ORIGINAL ARTICLE

The Intellectual Structure of Knowledge in the Field of analyses Distance Education Using the Co-Word

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Background: Co- word analysis is one of the content analysis methods used in scientometric studies and mapping the scientific structure of various fields. The purpose of the present research is to map the structure of distance education using the co-word analysis.

Methods: The research method is content analysis using co- word analysis. The research population are 31607 documents indexed in the field of distance education domain in the Web of Science database from 1985 to 2016. For data analysis, the "UCInet" and "BibExcel" softwares have been used. In this research, the symmetric matrix as well as the cluster analysis and the strategic diagram was used for analyzing the data.

Results: The findings showed that the concepts of electronic learning and blended learning had the highest frequency in distance education research. The pairs of "e-learning- blended learning", "e-learning-education and training", and "higher education-e-learning" with 446, 328, and 302 word co-occurrences respectively, and took the first to third places in the field of distance education studies. Findings on hierarchical clustering led to the formation of 13 clusters in this field.

Conclusion: The results of this study showed that based on the co-word analysis, the structure of the distance education is composed of thirteen clusters as follows: "The process of designing e-learning environments", "E-literacy", "The role of information and communication technologies in the process of teaching and learning", "Strengthening the process of virtual teaching and learning", "Educational scenario", "educational planning" and "Individual learning style" and "Learning and teaching quality", "Human interaction in the virtual environment", "educational feedback", "Educational system", and "Miscellaneous". Newly emerged fields of distance education include "human interaction in the virtual environment", "educational feedback", and "learning system".

Keywords: Co-occurrence of words, Distance education, Co-word analysis, Knowledge structure

البناء الفكري للعلم في مجال التعليم عن بعد بطريقة دراسة المفردات المشتركة

الأرضية والهدف : تجزئة وتحليل المفردات المشتركة هي طريقة تحليل للمحتوى،حيث أنها في دراسات علم القياس ورسوم الهياكل العلمية لها استفادات عديدة. الهدف من هذه الدراسة هو رسم هيكل للتعليم عن بعد حسب تجزئة وتحليل معجمية للمفردات.

الطريقة : طريقة هذا التحقيق تحليل المحتوى بالإستفادة من تحليل المفردات. الداخلين في هذه web of science الدراسة هم من ضمن الوثائقي في مجال الدراسة عن بعد في موقع في الفترة الزمنية بين ١٩٨٥ إلى ٢٠١٦ وعددهم ٣١٦٠٧. من أجل تحليل وتجزئة البيانات، "UCINET"و"Bibe Excel" تمت الإستفادة من برنامج في هذا التحقيق تحت الإستفادة من ماتريس المتماثل و طريقة التحليل العنقودية و المخطط الإستراتيجي من أجل تجزئة وتحليل البيانات.

الحاصل : مفاهيم التعليم الإلكتروني والتعليم المركب حصلت على أعلى نسبة تكرار في التعليم عن بعد. حاز (التعليم الإلكتروني – التعليم المركب) و (التعلم الإلكتروني – التعليم والتعليمي) و (التعليم العالي – التعلم الإلكتروني) بالترتيب على الأرقام التالية من دراسة المفردات المشتركة (٤٤٦ ، ٣٢٨ ، ٣٠٢) وكانت في المراتب الأولى والثانية والثالثة في تحقيقات مجال دراسات التعليم عن بعد. النتائج المتعلقة بهذه الدراسة بتقسيم المراتب أدى إلى تشكيل ١٣ عنقود أو فرع في هذا المجال.

