An Overview of How STEM-LW (Local Wisdom) Research Influences Character Over Time: An In-Depth Review with Bibliometric Analysis

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The use of STEM approaches based on local wisdom is a trend in itself in the multicultural country of Indonesia. The collaboration between the two became one of the builders in strengthening character building strategies with the STEM-LW relationship. This study aims to see the direction of the trend of STEM-LW character research over time. This research is an in-depth literature study research using bibliometric analysis techniques. The stages in the implementation include preparation, data collection, data management, data extraction, data visualization, and data conclusion drawing. Analysis techniques using manual investigations and bibliometric analysis with the help of supporting software Publish or Perish, Reference Manager Zotero, and VOS viewers. The results showed of 750 total publications in the period 2007-2002 which came from 3 indexers. The total articles after submission were 467 articles that met the requirements with STEM-LW character keyword. journal articles are predominantly from Indonesia with three developmental periods, namely the pioneer period, the development period, and the stable period. Development being the top item that appears most often in the article, and perception is the relevant palng item. The direction of STEM-LW character research is towards education, including development, analysis and implementation in learning. Development research trends are in item analysis, effectiveness, ability, impact, creativity, and stem approach. The clusters that are most often used as side topics in research are class I and II. No impact emphasizes STEM-LW on character.

Keywords: bibliometrics, depth review, STEM-LW, character

INTRODUCTION

STEM education in advanced industrial countries and in ASIA is making efforts to develop and provide innovative solutions, especially to global issues directly related to the 2030 Sustainable Development Goals approved by the United Nations. As the Industrial Revolution 4.0 gains momentum and affects every aspect of our daily lives, the boundaries between STEM (Science, Technology, Engineering and Mathematics) disciplines and non-STEM are becoming increasingly biased (Harun et al., 2021; Boon Ng, 2019).In time the education sector began to rethink the boundaries of traditional curricula whereby knowledge and skills are segregated into subjects.

The development of STEM (Science, Technology, Engineering, Mathematics) approach research in education is growing over time. STEM is becoming a popular approach to education at various levels (Eroğlu & Bektaş, 2022; Alea et al., 2020). STEM is used to achieve a cognitive, affectively, and psychomotorly learning objective. STEM approaches in learning support improved achievement and learning outcomes (Agung et al., 2022; Salazar-Mattews, 2020; Yıldırım & Selvi, 2016), science literacy (Krisantia, 2021; Herwandi et al., 2021; Parno et al., 2019; Shaffer et al., 2019), understanding of concepts in the cognitive realm of different ages (de Santana et al.,2022). STEM is also able to significantly influence the skills and knowledge of learners. STEM can also significantly influence learners' skills and knowledge (Han et al., 2021; Allina, 2018).

Local wisdom is one of the cultural treasures of a community that must be preserved. Apart from being an element of a culture, it is able to be a means of supporting and improving the educational and social processes of the community (Suprapto et al., 2021; Suastra, 2017). The use of local wisdom in the educational and social process is expected to be able to make people more accepting of knowledge (Dewinta et al., 2021). Many types of cultural elements can be used as examples of local wisdom. The examples of local wisdom include philosophies, life principles, literature, art, and other cultural elements that characterize a population of residents (Prasadi et al., 2020; Mohajan, 2018). A community in a certain environmental scope must have local wisdom that is highlighted based on existing categories.

Local wisdom should be used in the educational process, both formal and informal. The use of local wisdom in the learning process exerts a lot of influence on the individual in aspects of attitudes that are reflected in character, such as tolerance (Arliman, 2018; Junianti & Hariyanto, 2021), care for the environment (Speldewinde, 2022; Casto, 2022), scientific and social attitudes (Fortus et al., 2022; Iriaji & Rochbeind, 2021), and other character education (Abidin, 2019; Haryandi et al., 2021; Rokhman et al., 2014). Various skills are also trained by the use of local wisdom, namely critical thinking (Fadilah, 2022; Junianti & Hariyanto, 2021; Pageh & Permana, 2020; Puchumni et al., 2019; Suastra, 2017), Cooperation (Haka et al., 2020; Sümen & Çalisici, 2016), and troubleshooting (Permana & Jayanta, 2019; Rummel & Spada, 2005). The use of local wisdom will be maximized if it collaborates with a certain learning model or approach.

