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# A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades

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## Abstract

Many studies measure self-regulated learning in some fields but still a few studies in the education field or related fields. This study aimed to analyze performance analysis and science mapping related to the research trend in self-regulated learning over the past three decades. Therefore, it was conducted using the bibliometric analysis method on 2106 documents related to self-regulated learning published in the period 1990-2022 from the Scopus database. Those documents are limited in the final stage, English, journal source type, and article document type. The chosen subject areas were art and humanities, psychology, and social sciences which have a relation with the education field. The data analysis process was assisted by Publish or Perish and VOSviewer software to examine the publication and citation-related metric, publication, and citation trend analysis, citation analysis, co-authorship analysis, and co-word analysis. The results of this study are the trend and development of research regarding self-regulated learning over the past three decades presented that: 1) the publication-and-related metric in this study showed that there were 2,106 papers related to self-regulated learning which distributed in range 1990-2022 that has 20,752 citations and the h-index value is lower than g-index value, 2) the publication-and-citation trend analysis showed relatively fluctuative in periods and constant in particular year, 3) the citation analysis showed that the most influential document is written by B. J. Zimmerman in 2008 that has been cited around 1664 times, 4) the author who has collaborated the most with other authors is Järvelä, S., 5) the United Stated is the most productive and influential country who make studies in self-regulated learning, 6) the most productive organization is University of Oulu, Finland and the the most influential organization is the Department of Educational Psychology, Graduate Center, City University of New York, and 7) the 'self-regulated learning' keyword has the most occurrence amount 1766 times. These findings provide an overview of the evolution of self-regulated learning research papers during the last three decades. This study examines a period of time that was longer than previous studies. As a consequence, its resulting contribution is also larger, providing an overview of the field's evolution over the last 30 years and providing other researchers with a comprehensive resource for performing self-regulated learning research.

**Keywords:** bibliometric analysis, self-regulated learning, the past three decades, trend of studies

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## 1. Introduction

Self-regulated learning was introduced by Zimmerman in the 1980s (DiBenedetto and Zimmerman 2013; Linling and Abdullah 2022; Wong et al. 2019; Zimmerman 1989). Zimmerman explained that in general students can regulate themselves metacognitively, motivationally, and in terms of their behavior in their learning process (Jaramillo, Salinas-cerda, and Fuentes 2022). These stu-

dents personally direct themselves to acquire knowledge and skills rather than relying on teachers, parents, or other agents for guidance (Ishartono et al. 2022). In learning, students must involve certain strategies to achieve academic goals as a basis for perceptions of self-efficacy, including a) self-regulated learning strategies, b) self-efficacy perceptions of performance skills, and c) commitment to the goal. Self-Regulated Learning (SRL) is one component that can affect students' academic achievement. Students who have high SRL will also tend to have high academic achievement, conversely, students who have SRL problems will very likely have learning difficulties (Dian, Iffah, and Tristanti 2022; Sulistiawati and Surgandini 2019). Thus, SRL can be interpreted as self-evaluation of task progress, organizing, subject matter, making plans and learning goals, seeking information, taking notes on important matters, managing the environment, self-consequences after doing assignments, repeating and remembering, seeking social assistance, review previous notes, assignments, tests or materials.

Currently, many studies measure SRL in some fields or subject areas. Research on SRL in mathematics learning has been carried out by (Ansari et al. 2021) which examines variations in students' learning strategies and self-regulated learning in solving students' higher-order thinking skills problems and the result shows that the majority of students have better SRL. Another example such as (Blackmore et al. 2021) which reviews students' SRL in the fields of Science, Technology, Engineering, and Mathematics (STEM) refers to Zimmerman's model. In addition, there is also research that examines the SRL of first-year university students in online learning during the Covid-19 pandemic (Liebendörfer, Kempen, and Schukajlow 2022). However, there are still few studies reporting the development of research trends on the SRL variable. Therefore, in this study, the development of research on SRL will be studied using bibliometric analysis. Bibliometrics is a method of applying mathematics to books and other communication media which quantitatively analyzed both mathematical and statistical methods (Al Husaeni and Nandiyanto 2022). This method is used for exploring and analyzing large volumes of scientific data to present emerging trends in a topic or field from a reputable database (Donthu et al. 2021; Sulistiawati et al. 2023; Syahmani et al, 2021).

Research on bibliometrics in SRL has been carried out by previous researchers. First, research on the analysis of the development of studies on SRL from 2017 to 2021 using the Publish or Perish database (Saepulmilah and Azhari 2022). Second, research on bibliometric analysis of SRL research in flipped classrooms with the Scopus database shows an increase in publications from 2015 to 2020 with China and the US being the most contributing countries (Linling and Abdullah 2022). As much as has been found, it seems that there is still no research on SRL that has analyzed performance and science mapping for more than 1 decade, while this research analyzes studies on SRL for more than 3 decades back using the Scopus database. Then, previous bibliometric studies touched on specific fields such as science, medicine, psychology, STEM, etc., while this study analyzes research trends of SRL simultaneously in the fields of art and humanities, psychology, and social science that are close to the education field. We choose the fields because there is no education field as a subject area in the Scopus database. This is the gap in this study so that researchers aim to analyze research trends on SRL. This analysis includes performance

analysis and science mapping. This study contributes by offering an overview of the field's growth over the last 30 years and giving other researchers a comprehensive source of reference while conducting SRL research.

## 2. Method

The method used in this research is a descriptive method with a bibliometric approach. In its application, the bibliometric approach uses a quantitative technique (Donthu et al. 2021; Putri et al. 2022). This study uses the Scopus database because it is a data source with high quality and reputation (Baas et al. 2020; Putera et al. 2020). The results of the bibliometric analysis present research trends in a field of knowledge related to publication and citation metrics as the mapping of knowledge and networks (Hudha et al. 2020). Data analysis was carried out both quantitatively and qualitatively, in which quantitative included evaluation and interpretation while qualitative is interpretation only.

The bibliometric analysis consists of 2 techniques, namely: 1) the main technique which is divided into performance analysis and science mapping, and 2) enrichment. This study uses performance analysis and science mapping only. This analysis will be assisted by network visualization, overlay visualization, and density visualization displayed by the VOSviewer to make it easier to read. This software also gives information about network metrics and clustering (Waltman, van Eck, and Noyons 2010). There are 5 steps in the bibliometric analysis as presented in Figure 1 (Fahimnia, Sarkis, and Davarzani 2015; Setyaningsih, Indarti, and Ferry 2018).

