

MAPPING THE INTERSECTION OF PROBLEM-BASED LEARNING AND LIFELONG LEARNING: A BIBLIOMETRIC ANALYSIS

(Pemetaan Silang Diantara Pembelajaran Berasaskan Masalah Dengan Pembelajaran Sepanjang Hayat: Suatu Analisis Bibliometric)

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Abstract

Problem-Based Learning (PBL) is a pedagogical approach that immerses learners in real-world problems to develop essential skills like self-directed learning, critical thinking, and teamwork. PBL has shown to be especially effective in fostering lifelong learning, a vital skill in today's rapidly evolving world. By engaging learners in practical, collaborative problem-solving, PBL not only improves immediate academic outcomes but also equips individuals with competencies essential for continuous personal and professional growth. This bibliometric study aims to map and analyze research trends, key themes, and influential authors in the implementation of PBL within lifelong learning contexts, offering insights into the field's intellectual structure and future research directions. Using Scopus as the primary database, this study applied a systematic search strategy focusing on publications related to PBL and lifelong learning from 2019 to 2024. The search yielded 265 relevant articles, and data analysis involved descriptive statistics, citation analysis, and co-citation network mapping. Key bibliometric indicators were examined to identify the most influential authors, articles, and recurring themes in the literature. Additionally, the analysis highlights publication patterns, research dynamics, and identifies emerging areas of interest, such as the role of PBL in enhancing long-term knowledge retention and teamwork skills for real-world applications. The findings contribute to a comprehensive understanding of the relationship between PBL and lifelong learning, providing educators, researchers, and policymakers with valuable insights into the development of educational frameworks that support sustainable learning. This study not only underscores the importance of PBL in building adaptable and resilient learners but also offers guidance for future research, particularly in exploring new approaches to integrating PBL for lifelong learning in diverse educational and professional environments.

Keywords: Problem Based Learning, Lifelong Learning, Bibliometric.

Abstrak

Pembelajaran Berasaskan Masalah (PBL) ialah pendekatan pedagogi yang melibatkan pelajar dalam masalah dunia sebenar untuk membangunkan kemahiran penting seperti pembelajaran terarah sendiri, pemikiran kritis dan kerja berpasukan. PBL telah terbukti berkesan terutamanya dalam memupuk pembelajaran sepanjang hayat, kemahiran penting dalam dunia yang

berkembang pesat hari ini. Dengan melibatkan pelajar dalam penyelesaian masalah yang praktikal dan kolaboratif, PBL bukan sahaja meningkatkan hasil akademik serta-merta tetapi juga melengkapkan individu dengan kecekapan yang penting untuk pertumbuhan peribadi dan profesional yang berterusan. Kajian bibliometrik ini bertujuan untuk memetakan dan menganalisis arah aliran penyelidikan, tema utama dan pengarang yang berpengaruh dalam pelaksanaan PBL dalam konteks pembelajaran sepanjang hayat, menawarkan pandangan tentang struktur intelek bidang dan hala tuju penyelidikan masa hadapan. Menggunakan Scopus sebagai pangkalan data utama, kajian ini menggunakan strategi carian sistematik yang memfokuskan pada penerbitan berkaitan PBL dan pembelajaran sepanjang hayat dari 2019 hingga 2024. Carian tersebut menghasilkan 265 artikel yang berkaitan, dan analisis data melibatkan statistik deskriptif, analisis petikan, dan rangkaian petikan bersama pemetaan. Penunjuk bibliometrik utama telah diperiksa untuk mengenal pasti pengarang, artikel, dan tema berulang yang paling berpengaruh dalam kesusasteraan. Selain itu, analisis menyerlahkan corak penerbitan, dinamik penyelidikan dan mengenal pasti bidang minat yang muncul, seperti peranan PBL dalam meningkatkan pengekalan pengetahuan jangka panjang dan kemahiran kerja berpasukan untuk aplikasi dunia sebenar. Penemuan ini menyumbang kepada pemahaman yang menyeluruh tentang hubungan antara PBL dan pembelajaran sepanjang hayat, menyediakan para pendidik, penyelidik dan penggubal dasar dengan pandangan yang berharga tentang pembangunan rangka kerja pendidikan yang menyokong pembelajaran mampan. Kajian ini bukan sahaja menekankan kepentingan PBL dalam membina pelajar yang boleh menyesuaikan diri dan berdaya tahan tetapi juga menawarkan panduan untuk penyelidikan masa depan, khususnya dalam meneroka pendekatan baharu untuk mengintegrasikan PBL untuk pembelajaran sepanjang hayat dalam pelbagai persekitaran pendidikan dan profesional.