STEM approaches based on local wisdom will be a maximal-based approach or a perfect match in supporting the learning process. The collaboration between the two has been researched as educational research and cultural development. The collaboration of the two in rehearsing characters was researched in many studies such as Mardiastuti et al. (2021); Mann et al. (2021); Prasadi (2020); Abidinsyah et al. (2019); Pimthong & Williams (2018); Handriyan et al. (2018); Yıldırım & Selvi (2016). Based on the results of this study, the use of STEM with local wisdom, from now on referred to as STEM-Lw, has been able to train various types of characters based on the values of local wisdom.

This research aims to understand the development of STEM-Lw research in training character. The picture is taken from the development of the research period, the type of research, the analysis of index results, the country of origin of local wisdom, the types of local wisdom, the most popular authors, types of characters developed/trained, network visualization, overlay visualization overtime, density visualization, and the trend of development of STEM-LW research in influencing character.

METHOD

The methodology in this study is a literature review method with in-depth analysis accompanied by bibliometric analysis. In addition to manual data extraction, data collection is carried out using supporting software, Publish or Perish, zotero, and VOSviewers. Supporting applications are used in data collection, bibliography references and depictions of the research landscape from the studies carried out.

This study method uses the stages of preparation, data collection, data management, data extraction, data visualization, and data conclusion drawing.

Data Preparation

At this stage, the researcher makes preparations in the form of preparation of supporting applications and taking keywords in the study. The supporting applications prepared are publish or perish, Zotero and VOSviewers. The publish or perish application collects journal articles that will be processed using keyword search. Zotero serves as the library list management of the perish publisher application and as a place to filter the journal articles collected. VOSviewers is a visualization landscape of collected and filtered data. VOSviewers will show you an overview of the relationships that may be present in this study. The keywords used in this study were "STEM", "Local wisdom", "character". Keywords are used in the next process, namely data collection.

Data Collection

At the data collection stage, it is carried out with the help of the PoP application with settings in the form of a search engine using the Google Scholar database, with the type of article publication in journals and the period of 2017 to 2022, data is collected by typing keywords in the form of "STEM", "Local wisdom", "character". The data collected in this process will be continued by saving the results in RIS file format.

Data Management

Data saved in RIS format is entered into zotero software to filter existing journal articles. The standard in filtering is to eliminate articles that are not eligible such as not having a year, not having a publisher, not having a journal, and not being included in the keywords used. After this process the selected and eligible articles are saved again in the RIS file for later downloading one by one.

Data Extraction

Downloaded journal articles are extracted individually to see studies of STEM, local wisdom and character. Data extraction is carried out manually, where the journals designated as eligible items.

Data Visualization Analysis

Downloaded journal articles are extracted individually to see studies of STEM, local wisdom and character. Data extraction is carried out manually, where journals that have been designated as items that contain data are presented in the form of tables, diagrams, and visual landscape images. Visualization and data analysis were carried out with bibliometric analysis to see an overview of the research topic. This bibliometric analysis process uses a VOSviewers support application condition.

Drawing Conclusion

At the conclusion stage, data from the results of collection, management, extraction, visualization, and analysis are evaluated based on each analysis's objectives to see the research's big picture. In this tahao, the researcher will propose several things related to the state of the existing data. The stages in this study will be described in the details of the flow chart in Figure 1.