النتيجة : أظهرت نتائج التحقيق أنه حسب تحليل الكلمات المشتركة يتألف هيكل التعليم عن بعد من ١٣ عنقود وهم (عملية تخطيط بيئات التعليم الإلكتروني)، (المعرفة الإلكترونية)، (دور تكنولوجيا المعلومات والإتصالات في عملية التعليم والتعلم). (تقوية عملية التعليم والتعلم الإفتراضي)،(سيناريو التعليم)،(التخطيط التعليمي)،(طريقة التعليم الفردي) و(جودة التعليم والتعلم)،(العلاقات الإنسانية في الفضاء الإفتراضي)،(التصحيح التعليمي)،(النظام التعليمي)،(الشبكة التعليمية) و أخيراً (منوع). مجالات التعليم عن بعد أيضاً تشمل الموضوعات التالية (العلاقات الإنسانية في الفضاء الإفتراضي)، (التصحيح التعليمي) و(النظام التعليمي المنفصل).

الكلمات الدالية : التعليم عن بعد، تحليل المحتوى ، تحليل المفردات المعجمية المشتركة ، هيكل المعرفة ، الكلمات المشتركة.

ساختار فکری دانش در حوزهٔ آموزش از راه دور با روش مطالعهٔ هم واژگانی

زمینه و هدف: تحلیل هم رخدادی واژگان یکی از روش های تحلیل محتوایی است که در مطالعات علم سنجی و ترسیم ساختار علمی حوزه های گوناگون کاربرد فراوانی دارد هدف پژوهش حاضر ترسیم ساختار حوزه آموزش از راه دور بر اساس تحلیل هم رخدادی واژگان است.

روش: روش پژوهش حاضر تحلیل محتوایی با استفاده از تحلیل هم رخدادی واژگان است. جامعه پژوهش مدارکی است که در حوزه مطالعات آموزش از راه دور در پایگاه اطلاعاتی Web of Science در بازه زمانی ۱۹۸۵ تا ۲۰۱۶ نمایه شده‌اند و تعداد آن ۳۱۶۰۷ رکورد می‌باشد. جهت تجزیه و تحلیل داده‌ها از نرم افزارهای "UCINET" و " Bibe Excel" استفاده شده است. در این پژوهش از ماتریس متقارن و همچنین از روش تحلیل خوشه‌ای و نمودار راهبردی برای تجزیه و تحلیل داده‌ها استفاده گردید.

یافته‌ها: مفاهیم یادگیری الکترونیکی و یادگیری ترکیبی بالاترین فراوانی را در پژوهش-های آموزش از راه دور داشته اند. زوج «یادگیری الکترونیکی- یادگیری ترکیبی»، «یادگیری الکترونیکی- آموزش و پرورش» و «آموزش عالی- یادگیری الکترونیکی»، به ترتیب با تعداد ۴۴۶، ۳۲۸ و ۳۰۲ هم رخدادی واژگانی جایگاه اول تا سوم را در سطح پژوهش‌های حوزهٔ مطالعات آموزش از راه دور داشته‌اند. یافته های مربوط به خوشه بندی سلسله مراتبی منجر به شکل گیری ۱۳ خوشه در این حوزه گردید.

نتیجه گیری: نتایج پژوهش نشان داد ساختار حوزه آموزش از راه دور بر اساس تحلیل هم رخدادی واژگان از ۱۳ خوشه تشکیل شده است که شامل " فرایند طراحی محیط های یادگیری الکترونیکی "،"سواد الکترونیکی"، " نقش فناوری اطلاعات و ارتباطات در فرایند آموزش و یادگیری "، " تقویت فرایند آموزش و یادگیری مجازی "، " سناریوی آموزشی"، "برنامه ریزی آموزشی"، "سبک یادگیری فردی"، "کیفیت یادگیری و آموزش"، " تعامل انسانی در محیط مجازی"، "بازخورد آموزشی "، "سیستم عاملی آموزش"، "شبکه آموزشی" و "متفرقه". حوزه‌های نوظهور آموزش از راه دور هم شامل موضوعات "تعامل انسانی در محیط مجازی"، "بازخورد آموزشی" و "سیستم عامل آموزش" می‌باشند.