Kata Kunci: Pembelajaran Berasaskan Masalah, Pembelajaran Sepanjang Hayat, Bibliometrik.

1.0 INTRODUCTION

A method of teaching called Problem-Based Learning (PBL) uses real-world issues as a setting for students to practice important abilities like self-directed learning, teamwork and problem-solving (Martin et al., 2005). This approach is especially successful in encouraging lifelong learning (Sung et al., 2010), which is a crucial skill in the ever developing world of today.

Combining PBL into higher educational frameworks fosters lifelong learning principles in addition to improving academic achievement in the short term. By fostering critical thinking, adaptability and collaboration skills, PBL empowers students to navigate the complexities of modern life and thrive in dynamic workplace environments (Shin et al., 1993; Imam & Cleland, 2020). The synergy between PBL and lifelong learning is pivotal in shaping individuals who can excel in a world characterized by continuous change and evolving challenges

PBL has proven to be an effective approach for fostering lifelong learning and essential skills in adults. By immersing learners in real-world problems, PBL encourages the development of critical thinking, collaboration, and intrinsic motivation (Tunca et al., 2019). This hands-on, learner-centered approach not only aids in solving immediate issues but also equips individuals with the ability to continually grow both personally and professionally.

One of the advantages of PBL is its emphasis on collaboration and communication (Martin, 2019). Through group work, adults enhance their teamwork abilities by participating in discussions and collective problem-solving. PBL benefits individuals by fostering critical thinking, problem-solving, teamwork, adaptability, and

lifelong learning skills, empowering them to thrive in dynamic and complex environments. Such interactions build a sense of community and significantly improve interpersonal and communication skills, which are valuable across both personal and professional domains

Furthermore, studies show that PBL supports better long-term knowledge retention compared to traditional lecture-based learning (Amir et al., 2022). This is particularly beneficial for adults, who often need to apply knowledge consistently over time in their careers. By reinforcing information through active engagement, PBL helps learners retain and use knowledge effectively, making it an ideal approach for skill development in various professional contexts.

This paper aims to comprehensively map and graphically analyse the implementation of PBL in the long-life learning from a bibliometric standpoint. It focuses on key topics, existing of lifestyle in the new normal research dynamics, and future research potentials. This bibliometric study also aimed to identify the publication patterns and intellectual framework of this field. The research questions (RQs) that are addressed are as follows:

- (a) RQ1: What is the present state of implementation of PBL in the long-life learning?
- (b) RQ2: What authors and articles have evidenced the greatest impact on implementation of problem based learning (PBL) in the long-life learning?
- (c) RQ3: What are the most popular themes of implementation of PBL in the long-life learning?

The remainder of this paper is organised as follows. The first section emphasizes the methodologies employed in the investigation. The second section presents the analysis and findings. The final section elaborates on the discussion and conclusion of this study.