FIGURE 1
RESEARCH STEP CHART BASED ON THE TOPICS
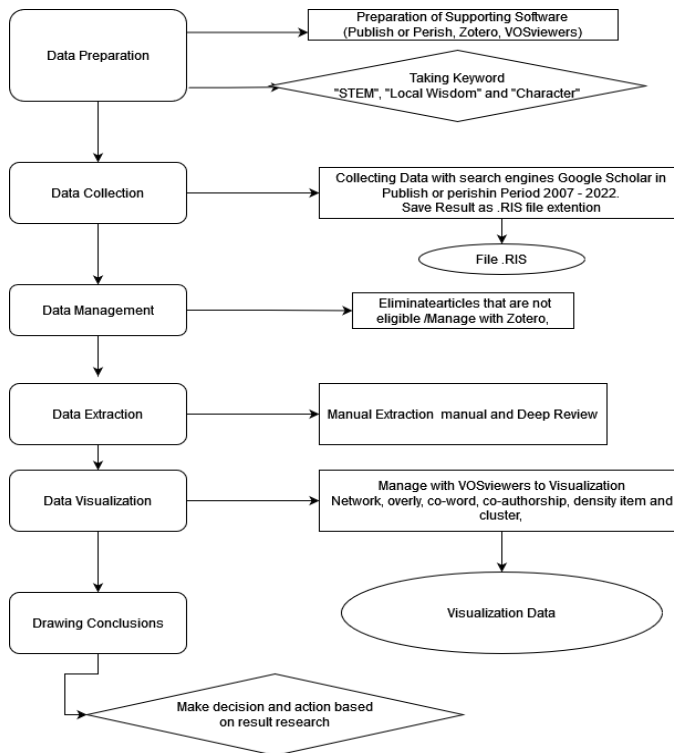
Findings and Discussions

Based on the data that has been collected, the research data is presented in the form of tables, diagrams, and figures which will be explained in detail below:

The Publication Findings Based on the Topic

Based on the results of the collection through Publish or Perish, the keywords "STEM", "Local Wisdom", "Character" with the category of article journals from 2007 to 2022 from sources indexed by Google Scholar, Scopus, and Crossref. Based on the results of the data collection, data on the number of article findings was obtained based on the Google Scholar, Scopus, and Crossref indices. Data shown in Table 1.

TABLE 1
PUBLICATIONS FINDINGS DATA BASED ON THE TOPICS IN DIFFERENT RESOURCES OF PUBLISH OR PERISH

Keyword	Result	Platform Journal Database		
		Google Scholar	Scopus	Crossref
"STEM", "Local Wisdom", "Character"	Publication Years	2007-2022	2007-2022	2007-2022
	Citations Years	11(2007-2022)	11(2007-2022)	11(2007-2022)
	Papers	648	24	78
	Citations	7995	168	389
	Citation/Year	726,83	23,64	78,41

	Cite/Paper	12,32	9,83	3,87
	Authors/paper	1,96	1,00	0,99
	h-index	38	16	22
	g-index	94	12	33
	hI-norm	34	18	22
	hI-Annual	3,00	0,97	11,02
	hA-index	18	6	14

Based on the data in Table 1 of the 3 source indices in PoP, the total publications in the form of overall scientific journal articles were 750 articles. The Google Scholar platform has a total of 648 articles, scopus 24 articles, and crossref as many as 78 articles.

The Google Scholar platform year of coverage consisting from 2007 to 2022 has a total of 648 paper articles in journals with a total of 7995. The number of citations per year shows a large number of 726.83 and the number of citations per paper is 12.32. The average number of authors per paper is 1.96 with a large h-index of 38 and a g index of 94. Previous figures show that the number of papers related to STEM-LW research is based on existing databases.

According to the Scopus database, the number of papers in the same time span is only 24 papers that have the keyword STEM-LW character. The total size of citations is 168 and citations per year reach 23.64. The number of citations per paper is also quite low, reaching only 9.83 with an average number of authors per paper is 1.00. In addition, the h-index and g-index values are quite high, indicating that ahwa scopus articles indexed by Scopus have a good reputation. The crossref platform has a total of 78 papers with the number of citations being 389 citations. The number of citations per year reached 78.41, and citations per paper reached 3.87 citations per paper and 0.99 authors per paper. The h-index and g-index values are also fairly high, with nails of 22 and 33, respectively.