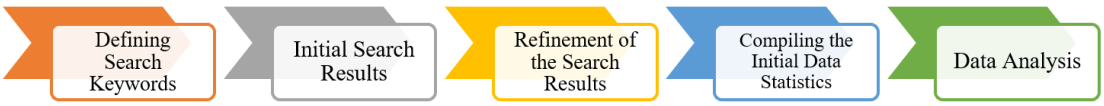


**Figure 1. Bibliometric Steps Analysis**

### a. Defining Search Keywords

The chosen keyword is 'self-regulated learning' which is used to search literature on the Scopus Database which was conducted on January 2, 2023, at 20:05 Western Indonesian Time by typing 'self AND regulated AND learning'. As an initial part, the researchers select a part of the document, keywords are written in the sub-section of the document which is the 'search document'. The 'article title, abstract, keyword' format in the Scopus database was chosen to find a large amount of literature.

### b. Initial Search Results

Searching the documents that are suitable for 'self-regulated learning' resulted from 7204 documents published in the range 1962-2023 sourced from journals, conference proceedings, books, book series, and trade journals. A total of 7018 documents are in the final stage and the rest are in the in-press stage. When the restrictions were narrowed on the languages used was English, 6664 documents were obtained. Furthermore, when restrictions were added that the articles come from the journal as a source type, 4738 documents are obtained. Then, when restrictions were added that the document type is the article, 4374 documents were obtained. Moreover, when the restrictions were narrowed in 1962-2022, 4363 documents were obtained. At this step, it turns out that documents were found where the used keywords were not self-regulated learning.

**c. Refining the Search Results**

Several inclusion criteria were set to obtain documents that fit this study. First, the title of the documents contains the keyword 'self-regulated learning. Second, the document is written in English. Third, the publication is in the final stage. Fourth, documents are sourced from journals and articles form. Fifth, documents published in the period 1962-2022. Systematically, to select documents that match the inclusion criteria, they are 4 steps: 1) identification, 2) screening), 3) eligibility, dan 4) inclusion (Donthu et al. 2021; Fuad et al. 2022). Figure 2 below presents the details of the four steps.

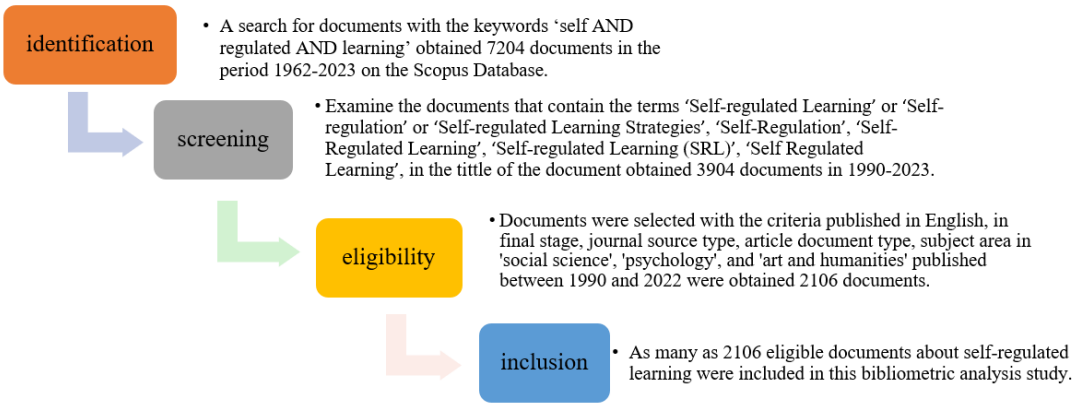


**Figure 2. Steps in Refining the Search Results of Bibliometric Analysis related to 'self-regulated learning'**

From Figure 2, it was obtained that as many as 2106 related to SRL in the range 1990-2022, use English, in the final stage, from journal source type, in article document type, and include in Art and Humanities, Psychology, and Social Science subject areas.

**d. Compiling the Initial Data Statistics**

Documents that meet the requirements and are included as a research data source are downloaded from the Scopus database in 2 formats, namely Comma Separated Values (CSV) and Research Information System (RIS). CSV and RIS. These formats contain several important information such as bibliometric and bibliographic information which provide information in total publications, total citations, number of authors per publication, number of citations per year, number of citations per year, h-index and g-index (Fuad et al. 2022; Hudha et al. 2020; Muhammad et al. 2022). In addition, the RIS format opened in Publish or Perish software provides information about citations, documents titles, authors, document type, source, year of publication, and publisher (Fahimnia et al. 2015).

**e. Analyzing the Data**

Data analysis in this study consisted of performance analysis and science mapping.

**1) Performance Analysis**

Science mapping in this study includes publication-and-citation-related metrics and publication-and-citation trend analysis (Donthu et al. 2021). The analysis of publication-and-citation-related metrics was carried out by presenting the results of publication and citation measurements whose data were obtained from Publish or Perish. This measurement is related to year and total publication, year and total citations, number of citations per year and paper, number of authors per document, h-index, and g-index.

**2) Science Mapping and Network Analysis**

Data analysis related to science mapping and network analysis was carried out by conducting citation analysis, co-authorship, and co-word analysis (Donthu et al. 2021). In this study, performance analysis is used to present the development of publications and citations related to SRL studies. Citation analysis is used to present productive and influential documents, authors, countries, sources, and institutions, whereas co-authorship analysis is used to present social interactions between authors and their institutions and countries related to SRL studies. Furthermore, co-word analysis is used to present the most occurrence keywords in the current period. In addition, network visualization, overlay visualization, and density visualization are performed and hierarchical clustering is presented to enrich citations, co-authorship, and co-word analysis. These visualizations are output from VOSviewer software (van Eck and Waltman 2010).

## 3. Result and Discussion

This section presents the results of analysis 2106 data related to SRL originating from the Scopus database by presenting the performance analysis and science mapping. This analysis used Publish or Perish (PoP) and VOSviewer software (Al Husaeni and Nandiyanto 2021; Yu et al. 2020).

### a. Performance Analysis

Generally, The data were exported from the Scopus database into RIS format file type. Then, they were input into PoP software (Harzing 2010) and VOSviewer (van Eck and Waltman 2018).

#### 1) Publication and citation-related metric

The citation metrics information is obtained from the RIS document format of the Scopus database related to SRL that was input to Publish or Perish software. The result can be seen in Table 1 below.

**Table 1. Citation Metrics Related to Self-Regulated Learning**

| Description | Result |
|---|---|
| Publication years | 1990-2022 |
| Citation years | 33(1990-2023) |
| papers | 2,106 |
| citations | 60,752 |
| Cites/year | 1,840.97 |
| Cites/paper | 28.85 |
| Author/paper | 3.02 |
| h-index | 109 |
| g-index | 182 |
| hI,norm | 68 |
| hI,annual | 2.06 |
| hA,index | 28 |

From Table 1, it can be seen that the publications were produced from 1990 to 2022 with a total of 2106 publications and have been cited 60,752 times. The table also informs that the citation average was stated as 1,840.97 which means that each year (1990 to 2022) the documents have been cited close to 1841 times. In addition, the average of citations per paper was stated at 28.85 which means each document is cited almost 3 ti-

mes. Furthermore, the average of authors per paper was stated as 3.02 which shows each document is authorized by 3 authors. On the other hand, the h-index of the document collection was 109 which means there are 109 documents with at least 109 citations, meanwhile, the g-index is 182 which means there are 182 papers with at least 121 citations. The indexes result shows that the value of the h-index is lower than the g-index. This result is following the results of previous studies (Donthu et al. 2021; Fuad et al. 2022)

**2) Publication and citation trend analysis**

This analysis was used to display the development of publication and citation regarding SRL studies in the period 1990-2022. Figure 3 shows the development of SRL studies around the world.

