS	
3	COOK GJR, 2018, INT J RADIAT ONCOL BIOL PHYS	CHALLENGES AND PROMISES OF PET RADIOMICS	10.1016/j.ijrobp.2017.12.268	2018	0	62	
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6	ROONEY MK, 2018, INT J RADIAT ONCOL BIOL PHYS	SIMULATION AS MORE THAN A TREATMENT-PLANNING TOOL: A S	10.1016/j.ijrobp.2018.05.064	2018	0	18	
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10	HAM T, 2018, J BIOMECH ENG	USING HANDS-ON PHYSICAL COMPUTING PROJECTS TO TEACH CC	10.1115/1.4040226	2018	0	1	
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13	WALLON RC, 2018, J SCI EDUC TECHNOL	IMPLEMENTATION OF A CURRICULUM-INTEGRATED COMPUTER	10.1007/s10956-017-9720-2	2018	0	7	
14	SPINA TV, 2018, IEEE COMPUT SOC CONF COMPUT VIS PATTERN F	SEGMENT3D: A WEB-BASED APPLICATION FOR COLLABORATIVE S	10.1109/ISBI.2018.8363600	2018	0	6	
15	SARKAR D, 2018, ACS NANO	MIMICKING BIOLOGICAL SYNAPTIC FUNCTIONALITY WITH AN INC	10.1021/acsnano.7b08272	2018	0	61	
16	MOEDJIONO S, 2018, PROC INT CONF INF COMPUT, ICIC	MEDIA INTERACTIVE LEARNING AND BIOLOGY SUBJECTS IMPLEM	10.1109/IAC.2017.8280626	2018	0	3	
17	LORE KG, 2018, NEURAL NETW	A DEEP LEARNING FRAMEWORK FOR CAUSAL SHAPE TRANSFORM	10.1016/j.neunet.2017.12.003	2018	0	14	
18	GENOVIA JA, 2018, AIP CONF PROC	DEVELOPMENT OF A WEBQUEST AS INSTRUCTIONAL MATERIAL IF	10.1063/1.5019510	2018	0	1	
19	ZHETPISBAYEVA BA, 2018, J ADV PHARM EDUC RES	ASSESSMENT ISSUES IN CONTENT AND LANGUAGE INTEGRATED LEARNING (CLIL)		2018	0	1	
20	MALLAWAARACHCHI V, 2018, INT J EMERG TECHNOL LEARN	EXPERIENTIAL LEARNING IN BIOINFORMATICS - LEARNER SUPPOI	10.3991/ijet.v13i12.8608	2018	0	7	
21	XIA D, 2018, INT J EMERG TECHNOL LEARN	DESIGN OF VISUAL EDUCATION RESOURCE LIBRARY BASED ON 3D	10.3991/ijet.v13i11.9609	2018	0	3	
22	ARRASATE S, 2018, CURR TOP MED CHEM	PERTURBATION THEORY MACHINE LEARNING MODELS: THEORY,	10.2174/1568026618666180810124031	2018	0	6	
23	TEKKUMRU-KISA M, 2018, PROC INT CONF LEARN SCI, ICLS	DESIGNING AN EDUCATIVE CURRICULUM EMBEDDED WITHIN AN	INTERACTIVE WEB-BASED PLATFORM TO FACILITATE TEACHER LE	2018	0	0	
24	BISHOP SM, 2018, ACTA NEUROCHIR SUPPL	MULTI-SCALE PEAK AND TROUGH DETECTION OPTIMISED FOR PE	10.1007/978-3-319-65798-1_39	2018	0	4	
25	AHLSTRAND E, 2018, BIOCHEM MOL BIOL EDUC	AN INTERACTIVE COMPUTER LAB OF THE GALVANIC CELL FOR STU	10.1002/bmb.21091	2018	0	0	
26	ARIFIN Y, 2019, TALE - IEEE INT CONF ENG, TECHNOL EDUC	TAXONDROID: DESIGN INTERACTIVE APPLICATION FOR ANIMAL T	10.1109/TALE48000.2019.9225967	2019	0	0	
27	SMITH JS, 2019, NAT COMMUN	APPROACHING COUPLED CLUSTER ACCURACY WITH A GENERAL-F	10.1038/s41467-019-10827-4	2019	0	168	
28	HALDER AK, 2019, IEEE/ACM TRANS COMPUT BIOL BIOINF	3GCLUST: HUMAN PROTEIN CLUSTER ANALYSIS	10.1109/TCBB.2018.2840996	2019	0	2	
29	BEUNZA J-J, 2019, J BIOMED INFORMATICS	COMPARISON OF MACHINE LEARNING ALGORITHMS FOR CLINICA	10.1016/j.jbi.2019.103257	2019	0	28	

Sheet1

Figure 3. Analysis Results of the Year Publishing Articles of Computer-Based Teaching Materials