In the google scholar paper database, there tend to be more, and the citation value is also much higher. This is because the Google Scholar platform is widely known in scientific publications or in academics. In addition, the high value is also influenced by the popular search engines of a country. In Indonesia, Google is the top search engine or developer application platform. This has caused Google Scholar to become one of the number 1 platforms to search for literature / scientific studies.

The Scopus platform has become known to academics as an article indexer or scientific journal. Scopus is also used as a reputational measure of a scientific paper. Although indexing platforms such as ERIC, SINTA, and others exist, scopus is still considered superior, especially in scientific research studies. However, based on existing data, scopus has the platform with the least number of articles, namely only 24 journal articles, and is lower than Google Scholar.

In addition to scopus and google scholar, crossref indexes taken from crossref databases published or perish are less popular than other indices. Covering this, the paper on this index is not at all non-existent, it's just that there are fewer of them than google scholars. Google scholar is the most popular platform and is included in the ranks of journal indexers. It is also stated in many literature studies with the same methodology that Google Scholar is in the top rankings in searches for articles.

After passing the data extraction process, the data processing process proceeds to the filtering stage of journal articles in a character-related publication of STEM-LW. Using zotero support applications filters journal articles in the form of non-publisher articles, magazines, and articles without journals. The filtering process only leaves journal articles from research that have indexed journals and publishers. The process of improving the data can be seen in table 2 below.

TABLE 2
REFINEMENT OF THE RESULT ARTICLE OF THE FINDINGS ON STEM-LW CHARACTER

Refining Indicators	Total article after refining		
	Google Scholar	Scopus	Crossreff
Finding articles with Publish or Perish (RIS File)	648 items	24 items	78items
Remove publications non-article journal from zotero and manual. investigation/extraction data	421 items	20items	65items
Eliminate articles without the STEM-Local wisdom-character keyword	391 items	14 items	62items

Result of Refinement and Filtering Article STEM-LW Character

The process of filtering articles using zotero is sorted and sorted by article type and the presence or absence of journals and publishers on the article. the process of improvement and screening is carried out with the help of the zotero application as a reference manager and manual investigation.

As a result of the process of refinement and filtering, there was an elimination of articles from the google scholar database was 257 articles, 10 from scopus and 16 from crossreff. The results of this process show that articles obtained from indexers through PoP are still not eligible for use in the bibliometrics analysis process. The investigation and manual data extraction must be carried out to select quality articles in the review stage. According to research from Haryandi et al. (2021), an in-depth study and bibliometric analysis is sent to a source with a good reputation of the article and publisher as whaelsli.l The better the reputation of the journal and the article reviewed, the more widely known the research will be (Al Husaeni & 2022; Usmayanti & Sofyana, 2022; Haryandi et al., 2021). Therefore, the investigation and manual extraction can help improve the quality of journal articles.

The Division of Period for the Development of Research STEM-LW Character

The time period of research development of stem-LW characters is divided into three stages of time including the pioneer period, the developer period and stable period. Result of annual research developments from the research of STEM- LW character can be seen in figure 2 and classifications of different periods of research development can be seen in table 2,