واژه‌های کلیدی: آموزش از راه دور، تحلیل محتوایی، تحلیل هم واژگانی، ساختار دانش، هم رخدادی واژگان

کو ورڈ اینالائسس پر مبنی الیکٹریکل میڈیم سے دور سے تعلیم دینی کی روش کا جائزہ

بیک گراونڈ: کو ورڈ اینالائسس کسی متن کے تجزیے کے لئے استعمال کی جاتی ہے، یہ روش سائنسی تحقیقات میں 'علمی ڈھانچہ' تشکیل دینے میں مدد گار ثابت ہوتی ہے۔اس تحقیق کا ہدف کو ورڈ اینالائسس کے سہارے دور سے تعلیم دینے کی روش کا ڈھانچہ تیار کرنا ہے۔

روش: اس تحقیق میں کوورڈ اینالائسس کے ذریعے مضامین اور متون کا تجزیہ کیا گیا ہے ۔ تحقیق کے لئے web of science نامی ویب سائٹ سے کو ورڈ اینالائسس کے بارے میں لکھے ہوئے مقالوں کا جا ئزہ لیا گیا، انیس سو پچاسی سے دوہزار سولہ تک لکھے گئے مقالوں کا جائزہ لیا گیا۔ان مقالوں کی تعداد اکتیس ہزار چھے سو سات تھی، ڈیٹا کا تجزیہ ucinet اور bibe exel سے کیا گیا۔اس کے علاوہ ڈیٹا کے تجزیے کے لئے سیمٹریک میٹرکس، کلسٹر اینالائسس اور اسٹرائجیک ڈیا گرام سے بھی استفادہ کیا گیا ۔

نتیجے: اس تحقیق سے پتہ چلتا ہے کہ الیکٹرانیک میڈیم سے تعلیم حاصل کرنا نیز ترکیبی روش تعلیم، دور سے تعلیم حاصل کرنے میں بے حد موثر واقع ہوتی ہیں۔ الیکٹرانیک میڈیم کے ذریعے تعلیم اور ترکیبی روش تعلیم، الیکٹرانیک تعلیم اور روایتی تعلیم، الیکٹرانیک تعلیم اور اعلی تعلیم کو کوورڈ اینالائسس کی اساس پر قابل توجہ پایا گیا اس طرح سے تحقیق نے ہمیں تیرہ روشوں کی جانب ہدایت کی ۔

سفارش:اس تحقیق سے پتہ چلا ہے کہ کوورڈ اینالائسس کی اساس پر دور سے تعلیم کے تیرہ امور حاصل ہوتے ہیں۔ الیکٹرانیک میڈیم میں تعلیم دینی کا ماحول تیار کرنا، الیکٹرانیک میڈیمز سے آگاہ ہونا،تعلیمی سرگرمیوں کو مفید بنانے میں انفارمیشن ٹکنالوجی اور مواصلات کا کردار، سائبر اسپیس میں تعلیمی روشوں کی تقویت کرنا،تعلیمی سٹاریو بنانا، تعلیمی منصوبہ بندی کرنا، فرد اکیلے کس طرح سے تعلیم حاصل کرسکتا ہے یہ روش تیار کرنا،تعلیم اور پڑھائی کو مزید مفید بنانا، سائبر اسپیس میں ایک دوسرے سے تعاون کرنا، تعلیمی روشوں کے بارے میں سامنے آنے والے رد عمل سے فائدہ اٹھانا، تعلیمی آپریٹنگ سسٹم بنانا،تعلیمی نیٹ ورک بنانا، یہ ساری چیزیں ہمیں کوورڈ اینالائسس کے تحت حاصل ہوتی ہیں۔