2.0 METHODOLOGY

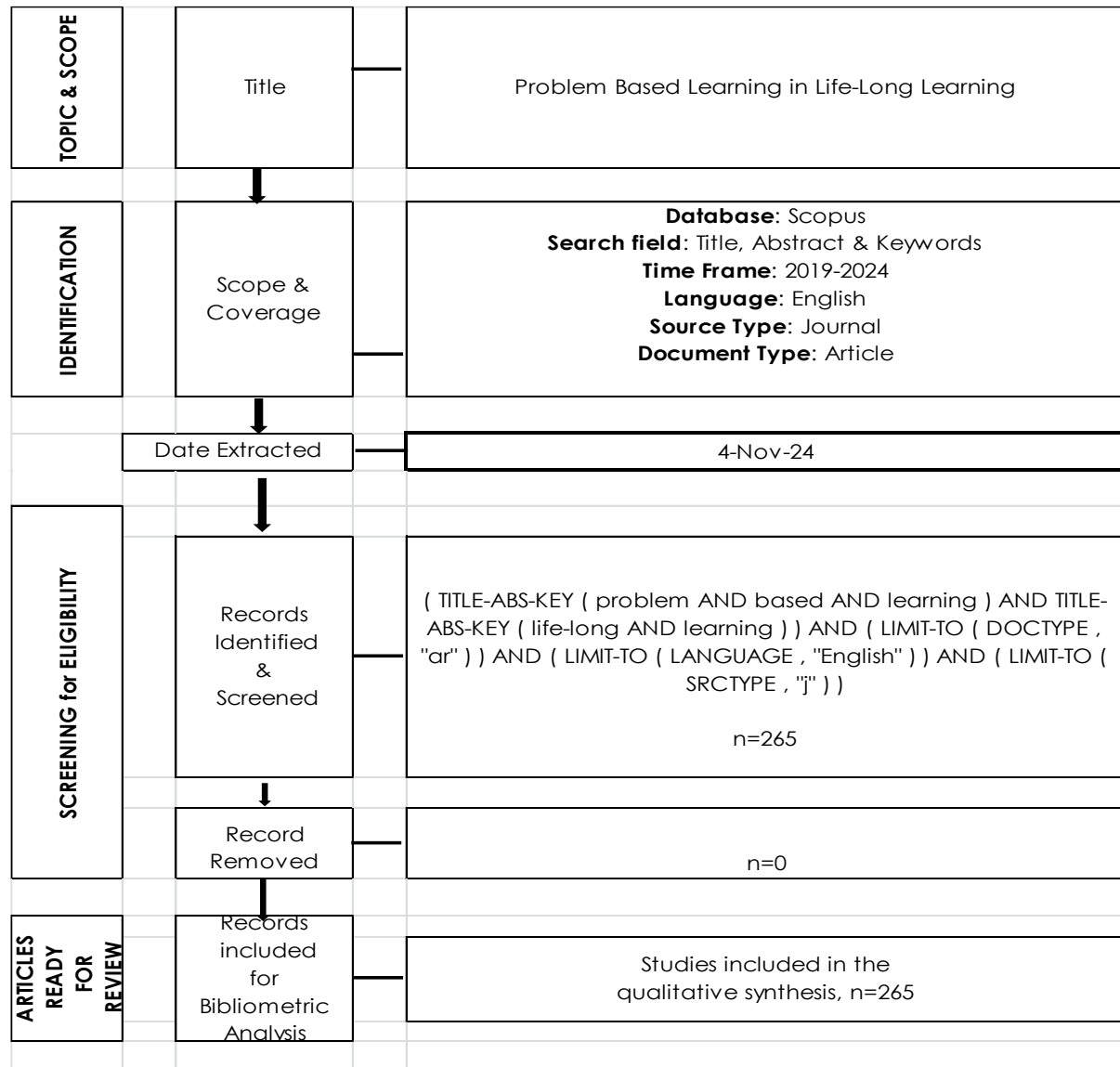
Alan Pritchard's 1969 paper with title of "Statistical Bibliography or Bibliometrics" is when the term "bibliometrics" first appeared (Andres, 2009; Gingras, 2016; Pritchard, 1969). According to Zupic and Čater (2015), this method has been utilized thus far to investigate the published scholar. The three most widely used database sources in the academic world are Google Scholar, Web of Sciences (WOS) and Scopus. Scopus was chosen as the data collection source for this study for three reasons: first, it uses a consistent criterion to choose which documents to include in its index; second, it has a larger selection of documents than the Web of Science for reviews of social science and educational research (Hallinger & Nguyen, 2020). Lastly, compared to Google Scholar, Scopus provides more advanced features for exporting bibliographic data (Hallinger & Nguyen, 2020). Furthermore, this approach can demonstrate the development and structural makeup of a knowledge base, claim White & McCain (1998).