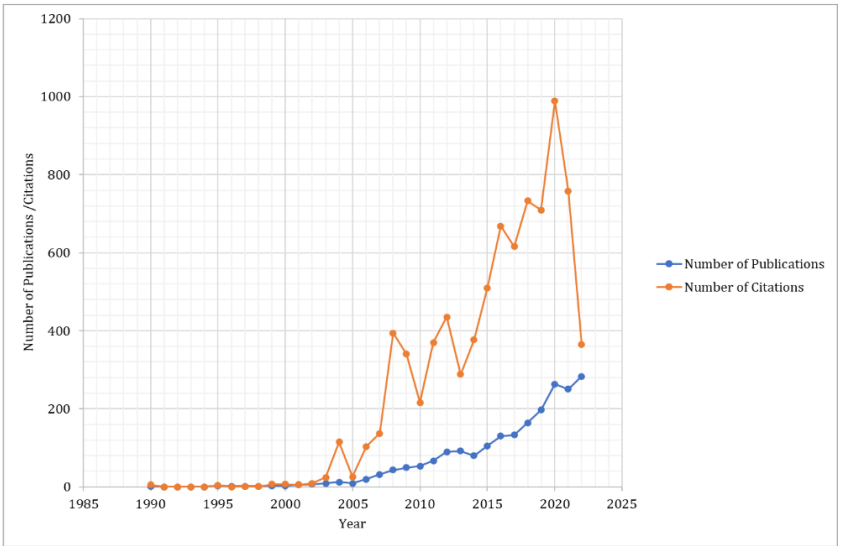


**Figure 3. The Development of Publication and Citation of The Studies about Self-Regulated Learning**

Figure 3 above shows that the development of publications related to SRL studies was relatively constant from the period 1990 to 2000 and relatively increased lustrum by lustrum started in the early 2000s to 2020 both for the number of publications and citations. From Figure 3, it is also seen that from 2020 to 2022 the number of publications and citations has decreased. The decrease in the number of publications and citations is most likely due to the presence of the Covid-19 pandemic which emerged at the end of 2019 that changes the life and research subject focuses (Riccaboni and Verginer 2022; Stuart et al. 2022). This data informs that there is a positive correlation between the number of publications and citations related to SRL: the greater number of publications, the greater number of citations, and vice versa. This result is following previous research (Sjögårde and Didegah 2022)

For the development of a publication, there is an increase in document publications number from 1998 to 1999, 2000 to 2004, 2005 to 2013, 2014 to 2020, and 2021 to 2022. Meanwhile, decreasing occurred from 2004 to 2005, 2013 to 2014, and 2020 to 2021, and constant document publication numbers occurred from 1996 to 1998 and 1999 to 2000. For the development of citation studies, an increase in the number of citations occurred in the period 2002 to 2004, 2005 to 2008, 2010 to 2012, 2013 to 2016, 2017 to 2018, and 2019 to 2020, while a decrease occurred in the period 2004 to 2005, 2008 to 2010, 2012 to 2013, 2016 to

2017, 2018 to 2019, and 2020 to 2022. The highest number of citations occurred in 2020 as many as 989 citations and the lowest one occurred in 1998 as many as 0.04 citations. There are no citations in the years 1994, 1995, 1996, and 1997 because there are no publications on these years. On the other hand, at the beginning of the period in 1990, there are 5 citations and at the end of 2022, there are 365 citations out of 8,211.14 citations. It informs that the number of publications and citations related to SRL over the past three decades is relatively fluctuating in some periods and constant in a particular year. This result is following previous research (Aksnes, Langfeldt, and Wouters 2019).

**b. Science Mapping and Network Analysis**

**1) Citation Analysis**

This analysis was employed to show the productive and influential documents, authors, countries, sources, and institutions related to SRL published from 1990 to 2022. To show the productive authors, countries, sources, and institutions, the number of publications was used while the number of citations was used to show the influential documents, authors, countries, sources, and institutions. Firstly, the influential documents were represented by the top 3 documents with the highest citation obtained from Publish or Perish software as we can see in Table 2 below.

**Table 2. Top Three Documents Related to Self-Regulated Learning with the Highest Citations**

| No | Document Title | Author | Source | Year | Cites | Cites/Year | Cites/Author |
|---|---|---|---|---|---|---|---|
| 1 | Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects | B.J. Zimmerman | American Educational Research Journal | 2008 | 1664 | 110.93 | 1664 |
| 2 | A conceptual framework for assessing motivation and self-regulated learning in college students | P.R. Pintrich | Educational Psychology Review | 2004 | 1432 | 75.37 | 1432 |
| 3 | Developing the theory of formative assessment | P. Black, D. Wiliam | Educational Assessment, Evaluation, and Accountability | 2009 | 1309 | 93.50 | 655 |

Table 2 shows that the most influential document related to the studies of self-regulated learning was written by B. J. Zimmerman in 2008 with the title 'Investigating self-regulation and motivation: Historical background, methodological developments, and prospects' (Zimmerman 2008). This document has been cited by other relevant studies as many as 1664 times. An example is the study on SRL in Iranian EFL learners (Mahmoodi, Kalantari, and Ghaslani 2014)

Secondly, the productive authors were represented by the top 3 authors with the highest publication while the influential authors were represented by the top 3 authors with the highest citation as we can see in Table 3.

**Table 3. Top 3 Authors with the Highest Publication and Citations**

| The Productive Authors | | | The Influential Authors | | |
|---|---|---|---|---|---|
| Author | Institution/ Country | Total Publication | Author | Institution/ Country | Total Citation |
| Winne, P. H. | Simon Fraser University, Canada | 6 | Zimmerman, B. J. | City University of Newyork, USA | 1829 |
| Moos, D. C. & Azevedo, R. | University of Maryland, USA & University of Memphis, USA | 4 | Pintrich, P. R. | University of Michigan, USA | 1438 |
| Vassallo, S. | American University, USA | 4 | Black, P. & William, D. | King's College London, UK | 1309 |

Of the 4400 authors involved in this study, Winne, P. H. was the most productive author who had published 6 documents related to the SRL study affiliated with Simon Fraser University, Canada. One of his publications is about a metacognitive view of individual differences in self-regulated learning (Winne 1996). Meanwhile, the most influential author related to SRL is Zimmerman, B. J. who is affiliated with the City University of Newyork, USA (Zimmerman 1989). His documents have been cited by other relevant studies about 1829 times.