FIGURE 2
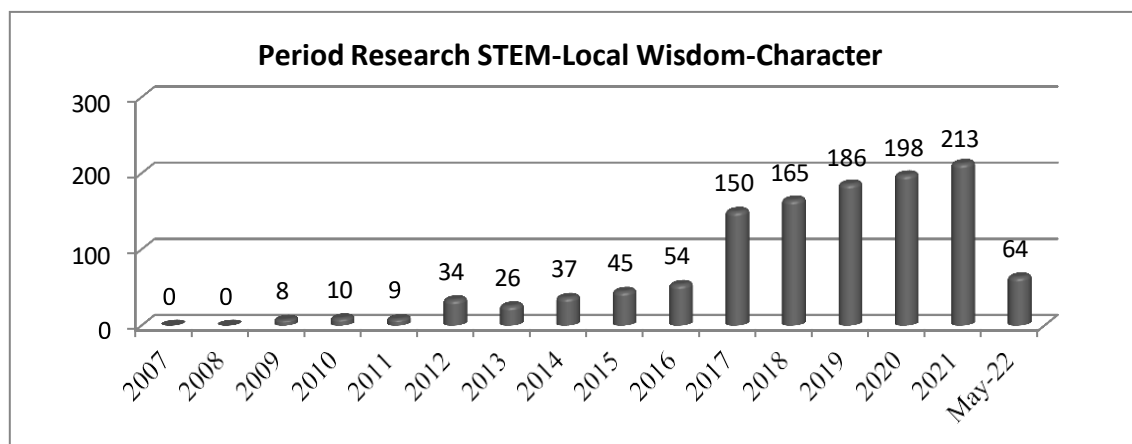**NUMBER OF PUBLICATIONS IN THE FIELD STEM-LOCAL WISDOM**

TABLE 3
DIVISION OF RESEARCH PERIOD STEM-LW

Period Name	Years period
Pioneer research	2009-2011
Developer research	2012- 2016
Stable research	2017- >2022

Classification of Research Period Based STEM-LW Character

The classification of research developmental periods from STEM-LW is included in three important periods in research development. The development of the research is divided based on year data and data on the number of research articles published during that time / year. In this study, the number of published articles is a summation based on the google scholar, scopus and crossref databases added up after the manual extraction process and from zotero based on the year of publication.

The result of the division of this period into, the pioneer period where the pioneer period began to be published in 2009 to 2011. The year 2012 to 2016 is a period of development from research to reaching a period of stability in 2017 to May 2022. The division of these three periods is based on the number of publication frequencies of existing articles by comparing the gaps of each year with the years before and after.

The division of this period aims to determine the level of interest and popularity of the themes raised in the world of research. This division of the period can also be used as a trace of research history and article pioneers on STEM-LW characters. Classification is also a way for researchers to record traces of research history from STEM-LW character.

TABLE 4
ANALYSIS OF TERM-OCCURRENCE STEM-LW CHARACTER

Item	Occurrence	relevance score	Item	Occurrence	relevance score
development	39	0,2	influence	5	4,6
education	25	1,9	junior high school student	5	4,6
analysis	23	3,0	persepsi	5	41.632,0
local wisdom	23	0,2	physics	5	2,5
mathematics	21	3,6	teaching	5	5,4
technology	21	3,6	blended	4	21.437,0
engineering	17	0,0	case	4	6,0
indonesia	17	0,5	content	4	11.328,0
effect	16	2,4	creativity	4	0,4
problem	16	4,0	critical thinking skills	4	5,1
covid	11	5,4	culture	4	0,0
teacher	11	3,9	discovery	4	12.995,0
context	10	3,2	e module	4	0,3
research	10	3,2	evaluation	4	5,1
application	9	0,3	higher education	4	11.603,0
effectiveness	9	3,3	identification	4	13.692,0
pandemic	9	0,5	integration	4	3,4
study	9	3,5	journal	4	0,6
approach	8	3,3	method	4	5,3
critical thinking skill	8	5,5	outcome	4	0,4
steam	8	3,4	science education	4	13.224,0

stem approach	8	3,2	science technology engineering	4	13.595,0
stem education	8	6,0	scientific attitude	4	4,1
case study	7	4,6	scientific literacy	4	6,8
design	7	5,0	secondary school	4	5,1
elementary school	7	3,5	students problem	4	6,6
impact	7	1.365,0	tool	4	5,0
learning model	7	5,6	use	4	6,1
management	6	4,2	21st century	3	6,4
media	6	4,8	animation learning media	3	5,6
motivation	6	2,5	environmental education	3	4,9
review	6	3,6	ethno stem	3	10.538,0
society	6	4,6	health	3	10.287,0
thailand	6	4,8	hot	3	11.738,0
assessment	5	5,7	indigenous knowledge	3	13.568,0
environment	5	5,2	learning styles	3	6,9