The term "problem-based learning" and "life-long learning" were two main keywords in the search string. The initial query was inputted the advanced search form of Scopus at 11:09 p.m on November 4, 2024, was (TITLE-ABS-KEY (problem AND based AND learning) AND TITLE-ABS-KEY (life-long AND learning)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "j")).

This review looked at PBL trends in the lifelong learning-related publications released six years back (between 2019 and 2024) using bibliometrics or scientific mapping. The search was restricted to English-language article journals, which was one of its primary limitations. There were 265 documents found in the search result. Descriptive statistics, citation analysis and co-citation analysis were among the data

analyzed. The goal of the studies was to obtain a thorough understanding of PBL in relation to lifelong learning.

For the document search, the study adhered to the Modified Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria (Zakaria et al., 2020). Figure 1 depicts the data search procedure.



Source: Modified from PRISMA (Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009).

Figure 1 Flow Diagram of The Search Strategy.

3.0 RESULTS

265 documents were gathered for this study from the Scopus database. Data frequencies based on the total number of papers published, including the yearly trend, the most active journals, the most prolific countries and the most prolific author in the study area, were calculated using descriptive analysis. Regarding the citation analysis, Harzing's Publish or Perish software was used to gather information on citation metrics and the most well-known scholarly works on the research topic. Additionally, VOSViewer software was used to analyze bibliometric meta-data for co-authorship, bibliographic coupling, keyword co-occurrence and citation. The quantity of shared resources determines the links between items like publications, journals and authors in

bibliographic coupling. A table or network visualization map is used to display the analysis's findings.

3.1 Publication by Year

To address RQ1, the research trend based on the year of publication and total publications was monitored. The trend of publications on the implementation of Problem-Based Learning (PBL) in life-long learning from 1989 to 2024 shows a generally upward trajectory with some fluctuations. Starting with 1 publication in 1989, the numbers experienced a slight decrease to 1 in 2000, possibly due to disruptions like the COVID-19 pandemic impacting research and publication activities. However, the trend picked up significantly in 2021, with publications rising to 17, and continued to climb to 24 in 2022.