**2) Co-Authorship Analysis**

Co-authorship analysis was used to present the social interactions among authors and their institutions and countries related to SRL studies. This analysis was supported by the visualization analysis and the hierarchical clustering analysis (Fuad et al. 2022).

**a) Co-Authorship Analysis with Authors' Unit Analysis**

The analysis in co-authorship with authors unit analysis presented the social relationships among authors who studied SRL. This analysis will help identify groups of people who work closely together. This analysis was conducted by selecting the full counting method and the minimum number of documents of an author of about 3 authors which resulted in 894 meetings the threshold and 196 inter-connected authors. The visualization can be seen in Figure 4.

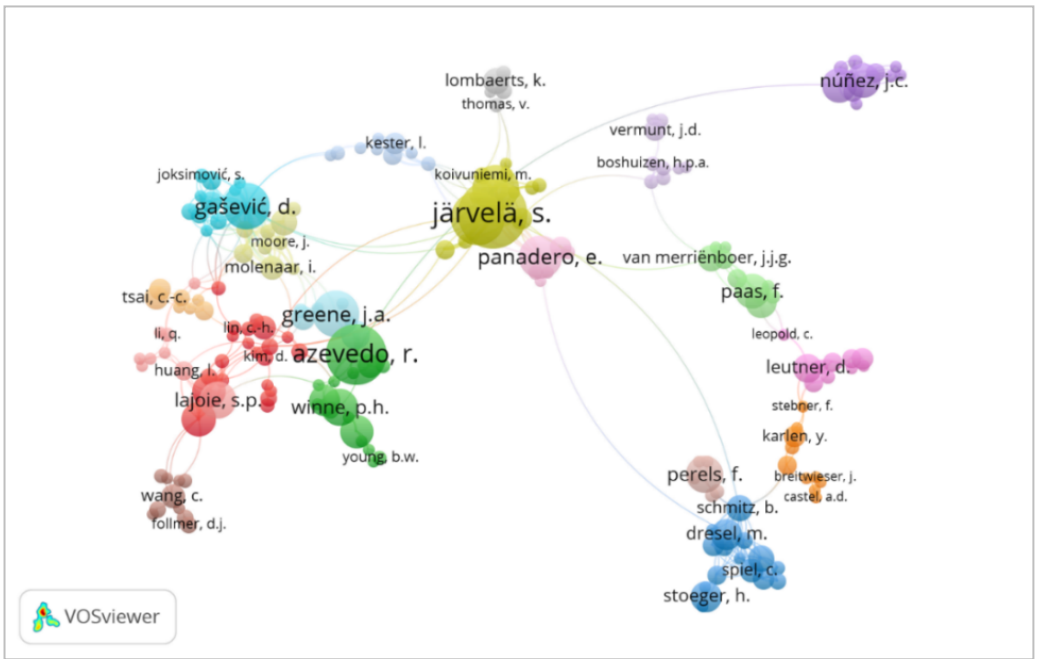


**Figure 4. Network Visualization of Co-Authorship Analysis in the Unit Author with the Minimum Number of Documents of An Author is 3 Authors**

Figure 4 above shows that there were 196 inter-connected authors (items) related to self-regulated learning studies come from 19 clusters such as cluster 1 in red color, cluster 2 in green color, cluster 3 in blue color, cluster 4 in yellow color, cluster 5 in purple color, cluster 6 in cyan color, cluster 7 in orange color, cluster 8 in brown color, cluster 9 in magenta color, cluster 10 in light red color, cluster 11 in light green color, cluster 12 in light blue color, cluster 13 in light yellow color, cluster 14 in light purple color, cluster 15 in light cyan color, cluster 16 in light orange color, cluster 17 in light brown color, cluster 18 in pink color, and cluster 19 in grey color. There are 483 links and 1111 total link strength. Based on the figure, it can be seen that the author named Järvelä, S. from cluster 4 has the biggest name label and circle symbol. It means that Järvelä, S. is the author who has collaborated the most with other authors regarding self-regulated learning studies. Later, this condition occurred in other authors such as Azevedo, R. from cluster 2, Gašević, D. from cluster 6, Núñez, J. C. from cluster 5, and so on. In detail, these authors were hierarchically clustered into 19 groups which can be seen in Table 4.

Table 4 shows that the highest inter-connected is cluster 1 (red) amount 21 inter-connected. An example of the author from cluster 1 is Li, S. who has published 13 documents that have the biggest name label and circle symbol among other authors. It shows that he has collaborated the most with other authors in writing the SRL study. Otherwise, the lowest inter-connected is cluster 19 (grey) amount 5 interconnected. In this case, Lombaerts, K. is the author who has the biggest name label and circle symbol among other authors. This means he is the author who has intertwined with other authors regarding SRL.

As additional information, the collaboration between the authors occurred in the period year of 2014 to 2020. It can be seen in the overlay visualization in Figure 5 below.