Analysis Term-Occurrence Research Based on STEM- LW Research

The results of data extraction based on journal articles, followed by the analysis stage using the research landscape with the VOSviewers application to find the frequency of words appearing in article titles in publications with STEM- LW topic characters. Using the settings create a map using text data>read data from reference manager>select source>field from title field>full counting>minimum number of occurrences is 3 times>numbers of term to be selected 72>verify term selected>result.

Based on the analysis results from VOS viewers with a minimum of kat appearing in the title 3 times, 77 words / items appeared in the visualization results. The words that appear the most and are in the top 20 categories are development, education, analysis, local wisdom, mathematics, technology, engineering, Indonesia, effect, problem, covid, teacher, context, research, application, effectiveness, pandemic, and study.

Words with a high frequency of appearing in the study's title do not have a comparable relevance value. The term perception sequentially holds words that have a high relevance value, superior to the independent learning program, comparison model discovery, blended, pre service biology teacher, experiment, guided inquiry, melde, medium enterprise, portable purchase display, creative thinking skill, microbiology, indonesian curriculum, comparison, multimedia development, senior high school, and development.

Visualization Network and Terms Landscape Research STEM-LW Character

The data extraction results carried out manually or assisted by the VOSviewers application produce image data from network term visualization, overlay visualization, and density visualization. Visualization hasl data shown in Figures 3-5.

FIGURE 3
NETWORK VISULIZATION STEM-LW CHARACTER RESEARCH

The results of network visualization in Figure 3 show the relationship between the 144 terms in data extraction. VOSviewers in this data processing process provides an overview of the items that often appear in research. Local wisdom is a main term in research that is in the main cluster in the landscape. the larger the sphere in the network visualization, the more and stronger the relationship between these items in the study.

Local wisdom is central to this analysis and has a strong relationship with education, student development, STE education, analysis, science, learning, teacher, and project. Based on this, it is shown that the research direction in STEM-LW character is centered on research in education and teaching including the development of material, media, effectiveness, projects, cognitive, psychomotor, and affective skills of learners.

This shows that popular STEM-LW character research is carried out in education, including types of media development research, learning resources or teaching materials, analysis, or the effectiveness of a learning method using the basis of local wisdom with a STEM approach.

Local wisdom is used as a basis in the learning process and development of a learning product because it is close to the lives of students (Iriaji & Rochbeind, 2021; Krisantia, 2021; Haka et al., 2020; Abidin, 2019; Permana & Jayanta, 2019; Çevik, 2017; Khusniati et al., 2017; Ata Akturk et al., 2017; Kelley & Knowles, 2016; Becker, et al., 2011;). The research makes local wisdom the basis for developing the learning process. Apart from being a learning base for using local wisdom as a basis for developing a certain character in students, it is also carried out using the STEM-LW approach. According to Haryandi et al., 2021; Atmojo et al., 2018; Haka et al., 2020, local wisdom becomes the basis in forming the child's character because it is close to the relevant life.

The items in each cluster are spelled out with details in Table 5.