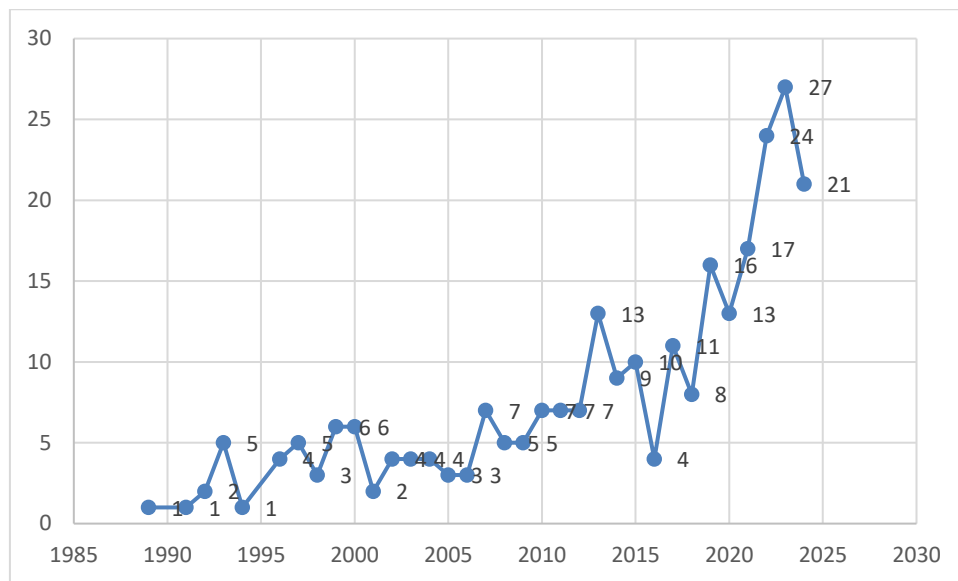


Figure 2 Total Publication by Year

The peak occurred in 2023, with 27 publications, indicating heightened interest or advances in PBL applications in that year. Although there was a minor decline to 21 publications in 2024, the overall trend demonstrates an increasing focus on integrating PBL approaches in lifelong learning contexts over this six-year period. This pattern underscores a growing recognition of PBL's value in fostering critical thinking and practical problem-solving skills in education.

3.2 Citation Network Analysis

This study expected to identify the most significant publication based on RQ2 (Which are the most influential publications on implementation of PBL in life-long learning?). Thus, to answer the RQ2, citation networks of 265 publications were examined.

To perform the centrality analysis of citations and construct a network visualisation map of the article's citations, the Harzing Publish or Perish and VOSViewer tools were used. Table 1 shows the citation metrics data for the publications. As for the 265 publications on implementation of PBL in life-long learning, there were 4094 citations. The typical number of citations per year is 116.97, with each document receiving an average of 17.72 citations.

The trend of publications on Problem-Based Learning (PBL) and its applications reflects a diverse exploration across disciplines, with a particular focus on its impact on competencies, long-term learning, and practical skill development. From earlier works, such as Shin et al. (1993) on lifelong learning impacts, to more recent studies like Imam & Cleland's (2020) research on neuromorphic learning, there is a steady

evolution in applying PBL in specialized fields, including engineering, health and ICT education.

Table 1 Citation Metrics

Metrics	Data
Papers	265
Number of Citations	4094
Years	6
Citations per Year	116.97
Citations per Paper	17.72
Cites_Author	1785.58
Papers_Author	103.83
Authors_Paper	3.24
h_index	32
g_index	54

Over time, there is an increase in interdisciplinary approaches (e.g., reinforcement learning and digital skills), indicating a growing recognition of PBL's adaptability. The consistent citations across years suggest a sustained interest, highlighting PBL's relevance and evolving methodologies to meet the educational and skill demands of different fields. This shows that PBL is not only foundational in educational strategies but also adaptable to emerging technology-driven learning environments.

Table 2 Top 10 Highly Cited Publications

No.	Authors	Title	Year	Cites
1	Passow, H. J., & Passow, C. H.	What competencies should undergraduate engineering programs emphasize? A systematic review.	2017	341
2	Martin, R., Maytham, B., Case, J., & Fraser, D.	Engineering graduates' perceptions of how well they were prepared for work in industry	2005	219
3	Shin, J. H., Haynes, R. B., & Johnston, M. E.	Effect of problem-based, self-directed undergraduate education on life-long learning	1993	216
4	Zhou, Q., Li, J., Shuai, B., Williams, H., He, Y., Li, Z., ... & Yan, F.	Multi-step reinforcement learning for model-free predictive energy management of an electrified off-highway vehicle	2019	116
5	Imam, N., & Cleland, T. A.	Rapid online learning and robust recall in a neuromorphic olfactory circuit	2020	115
6	Aesaert, K., Van Nijlen, D., Vanderlinde, R., & van Braak, J.	Direct measures of digital information processing and communication skills in primary education: Using item response theory for the development and validation of an ICT competence scale	2014	84
7	Bate, E., Hommes, J., Duvivier, R., & Taylor, D. C.	Problem-based learning (PBL): Getting the most out of your students—Their roles and responsibilities	2014	84
8	Tunca, C., Salur, G., & Ersoy, C.	Deep learning for fall risk assessment with inertial sensors: Utilizing domain knowledge in spatio-temporal gait parameters	2019	75
9	Polyzois, I., Claffey, N. and Mattheos, N.	Problem-based learning in academic health education. A systematic literature review	2010	71
10	Sung, Y. T., Chang, K. E., Hou, H. T., & Chen, P. F.	Designing an electronic guidebook for learning engagement in a museum of history	2010	68