**Table 4. The Results of the Hierarchical Clustering Analysis of the Author's Social Interaction**

| Hierarchical clustering analysis | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cluster Number | Cluster Color | Author | Total Link Strength | Cluster Number | Cluster Color | Author | Total Link Strength |
| 1 (21 items) | Red | Baker, R. S. | 3 | 8 (10 items) | Brown | Du, J. | 3 |
| | | Biswas, G. | 4 | | | Follmer, D. J. | 3 |
| | | Chen, G. | 13 | | | Gan, Z. | 4 |
| | | Chen, J. | 3 | | | Li, H. | 4 |
| | | Guo, W. | 3 | | | Ogata, H. | 1 |
| | | Huang, X. | 13 | | | Sperling, R. A. | 4 |
| | | Kim, D. | 7 | | | Wang, C. | 5 |
| | | Lau, K. L. | 1 | | | Wang, Y. | 2 |
| | | Li, J. | 4 | | | Xu, J. | 4 |
| | | Li, S. | 32 | | | Yan, Z. | 1 |
| | | Lin, C. -H. | 7 | 9 (10 items) | Magenta | Fleischer, J. | 12 |
| | | Song, D. | 4 | | | Fries, S. | 5 |
| | | Wang, Q. | 9 | | | Grunschel, C. | 6 |
| | | Wang, X. | 3 | | | Leopold, C. | 4 |
| | | Wang, Z. | 3 | | | Leutner, D. | 19 |
| | | Xie, C. | 14 | | | Roelle, J. | 6 |
| | | Xing, W. | 12 | | | Schwinger, M. | 5 |
| | | Yoon, M. | 4 | | | Steinmayr, R. | 5 |
| | | Zhang, Y. | 9 | | | Waldeyer, J. | 11 |
| | | Zheng, B. | 5 | | | Wirth, J. | 15 |
| | | Zheng, J. | 29 | 10 (10 items) | Light red | Chen, H. | 7 |
| 2 (17 items) | Green | Azevedo, R. | 32 | | | Chen, W. | 3 |
| | | Baker, J. | 4 | | | Huang, I. | 12 |
| | | Bouchet, F. | 6 | | | Jiang, Y. | 6 |
| | | Di Leo, I. | 3 | | | Lajoie, S. P. | 24 |
| | | Duffy, M. C. | 4 | | | Li, Q. | 7 |
| | | Hadwin, A. F. | 9 | | | Liu, J. | 4 |
| | | Lester, J. | 8 | | | Poitras, E. G. | 6 |
| | | Mccardle, L. | 5 | | | Warschauer, M. | 2 |
| | | Muis, K. R. | 7 | | | Xiang, P. | 4 |
| | | Nesbit, J. C. | 3 | 11 (9 items) | Light green | Baars, M. | 20 |
| | | Perry, N. E. | 2 | | | De Bruin, A. B. H. | 8 |
| | | Smith, A. | 3 | | | De Koning, B. B. | 9 |
| | | Taub, M. | 13 | | | Paas, F. | 24 |
| | | Trevors, G. | 5 | | | Rovers, S. F. E. | 8 |
| | | Webster, E. A. | 4 | | | Savelberg, H. H. C. M. | 8 |
| | | Winne, P. H. | 9 | | | Van Gog, T. | 9 |
| | | Young B. W. | 4 | | | Van Merriënboer, J. J. G. | 17 |
| | | | | | | Wong, J. | 11 |
| 3 (16 items) | Blue | Dresel, M. | 23 | 12 (9 items) | Light blue | Drachsler, H. | 4 |
| | | Eckerlein, N. | 10 | | | Jansen, R. S. | 10 |
| | | Engelschalk, T. | 22 | | | Janssen, J. | 19 |
| | | Finsterwald, M. | 16 | | | Kalz, M. | 5 |
| | | Jöstl, G. | 14 | | | Kester, L. | 19 |
| | | Klug, J. | 20 | | | Phielix, C. | 15 |
| | | Lüftenegger, S. | 24 | | | Scheffel, M. | 3 |
| | | Obergriesser, S. | 3 | | | Van Alten, D. C. D. | 9 |
| | | Schmitz, B. | 17 | | | Van Leeuwan, A. | 10 |
| | | Schober, B. | 35 | 13 (9 items) | Light yellow | Bannert, M. | 33 |
| | | Sontag, C. | 4 | | | Fan, Y. | 37 |
| | | Spiel, C. | 31 | | | Kilgour, J. | 30 |
| | | Steuer, G. | 23 | | | Lim, L. | 37 |
| | | | | | | Molenaar, I. | 31 |

| Hierarchical clustering analysis | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cluster Number | Cluster Color | Author | Total Link Strength | Cluster Number | Cluster Color | Author | Total Link Strength |
| | | Stoeger, H. | 9 | | | Moore, J. | 30 |
| | | Wagner, P. | 16 | | | Rakovic, M. | 19 |
| | | Zieglar, A. | 12 | | | Reimann, P. | 3 |
| 4 (13 items) | Yellow | Dindar, M. | 12 | | | Van Der Graaf, J. | 30 |
| | | Haataja, E. | 17 | 14 (9 items) | Light purple | Boshuizen. H. P. A. | 7 |
| | | Hirsto, L. | 1 | | | Brand-Gruwel, S. | 10 |
| | | Järvelä, S. | 79 | | | Brekelmans, M. | 6 |
| | | Kirscner, P. A. | 23 | | | Donche, V. | 2 |
| | | Koivuniemi, P. A. | 16 | | | Endedijk, M. D. | 7 |
| | | Malmberg, J. | 65 | | | Jossberger, H. | 10 |
| | | Näykki, P. | 10 | | | Van De Wiel, M. W. J. | 10 |
| | | Pyhältö, K. | 2 | | | Van Den Bossche, P. | 4 |
| | | Saqr, M. | 8 | | | Vermunt, J.D. | 8 |
| | | Törmänen, T. | 9 | 15 (7 items) | Light cyan | Aleven, V. | 1 |
| | | Volet, S. | 2 | | | Bernacki, M. L. | 8 |
| 5 (11 item) | Purple | Cerezo, R. | 8 | | | Costa, L. -J. | 3 |
| | | Fernández | 10 | | | Greene, J. A. | 17 |
| | | García, T. | 7 | | | Moos, D. C. | 9 |
| | | González-castro, P. | 7 | | | Panter, A. T. | 6 |
| | | González-pienda, J. | 8 | | | Winters, F. I. | 4 |
| | | González-pienda, J. A. | 15 | 16 (7 items) | Light orange | Hu, H. | 6 |
| | | Núñez, J. C. | 33 | | | Li, X. | 5 |
| | | Rodríguez, C. | 7 | | | Li, Y. | 11 |
| | | Rosário, P. | 29 | | | Liang, J.-C. | 9 |
| | | Valle, A. | 15 | | | Peng, Y. | 5 |
| | | Vallejo, G. | 8 | | | Su, Y. | 9 |
| 6 (11 items) | Cyan | Dawson, S. | 12 | | | Tsai, C. -C. | 9 |
| | | Gašević | 67 | 17 (6 items) | Light brown | Büttner, G. | 2 |
| | | Gentili, S. | 13 | | | Dignath, C. | 4 |
| | | Hatala, M. | 6 | | | Dörrenbächer, L. | 3 |
| | | Joksimović, S. | 8 | | | Dörrenbächer, S. | 6 |
| | | Jovanović, J. | 18 | | | Jacob, L. | 6 |
| | | Maldonado-Mahauad, J. | 10 | | | Perels, F. | 12 |
| | | Matcha, W. | 13 | | | | |
| | | Pardo, A. | 18 | 18 (6 items) | Pink | Alonso-Tapia, J. | 5 |
| | | Pérez-sanagustín, M. | 10 | | | Broadbent, J. | 7 |
| | | Siadaty, M. | 6 | | | Fraile, J. | 7 |
| 7 (10 items) | Orange | Bellhäuser, H.. | 6 | | | Fuller-tyszkiewicz, M. | 6 |
| | | Breitwieser, J. | 5 | | | Gárcia-Pérez, D. | 6 |
| | | Brod, G. | 5 | | | Panadero, E. | 33 |
| | | Castel, A. D. | 2 | 19 (5 items) | Grey | De Backer, F. | 12 |
| | | Hertel, S. | 6 | | | Engels, N. | 4 |
| | | Hirt, C. N. | 5 | | | Lombaerts, K. | 14 |
| | | Karlen, Y. | 8 | | | Peeters, J. | 8 |
| | | Murayama, K. | 5 | | | Thomas, V. | 11 |
| | | Stebner, F. | 6 | | | | |
| | | Theobald, M. | 4 | | | | |