TABLE 5
COMPARISON ITEMS ANALYSIS BASED ON THE TOPIC RESEARCH

No	Cluster Color	Item in Cluster		
I	Red	Animation learning media. Assessment Case Comparison Creative thinking skill Critical thinking skill Development E module Effect Elementary school Etho-STEAM Skill	Indonesian school Learning Local wisdom Management Model Outcome Physic Preservice biology teacher Primary school student Project Research scientific literacy Secondary school	Study Teaching material Thailand Tools Utilization Stem Approach Student Student critical thinking Chemistry Hot Impact implementation
II	Green	Art Arts century skill engineering ethno science Indonesian curriculum technology	Mathemathics Microbiology Multimedia Development Reviews Science Science attitude Student creative thinking	Science educations Science technology engineering STEAM STEM STEM educations Student worksheet
III	Blue	Ability Analysis Android Creativity Junior high school	Media Method Motivation Role Literature review	Self-efficacy Student problem Term Schoology Science subject
IV	Yellow	Application Approach Discovery Indigenous knowledge Influence	Learning model Pre service teaching Science environmental technology	Society Teaching Type Use
V	Purple	Blended Effectiveness Evaluation Indonesia STEM implementation Teacher belief	Javanese learning material local wisdom curriculum perbandingan mode discovery learning school	

Based on table 5, the clusters are described in the existing data visualization stage. The total number of clusters is as many as 12 clusters. The presentation of data in the table is limited to 5 clusters, namely clusters 1 to 6 with cluster colors of red, green, blue, yellow and purple. These clusters are the top clusters with the terms that have the most connections between each other.

Terms in the same cluster are characterized as having many relationships in the same study and being researched in one joint research title. The cluster level indicates how strong the relationship between terms between clusters is. Cluster I has a stronger relationship with cluster II compared to the relationship between cluster I and cluster III. Term/items in cluster I with a total of 38 items including Animation learning media, Assessment, Case, Comparison, Creative thinking skill, Critical thinking skill, Development, E module, Effect, Elementary school, Ethno-STEAM, Indonesian school, Learning, Local wisdom, Management, Model, Outcome, Physic, Pre service biology teacher, Primary school student, Project, Scientific research literacy, Secondary school, Skill, Study, Teaching material, Thailand, Tools, Utilization, Stem approach, Student, Student critical thinking, Chemistry, Hot, Impact, implementation, have a strong relationship with each other.

Cluster I also has the strongest relationship with cluster II (green) with items including Art, Arts, century engineering skills, ethnoscience, Indonesian curriculum, technology, mathemathics, Microbiology, Multimedia development, Reviews, Science, Science attitude, Student creative thinking Science

educations, Science technology engineering, STEAM, STEM, STEM educations, Student worksheets. Items from clusters I and II are where local wisdom, character and STEM are located. This shows that these three items have many joint publications in research publications.

Using item and network analysis helps researchers see which studies are frequently and rarely conducted. Research that is rarely done will give our research a greater disciplinary rate compared to already frequent research. Therefore, the selection of items based on network visualization is one of the decision supporters before conducting further research on a research theme.

The analysis is in the form of an analysis of the research development based on time or year. The visualization results of the development over time can be seen in figure 4 in overlay visualization.

FIGURE 4
OVERLAY VISULIZATION STEM-LW CHARACTER RESEARCH
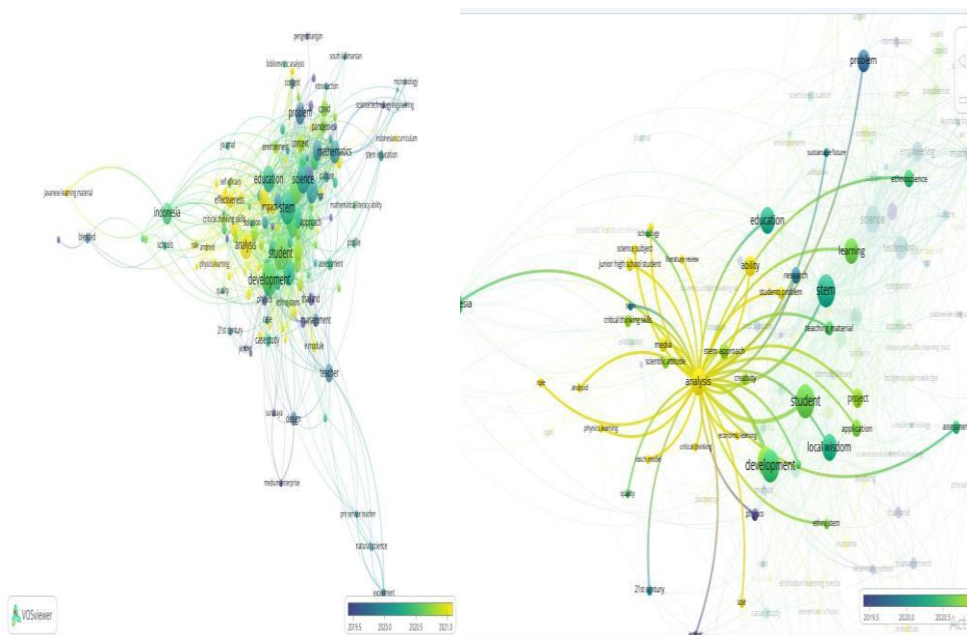
According to Figure 4, which shows the development of research trends from time to time, the purple color symbolizes the research that has often been done in previous years. The gradation of colors towards the youngest color, yellow, is the latest research trend ever carried out. Old research trends include item identification, implementation, problem, and comparison research.