کلیدی الفاظ: دور سے تعلیم، الیکٹرانیک میڈیا،کو ورڈ اینالائسس۔

INTRODUCTION

Following the Industrial Revolution of the nineteenth century, technological advances put people at the heart of a new form of education, now known as distance education. In the last decade, the high level of electronic communication has provided a new opportunity for distance education, transforming it into an educational approach to educating employees and for those who are not able to attend schools or universities. In response to these demands, distance education organizations are working to provide a complete educational system from enrollment to examinations for their learners that is equal in quality, quantity and in the provision of training for learners with schools, faculties, and universities around the world. The quantitative and qualitative expansion of science and industry, and the growing economic, social and cultural development of the population, and the increasing population growth and the high need of the talented younger generation to education, and the growing need for thriving for the acquisition of technical skills and scientific expertise, make the educational system of societies to go beyond the traditional education in order to keep up with changes and meet the many needs of enthusiasts, and provide a special educational system for the current conditions of the community. Distance education can meet some of the educational needs of the community and bring thousands of enthusiastic young learners to the path of self-improvement and community development and will lead to an improvement in the quality and quantity of education (1). This enthusiasm towards the field of distance education has led to the emergence of universities and research in the world which in addition to training for improving and efficiency in this field, various researches are published and indexed in reputable journals.

Today, researchers publish their researches in the form of scientific document that are indexed in reputed academic bases. These researchers and their research achievements need to be evaluated and assessed in order to identify the strengths and weaknesses of each individual or scientific field and to make policy-making possible in line with the long-term and short-term goals of each area. Several research studies in the field of distance education have been carried out annually and the results of these researches is published in the form of articles in journals and conferences. A significant portion of the scientific production of distance education is published at the web of science database. This massive amount of scientific production needs to be evaluated continuously to identify their developmental stages, newly emerged fields, and obsolete fields, helping researchers in this field to identify the newly emerged fields and focus their research on them. Some research shortages that are present in this field, can help further improve the field by implementing further research. The techniques and methods that can be achieved in this matter is the co- word analysis. Co-word analysis is one of the methods used to identify research topics and inter-topic relationships (2).

The frequency of words' occurrence is an important scale in content analysis methods. This measure is used to determine the most important research topics in a field focusing on high-frequency words; the frequency of a word is considered as an indicator of importance, attention, or emphasis on that term or thought, or the concept is related to it (3). The keywords have the capability to provide a good description of the content of the articles. When two keywords appear simultaneously in the same article (co-occurrence/co-word), they have a semantic relationship. When the frequency of the co-word relationship of a pair of keywords is high in many articles, the articles will belong to a particular subject area; and the correlation between the keywords will be calculated based on the number of articles that have these two keywords. Co-word analysis is a type of co-occurrence analysis and is one of the important bibliometric methods used to map the relation between concepts, thoughts, and problems in basic sciences and social sciences (4).

The purpose of this analysis is to examine the main issues in a field and to define its semantic structure and its evolution over time. It also emerges thematic clusters and developed clusters in order to predict the direction of future research (5). This method is similar to other co-occurrence analyzes, including co-citation, and is used as a suitable method for mapping relationships between concepts (6). Co-word analysis which is developed to map the structure and dynamics of research areas, is a powerful tool for knowledge discovery (7).

Many years have passed since the emergence of and implementation of distance education programs, and during this period, frameworks as well as researches in this field have been relatively well-developed, but what has been left behind by many years of research and experience in the field of distance education, is a research that, in a scientific way and using objective and non-reactive data, will consider the state of these researches comprehensively and in different aspects. In this regard, due to the emergence and gradual development of distance education studies, it is necessary to present a comprehensive picture of the status of the research carried out in this field. In other words, the structure of knowledge in this area should be examined in order to understand how the development of this field has occurred over time.

Therefore, the problem being investigated in this study is the identification of the intellectual structure of knowledge in the field of distance education using the co-word analysis. The present study aims to investigate the sub-topics of distance education and the relationships of these sub-topics and the application of this method and examines its effectiveness in designing the structure of scientific fields.