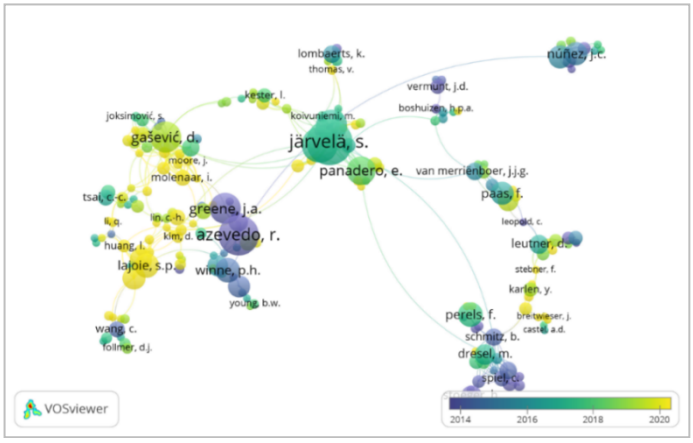


**Figure 5. Overlay Visualization of Co-Authorship Analysis in the Unit Author with the Minimum Number of Documents of An Author is 3 Authors**

Figure 5 shows that the authors who have the most co-authorship related to SRL successively occurred in 2016-2018 and 2014-2016. However, fewer co-authorship occurred in 2018-2020.

**b) Co-authorship analysis with countries unit analysis**

Co-authorship analysis with country unit analysis presents the social relationships among countries that studied SRL (Donthu et al. 2021). This analysis was conducted by selecting the minimum number of documents of a country as many as 2 documents. The result is visualized in Figure 6

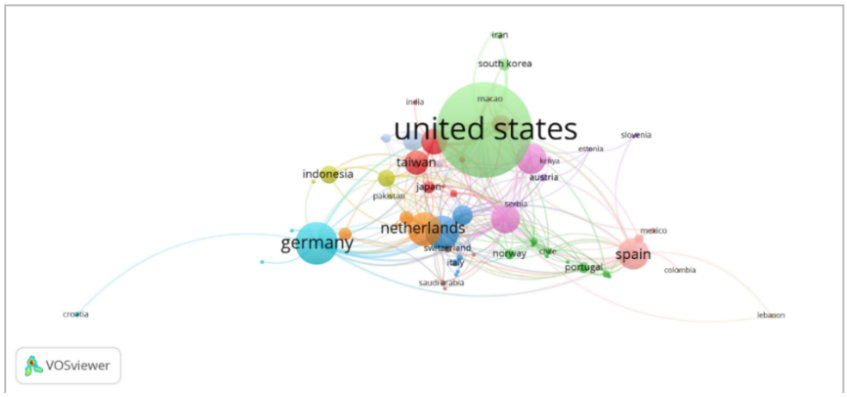


**Figure 6. Network Visualization of Co-Authorship Analysis in the Countries Unit Analysis with the Minimum Number of Documents of An Author is 2 Documents**

The figure above presents that there are 91 inter-connected that are distributed into 19 clusters and 705 Total Link Strengths (TLS). This figure also obtained 68 interconnected countries between countries that carried out related SRL studies which were distributed into 14 clusters and 670 TLS. Cluster 1 consists of 10 inter-connected countries, cluster 2 consists of 9 inter-connected countries, cluster 3 consists of 6 inter-connected countries, cluster 4 consists of 6 inter-connected countries, cluster 5 consists of 6 inter-connected countries, cluster 6 consists of 5 inter-connected countries, cluster 7 consists of 4 inter-connected countries, cluster 8 consists of 4 inter-connected countries, cluster 9 consists of 4 inter-connected countries, cluster 10 consists of 4 inter-connected countries, cluster 11 consists of 4 inter-connected countries, cluster 12 consists of 3 inter-

connected countries, cluster 13 consists of 2 inter-connected countries and cluster 14 consists of 1 inter-connected country.

Figure 6, it was obtained pieces of information that the most productive country related to SRL studies is the United States (US) which produces 581 documents. This achievement was followed by Germany producing 194 documents (the 2nd), then the Netherlands producing 145 documents (the 3rd), later Australia producing 143 documents (the 4th), afterward Spain producing 130 documents (the 5th), and so on. Meanwhile, the most influential country is also the United States because it has the most citations i.e. 24,681 citations. The next most influential countries are Germany (the 2nd) amount 7,170 citations, then the Netherlands (the 3rd) amount 5,557 citations, later the United Kingdom (the 4th) amount 5,029 citations, and Canada (the 5th) amount 4873 citations.

In this discussion, the US is the most productive and influential country related to SRL study. This shows that researchers from other countries who make studies on SRL are oriented to the US (Purdie 2016), the author is Zimmerman (Zimmerman 1989, 2008; Zimmerman and Schunk 1989). The emerging results also show that the US is a country that has a large and significant contribution to self-regulated learning studies (Linling and Abdullah 2022).

**c) Co-authorship analysis with organizations unit analysis**

Co-authorship analysis with organizations unit analysis presents the social relationships among organizations that studied SRL (Donthu et al. 2021; Fuad et al. 2022). This analysis was conducted by selecting the minimum number of documents of an organization amount 1 document. The results are visualized as Figure 7.

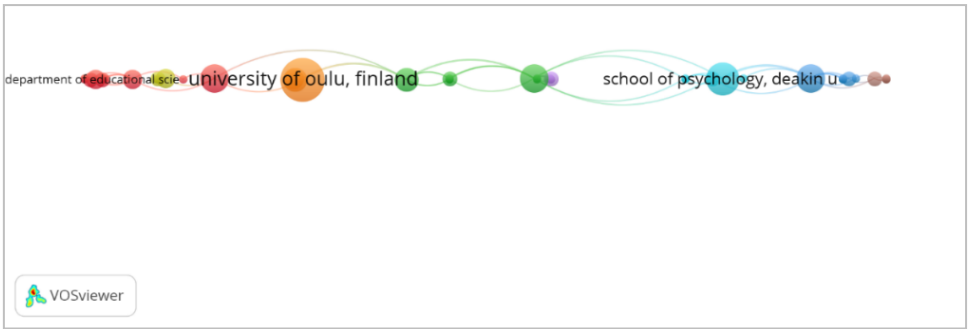


**Figure 7. Network Visualization of Co-Authorship Analysis in the Organizations Unit Analysis with the Minimum Number of Documents of an Author is 1 Document**

The choice of the minimum number of documents resulted in 3810 organizations so it meets 3810 thresholds. It also resulted in 66 inter-connected organizations that conducted the study of SRL distributed into 10 clusters and 147 Total Link Strength (TLS). Cluster 1 has 10 inter-connected organizations, cluster 2 has 8 inter-connected organizations, cluster 4 has 7 inter-connected organizations, cluster 5 has 6 inter-connected organizations, cluster 6 has 6 inter-connected, cluster 7 has 6 inter-connected, cluster 8 has 6 inter-connected organizations, cluster 9 has 6 inter-connected organizations, and cluster 10 has 3 inter-connected organizations.