The top 10 highly cited publications on PBL and lifelong learning reflect a strong focus on assessing competencies, educational outcomes and innovative learning methods across various fields. The most cited paper by Passow and Passow (2017)

emphasizes the competencies needed in undergraduate engineering programs, highlighting a systematic approach to determining essential skills for the industry. Martin et al. (2005) contributes to this theme by evaluating engineering graduates' perceptions of their preparedness for industry, indicating a focus on bridging the gap between education and professional readiness. Shin, Haynes, and Johnston's (1993) research on the effects of PBL on lifelong learning underscores the long-term benefits of self-directed education, resonating with the lifelong learning agenda. Additional studies explore interdisciplinary applications: Zhou et al. (2019) utilize reinforcement learning in energy management, while Imam and Cleland (2020) examine rapid learning in a neuromorphic context, showcasing the adaptive capabilities of PBL-related methodologies.

Other significant studies, such as those by Aesaert et al. (2014) and Bate et al. (2014), focus on competencies in digital information processing and the roles of students in PBL settings, respectively. These works highlight the integration of digital and PBL methods to enhance primary and secondary education outcomes. Health and safety applications are also addressed by Polyzois et al. (2010) in academic health education and Tunca et al. (2019) in fall risk assessment, expanding PBL's influence beyond traditional classroom settings. Finally, the work by Sung et al. (2010) on electronic guidebooks for museum learning engagement demonstrates the versatility of PBL in informal educational settings. Collectively, these publications underline PBL's adaptability and its value in fostering competencies that support lifelong learning across diverse contexts.

3.3 Keywords and Co-occurrence Analysis

Baker, Pandey, Kumar, and Haldar (2020) mentioned that the presence of two keywords together in a piece of writing signifies a relationship between two ideas. This phrase is known as co-occurring keywords. In response to RQ3 (What are the most prevalent themes of PBL in life-long learning?), the current study sought to identify the keywords that scholars looking into PBL in long-life learning most commonly employ. Table 3 shows the data frequencies of the terms used in the research topic, which were computed using Microsoft Excel. In long-term learning, the most used PBL keyword is "life long learning" (167: 63.02%), followed by "Human" and "Teaching & Learning" with a frequency of 115 (43.04%) and "Problem Based Learning" with a frequency of 87 (32.83%). Education ranked fifth with a frequency of 81 with a percentage of 30.57%.

Table 3 Top Keywords

Author Keywords	Total Publications (TP)	Percentage (%)
Life long Learning	167	63.02
Human	115	43.04
Teaching & Learning	115	43.04
Problem Based Learning	87	32.83
Education	81	30.57

In order to create a network visualization map, this study also used the VOSViewer program to do a term co-occurrence analysis. A term had to appear at least ten times in an article's title and abstract in order to be counted in binary. The minimum number of occurrences per publication was fixed at five, and fractional counting was employed. Out of 2299 keywords, 108 of them satisfied the requirement. A network visualization map showing the co-occurrence of the author's keywords is shown in Figure 3. The biggest circle found that the most frequently used keyword by authors in publications relating to the research topic was "lifelong learning" (85 occurrences). The terms "human (67 occurrences), the term "problem-based learning" (45 occurrences) and the term "teaching" (39 occurrences).

Figure 3 displays a network visualization map of term co-occurrences based on the titles and abstracts of the 231 Scopus papers.