In the Figure 3 it is known that 113 journal articles are sorted by year the longest to the latest. In 2018 there were 23 articles, in 2019 there were 34 articles, in 2020 there were 23 articles, in 2021 there were 32 articles, and in 2022 there were 1 article. The whole article discusses the same topic, namely computer -based teaching materials

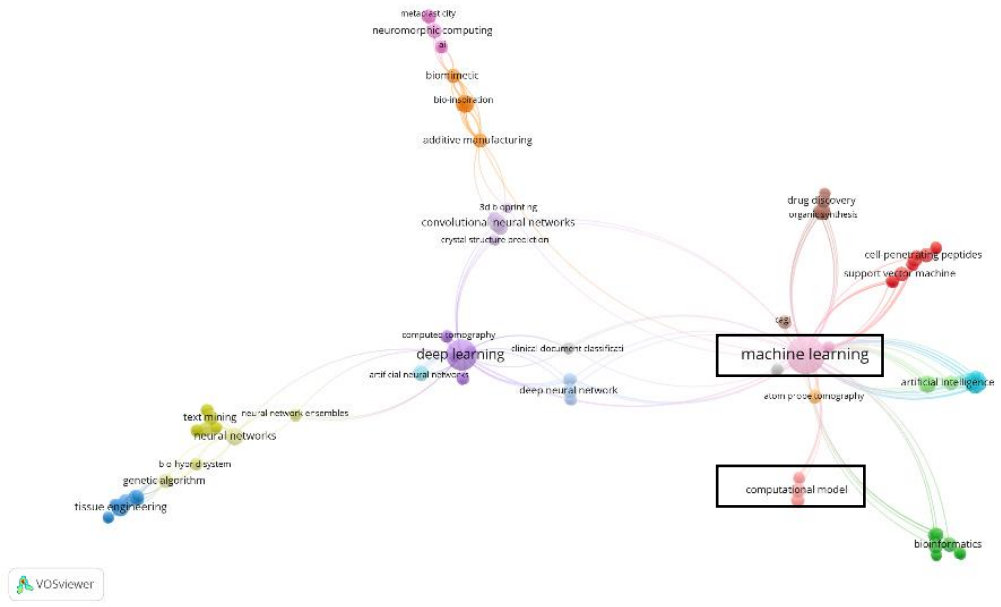

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Figure 4. The results of the analysis of the theme network related to the topic of computer -based teaching materials

The Figure 4 is shown the linkages between one topic to another. For example the topic of Machine Learning is related to the computational model, which means the computing model as a learning material used to simulate behavior or phenomenon using a computer. This means that there is a compatibility between 1 topic with another topic.

Keywords in Figure 4 shows keywords in article abstracts related to computer-based teaching materials on biotechnology material. One of them is the word deep learning. In the research article with the keyword deep learning carried out by the authors in Table 1, the results show that material considered difficult can be done with deep learning by utilizing ICT-based animation teaching material developed. This is done to increase understanding related to biology learning and determine the effectiveness of the media in giving high marks in the student learning process. The following keyword is related to computational models, where the keywords in this study were carried out by El Hammoumi et al., (2022). The results show that the survey results regarding the use of ICT-based learning materials show a positive attitude towards biology teachers. So that with the help of technology, they can develop teaching materials based on computational models. Colclasure et al. (2022) also conducted other research on computational models, the results of which show that student interest and learning outcomes were the factors found to be most influential to teachers' use of computational models. The deficiencies in the application of this method are the lack of resources and the lack of self-confidence of students. In the case of implementing a computational model, self-confidence or self-efficacy is also so that one of the methods used is repetition so that the application of a computational model (Yang et al., 2022).

From these two keywords, the use of computer-based teaching materials makes it easier for teachers to overcome a number of things, especially those related to learning difficulties. Research on the development of biological interactive multimedia shows that communication between teachers and students requires media that can be accessed anywhere, anytime, and in large quantities (Palts & Pedaste, 2020). This is because the material in the teaching materials is presented in a more complex form, looks more real and of course more efficient because Teaching materials in the form of e-modules in learning activities will make it easier for students to access material and are considered to save paper (Hikmaturrosyidah & Rachmadiarti, 2022).

The application of computer-sharing teaching materials provides many conveniences for both teachers and students. This can be seen by the various complexities of learning problems encountered and can be solved by applying these teaching materials. Such a complex concept can be converted into a more understandable one with the addition of computer elements. Especially the problems related to effectiveness, where this teaching material is easy to use anytime and anywhere

CONCULSION

Computer Teaching Materials in Biotechnology Learning Using Bibliometrix Tools (Application of SLNA Method) resulting in the effectiveness of the use of computer teaching materials that produce positive influences that are effective and flexible in biology learning because it can visualize

teaching materials into the form of images, sounds so as to give the impression that is not boring when Learning activities take place.

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