In this analysis, it was found that the most productive organization was the University of Oulu, Finland because it produced the most documents related to self-regulated learning study i.e. 9 documents. It shows that the University has a concern about improving students' SRL (Vuorenmaa et al. 2022).

Moreover, the most influential organization is the Department of Educational Psychology, Graduate Center, City University of New York, US because it is the organization that has the most citations related to SRL i.e. 1669 citations. It shows that the City University of New York is the destination institution if researchers want to study SRL.

### 3) Co-Word Analysis

Co-word analysis is used to determine the keywords in the paper that appear frequently (Donthu et al. 2021; Fuad et al. 2022). Using the minimum occurrence keywords amount 10 times, resulting in network and density visualizations as in Figure 8.


**(i) Network visualization** **(ii) Density visualization**

**Figure 8. Visualizations of the Most Emerging Keywords Regarding Self-Regulated Learning with Minimum Occurrence Keywords 10 Times**

Figure 8 presents 225 interconnected keywords distributed into 7 clusters. These items have 7,468 links and 33,387 total link strength. It can be seen that the 'self-regulated learning' keyword has the biggest name label and circle symbol. It means that 'self-regulated learning' is a keyword that has the most occurrence, amount 1766 occurrences (Říčan, Chytrý, and Medová 2022; Yilmaz, Topu, and Takkaç Tulgar 2022). It is followed by 'self-regulation' amount of 266 occurrences, motivation amount of 246 occurrences, students amount of 227 occurrences, and so on. See Table 5 to see the complete hierarchical clustering of co-word analysis related to SRL.

**Table 5. The Results of the Hierarchical Clustering Analysis of the Author's Social Interaction**

| Hierarchical clustering analysis of the most emerging keywords | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cluster Number | Cluster Color | Keywords | TLS | Occurrence | Cluster Number | Cluster Color | Keywords | TLS | Occurrence |
| 1 (75 items) | red | Academic achievements | 77 | 10 | 2 (51 items) | Green | Achievement | 516 | 61 |
| | | Active learning | 71 | 14 | | | Analysis of variance | 180 | 12 |
| | | Behavioral research | 116 | 16 | | | Article | 1735 | 124 |
| | | Blended learning | 196 | 39 | | | Attitude | 67 | 10 |
| | | Cluster analysis | 101 | 15 | | | autoregulation | 503 | 31 |
| | | Cognitive load | 30 | 12 | | | Clinical article | 259 | 16 |
| | | Computer-aided instruction | 664 | 89 | | | Clinical clerkship | 137 | 10 |
| | | Covid-19 | 106 | 28 | | | Clinical competence | 421 | 25 |
| | | Critical thinking | 92 | 17 | | | Clinical education | 175 | 13 |
| | | Curricula | 246 | 33 | | | Cross-sectional studies | 191 | 10 |
| | | Data mining | 115 | 17 | | | Cross-sectional study | 191 | 10 |
| | | deregulation | 158 | 19 | | | curriculum | 281 | 18 |
| | | Distance education | 66 | 17 | | | Education, medical, undergraduate | 328 | 18 |
| | | Distance learning | 58 | 11 | | | Education, nursing, baccalaureate | 197 | 11 |
| | | e-learning | 939 | 140 | | | Educational measurement | 286 | 17 |
| | | Education | 1201 | 110 | | | Educational status | 167 | 10 |
| | | Education computing | 233 | 28 | | | goals | 319 | 22 |

| Hierarchical clustering analysis of the most emerging keywords | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cluster Number | Cluster Color | Keywords | TLS | Occurrence | Cluster Number | Cluster Color | Keywords | TLS | Occurrence |
| | | Educational data mining | 65 | 10 | | | Human | 2870 | 209 |
| | | Engagement | 62 | 14 | | | Human experiment | 1319 | 87 |
| | | Engineering education | 228 | 39 | | | Humans | 2174 | 146 |
| | | Flipped classroom | 162 | 26 | | | Interview | 144 | 10 |
| | | Flipped learning | 49 | 13 | | | Learning environment | 299 | 31 |
| | | Game-based learning | 45 | 11 | | | Learning goals | 115 | 10 |
| | | Help seeking | 43 | 11 | | | Major clinical study | 652 | 46 |
| | | Higher education | 445 | 120 | | | Medical education | 646 | 41 |
| | | Indiviadual differences | 28 | 11 | | | Medical school | 221 | 12 |
| | | Intelligent tutoring system | 88 | 13 | | | Medical student | 662 | 39 |
| | | Intelligent tutoring systems | 64 | 12 | | | Medical students | 134 | 10 |
| | | internet | 91 | 15 | | | Methodology | 164 | 11 |
| | | Intrinsic motivation | 41 | 10 | | | Nursing education | 222 | 13 |
| | | Latent profile analysis | 61 | 16 | | | Nursing student | 258 | 15 |
| | | Learning achievement | 80 | 11 | | | perception | 149 | 11 |
| | | Learning analytics | 331 | 63 | | | Problem based learning | 306 | 19 |
| | | Learning environments | 105 | 15 | | | Problem solving | 213 | 27 |
| | | Learning motivation | 89 | 16 | | | Problem-based learning | 312 | 26 |
| | | Learning outcome | 128 | 20 | | | procedures | 370 | 23 |
| | | Learning outcomes | 56 | 14 | | | Psychological aspect | 221 | 13 |
| | | Learning performance | 79 | 16 | | | Psychology | 724 | 43 |
| | | Learning strategy | 176 | 30 | | | Qualitative research | 252 | 20 |
| | | Learning systems | 598 | 90 | | | Questionnaire | 473 | 30 |
| | | Massive open online course | 154 | 20 | | | Self concept | 441 | 25 |
| | | Metacognitive skills | 33 | 11 | | | Self efficacy | 469 | 33 |
| | | Mobile learning | 74 | 16 | | | Self evaluation | 252 | 16 |
| | | mooc | 52 | 14 | | | Self- directed learning | 259 | 35 |
| | | Motivational beliefs | 57 | 12 | | | Skill | 391 | 24 |
| | | Motivational regulation | 25 | 11 | | | Students, medical | 606 | 34 |
| | | Online course | 95 | 12 | | | Students, nursing | 258 | 15 |
| | | Online learning | 460 | 106 | | | Surveys and question-naires | 249 | 13 |
| | | Online learning environment | 116 | 16 | | | Teacher | 201 | 18 |
| | | performance | 108 | 19 | | | university | 201 | 17 |
| | | Personal learning environment | 57 | 11 | | | writing | 122 | 13 |
| | | Prior knowledge | 67 | 11 | 4 (28 items) | yellow | adolescent | 534 | 34 |
| | | Process mining | 66 | 18 | | | Adult | 1291 | 79 |
| | | reflection | 128 | 30 | | | Aged | 164 | 10 |
| | | Regression analysis | 128 | 15 | | | Aging | 142 | 10 |
| | | Satisfaction | 195 | 23 | | | Attention | 181 | 13 |
| | | Scaffolds | 170 | 21 | | | Cognition | 301 | 31 |
| | | Secondary education | 80 | 19 | | | Comprehension | 134 | 11 |
| | | Self regulated learning | 78 | 19 | | | Controlled study | 732 | 47 |
| | | Self regulation | 159 | 24 | | | Decision making | 411 | 32 |
| | | Self-determination theory | 38 | 12 | | | Female | 1832 | 116 |
| | | Self-regulated learning | 5854 | 1766 | | | Language | 184 | 14 |
| | | Self regulated learning (srl) | 126 | 50 | | | Learning | 2534 | 222 |
| | | Self-regulated learning strategies | 241 | 73 | | | Male | 1831 | 117 |
| | | Social networking (online) | 91 | 14 | | | Memory | 234 | 18 |
| | | srl | 39 | 15 | | | Mental recall | 234 | 16 |
| | | Student learning | 42 | 10 | | | Metacognition | 1036 | 200 |
| | | students | 1740 | 227 | | | Metacomprehension | 102 | 11 |
| | | surveys | 222 | 28 | | | Middle aged | 208 | 12 |
| | | teaching | 842 | 95 | | | Physiology | 524 | 38 |
| | | Teaching/learning strategies | 68 | 10 | | | Randomized con-trolled trial | 275 | 18 |
| | | Time management | 122 | 23 | | | reading | 209 | 14 |
| | | undergraduate | 59 | 11 | | | Recall | 290 | 21 |
| | | Undergraduate students | 134 | 20 | | | Retrieval practice | 82 | 10 |
| | | University students | 138 | 30 | | | Self control | 424 | 28 |
| 3 (45 items) | Light Blue | Achievement goals | 58 | 15 | | | Self-control | 420 | 30 |
| | | Assessment | 158 | 29 | | | Social control, informa | 146 | 10 |
| | | Assessment for learning | 33 | 15 | | | Study strategies | 65 | 15 |
| | | Autonomy | 43 | 15 | | | Young adult | 762 | 45 |
| | | Classroom assessment | 20 | 10 | 5 (9 items) | Light purple | Cognitive strategies | 44 | 17 |
| | | Co-regulation | 43 | 18 | | | Epistemological beliefs | 38 | 16 |
| | | Collaborative learning | 146 | 38 | | | Evaluation | 99 | 11 |
| | | College students | 110 | 30 | | | Goal orientation | 48 | 13 |
| | | Computer supported collaborative learning | 53 | 15 | | | Learning strategies | 400 | 101 |