Research items currently trending until 2022 are items on analysis, effectiveness, ability, impact, creativity, stem approach, use, media, android, use, science subject, discovery, and e-module. The latest research trends can help new researchers choose the direction of research trends so that they are not timeless.

Bibliometrics analysis with landscape depictions can assist researchers in making decisions and determining variables appropriate to the development of research in that theme. One of the advantages of the results of this visualization is that researchers have the opportunity to get high citations in recent studies (Al Husaeni, 2022; Nyirahabimana et al., 2022; Putra, 2021; Haryandi et al., 2021; Mardiastuti et al., 2021).

FIGURE 5
DENSITY VISUALIZATION STEM-LW CHARACTER RESEARCH

Density visualization analysis shows the frequency with which items in the cluster appear in the title. The cluster density shown in Figure 5 shows that the items' frequencies appear in a balanced alignment in the existing research title. The bolder the color in the density visualization indicates that the item appears more often.

In figure 5, the cluster density is dominated by items from clusters I and II, namely items animation learning media, assessment, case, comparison, creative thinking skill, critical thinking skill, development, e module, effect, elementary school, ethno-steam, Indonesian school, learning, local wisdom, management, model, outcome, physic, pre-service biology teacher, primary school student, project, scientific research literacy, secondary school, skill, study, teaching material, Thailand, tools, utilization, stem approach, student, student critical thinking, chemistry, hot, impact, implementation and in cluster II including art, arts, century engineering skills, ethnoscience, Indonesian curriculum, technology, mathematics, microbiology, multimedia development, reviews, science, science attitude, student creative thinking science educations, science technology engineering, STEAM, STEM, STEM educations, student worksheets.

Implications of STEM-LW Research

Based on the processing and analysis of data carried out. The development of STEM-LW research is dominated by research in education, including the development, implementation, influence of a model on learning with the impact of cognitive abilities and psychomotor skills.

The impact in attitude, character and everything that belongs to the affective has not yet appeared in the picture of the research carried out. Existing publications have not collaborated on STEM-LW by elevating the impact of character/attitude/affective. This means there is no picture of the impact of applying STEM-LW on character. STEM-LW collaboration with character impact is a novelty in the development of STEM-LW research.

CONCLUSION

Based on the results of the extraction and analysis of data that has been carried out, it can be concluded that there are a total of 750 publications in the period 2007-2022, which came from 3 indexers and the total articles after submission were 467 article items that met the requirements with STEM-LW character keyword. Journal articles are predominantly from Indonesia with three developmental periods, namely the pioneer period, the development period, and the stable period. development being the top item that appears most often in the article, and perception is the most relevant item. The direction of STEM-LW character research is toward education, including development, analysis and implementation in learning. Development research trends are in item analysis, effectiveness, ability, impact, creativity, and stem

approach. The clusters that are most often used as side topics in research are class I and II. No impact emphasizes STEM-LW on character.

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