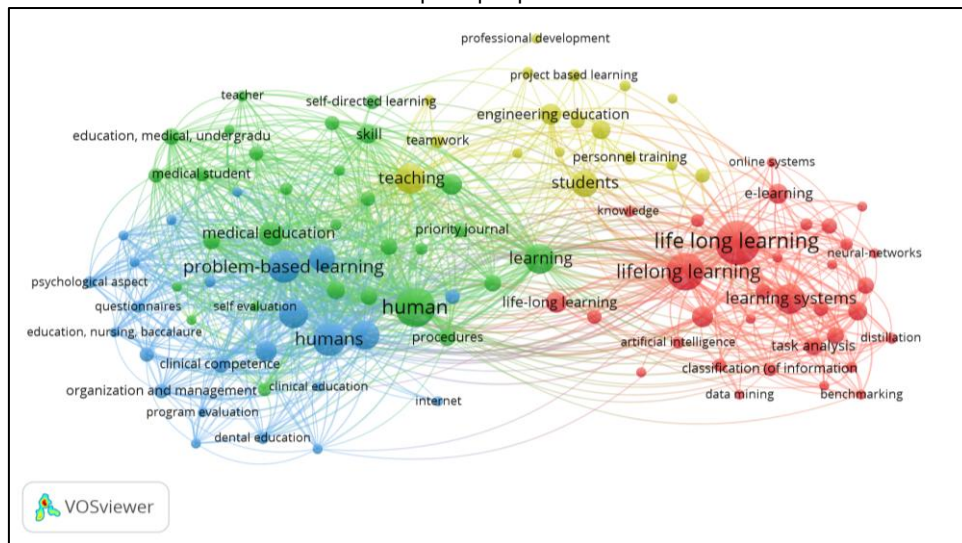


Figure 3 Network Visualisation Map for Co-Occurrence of Keywords

The network visualization map with four clusters is displayed in Figure 3. The content of each cluster was represented by the largest circle of each color. The integration of technology in life-long learning and PBL were the main topics of Cluster 1 (red). Cluster 2 is visualized by the green color. This cluster represented the humanistic part that is involved in life-long learning and PBL. The third cluster (blue) discusses on the strategies of PBL. The fourth cluster (yellow) represent the teaching and learning part that is combined with PBL. Figure 4 shows the co-occurrence of the title and abstract field.

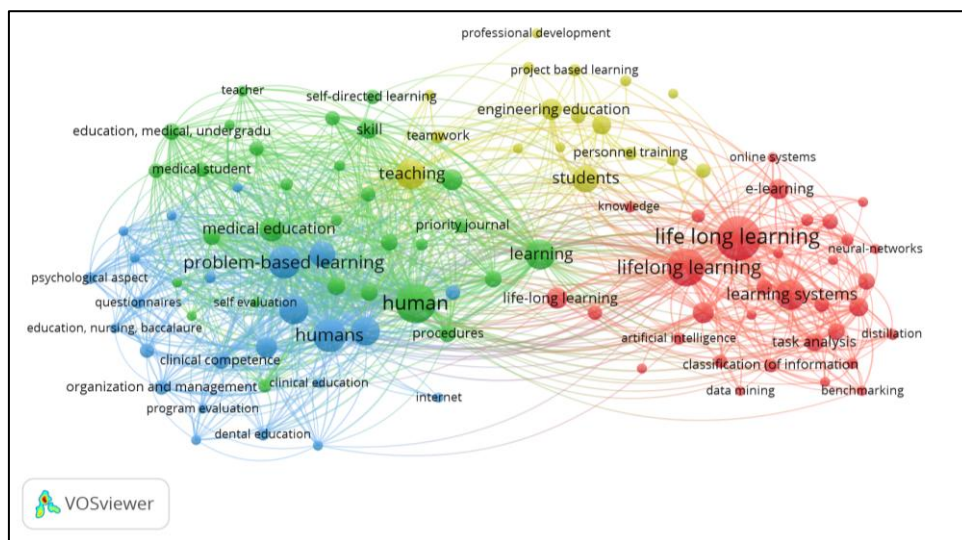


Figure 4 Network Visualisation Map of Term Co-Occurrence of Title and Abstract Field

According to Goksu (2021), the overlay map that emerged from the keyword co-occurrence analysis reveals the trend over the years (from 2021 to 2022), and gives an idea about research topics tendency.

- Goksu, I. (2021). Bibliometric Mapping of Mobile Learning. *Telematics and Informatics*, 56, 101491.
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