| Hierarchical clustering analysis of the most emerging keywords | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cluster Number | Cluster Color | Keywords | TLS | Occurrence | Cluster Number | Cluster Color | Keywords | TLS | Occurrence |
| | | Confirmatory factor analysis | 116 | 14 | | | Learning to learn | 22 | 10 |
| | | emotion | 55 | 18 | | | Lifelong learning | 158 | 26 |
| | | Emotion regulation | 35 | 14 | | | Metacognitive strategies | 52 | 17 |
| | | emotions | 31 | 13 | | | mslq | 55 | 12 |
| | | Factor analysis | 79 | 11 | 6 (9 items) | cyan | Academic performance | 294 | 57 |
| | | feedback | 355 | 60 | | | calibration | 92 | 21 |
| | | Formative assessment | 104 | 33 | | | Goal setting | 115 | 17 |
| | | Gender | 146 | 19 | | | Meta-analysis | 39 | 10 |
| | | Homework | 23 | 10 | | | Metacognitive monitoring | 47 | 12 |
| | | Intervention | 49 | 12 | | | Physical education | 18 | 11 |
| | | Measurement | 37 | 10 | | | Reading comprehension | 105 | 24 |
| | | microanalysis | 39 | 10 | | | Strategy instruction | 26 | 14 |
| | | Monitoring | 146 | 21 | | | training | 140 | 15 |
| | | Moocs | 69 | 18 | 7 (8 items) | orange | Academic achievement | 322 | 52 |
| | | Motivation | 1337 | 246 | | | Academic success | 107 | 12 |
| | | Planning | 122 | 14 | | | Child | 323 | 25 |
| | | Primary education | 65 | 26 | | | Hypermedia | 77 | 17 |
| | | Procrastination | 75 | 18 | | | Knowledge | 75 | 11 |
| | | Professional development | 56 | 14 | | | Mathematics | 164 | 25 |
| | | Professional learning | 34 | 10 | | | Science | 73 | 13 |
| | | research | 49 | 11 | | | Student | 731 | 66 |
| | | Scaffolding | 47 | 19 | | | | | |
| | | Scale development | 22 | 10 | | | | | |
| | | Self-assessment | 281 | 42 | | | | | |
| | | Self-efficacy | 412 | 114 | | | | | |
| | | Self-monitoring | 28 | 11 | | | | | |
| | | Self-reflection | 21 | 10 | | | | | |
| | | Self-regulation | 831 | 266 | | | | | |
| | | Strategies | 50 | 13 | | | | | |
| | | Structural equation modeling | 174 | 29 | | | | | |
| | | Task value | 31 | 10 | | | | | |
| | | Teacher education | 50 | 19 | | | | | |
| | | Teacher training | 43 | 10 | | | | | |
| | | Trace data | 62 | 15 | | | | | |
| | | Validity | 71 | 17 | | | | | |
| | | Workplace learning | 76 | 14 | | | | | |

Table 5 provides that the highest interconnected keyword is cluster 1 (red) amount 75 inter-connected. An example of the keyword from cluster 1 is 'self-regulated learning' which has 1766 occurrences and 5854 total link strength. It is the keyword that has the most occurrence among other keywords. Otherwise, the lowest interconnected is cluster 7 which has 8 interconnected. Moreover, the least occurrence is for the 'knowledge' keyword.

## 4. Conclusion

The publication-and-related metric showed as many as 2,106 documents related to self-regulated learning studies distributed in the range 1990-2022 have 20,752 citations. It also shows that the h-index value is lower than the g-index value. Furthermore, the publication-and-citation trend analysis is relatively fluctuating in periods and constant in a particular year. Moreover, the citation analysis showed that the most influential document is written by B. J. Zimmerman in 2008 with the title 'Investigating self-regulation and motivation: Historical background, methodological developments, and prospects' and has been cited around 1664 times. Hereinafter, co-authorship analysis with authors unit analysis resulted that the author who has collaborated the most with other authors is Järvelä, S., co-authorship analysis with countries unit analysis resulted that the United States is the most productive and influential country who make studies in self-regulated learning, and co-authorship analysis with organizations unit analysis resulted that the most productive organization

is University of Oulu, Finland, and the most influential organization is the Department of Educational Psychology, Graduate Center, City University of New York. In addition, the co-word analysis showed that the 'self-regulated learning' keyword has the most occurrence as many as 1766 times.

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