This research can provide a comprehensive picture of the status of research on distance education at international level and as a good roadmap for improving the quality of the content of the specialized courses of the trend of distance education and as a systematic source for modifying and revising the present curriculum. In addition, in the field of distance education studies (as well as other fields), it can provide useful information to interested researchers and help academic managers in policy-making in this area.

Few studies have been conducted in the field of distance education so far using scientometric method, which some

examples are mentioned here. Davies (8) investigated a review of the research process of distance education scholarship at North American University of Research. The results indicated that the students who were conducting thesis in distance education at this university, subject of research, data collection method, their data analysis method in the field of distance learning was descriptive and often they addressed the concerns and levels of satisfaction of various stakeholders who had a special experience in the field of distance education.

Chiang (9) reviewed the published articles regarding e-learning in SSCI database during 1967- 2001. Recent research findings in e-learning show that this type of training is expanding considerably.

In his doctoral thesis, Skinner (10) reviewed the theses regarding distance education at North American institutions during 2000 to 2014. This research uses bibliographic analysis and social networking methods to review abstracts, keywords, classification and other bibliographic information. This method was performed on 3945 studies. The results showed that there were various common themes in the field of distance learning during the 2000-2004, 2005-2009, 2010-2014, where graduates were involved. In total, seven subjects including: 1. Student, 2. Trainer, 3. Interaction, 4. Management 5. Design, 6. Educational field, and 7. The technical format were the common themes. It was found that in all studies, the student was focused. Wu and Zhang (11) examined the studies in the field of evaluation of the e-learning system in Taiwan. The results showed that 41% of the studies are computer training and 83% are computer science.

Zancarano et al. (12) investigate the structure of the open educational field, using scientometric method and address some issues: 1) The current state of research in the field of open education at international levels 2) Review of the history of the development of open education 3) The main sources of the publication of open education 4) Identifying the authors, institutions and countries that began their research in this field since 2002. 5) The main key keywords related to this field. 6. The main concepts that underpin the theoretical basis of open education. This research aims at highlighting the main scientific resources in this field that open-training scholars, especially newcomers to this field, could base their studies and be able to receive current trends from reference journals that provide the correct theoretical basis.

Several researches have used the co-word analysis to review the scientific structure of different fields, and some have also addressed emerging concepts in various scientific fields, including the following: : Robotic Technology (13), Climate Change (14), Stem Cells (15), Economics (16), Library and Information sciences (17), Knowledge Management (18), Human and Computer Interaction (19), creativity (20), and computer games (21). In the following, a few are briefly mentioned.

Yan et al. (22) examined the intellectual structure of the "Internet of Things". The results of hierarchical clustering led to the identification of seven major clusters in this area, including RFID, cloud computing, wireless sensor networks,

and security in the Internet of Things.

In another study, Khasseh et al. (23) mapped out the knowledge structure in the area of information Metrics. Their hierarchical clustering results showed that the structure of this field consists of 11 clusters. These clusters are: indicators and bases of scientific knowledge, citation analysis and theoretical foundations, sociology of science, issues related to the ranking of universities, journals, etc., visualization and information retrieval, the mapping of the intellectual structure of science, webometrics, industry-university-government communication, technology measurement (innovation and patent application), network analysis, and academic collaboration at universities.

Jia et al. (24) reviewed the features and topics of recent research on the effects of air pollution on the cardiovascular system using the Mesh Base and Medline between 2007 and 2012 and co-word analysis, the top 10 clusters popular topics were extracted.

Wu et al. (25) investigated the evolution of psychiatry topics using the analysis of co-word network. The statistical population of their research was the articles of the top 10 journals of this field that were published on the Citation Index of Sciences between 2001 and 2015. The results showed that the growth trend of the articles in these years was increasing. The network design showed that the subject area of the articles was divided into four clusters of children and adolescent psychiatry, depression, schizophrenia, and forehead cortex.

The review of literature shows that co-word analysis is an effective and common method for investigating the scientific structure of various scientific fields. So far, the field of distance education has not been investigated by this method. Therefore, this has been addressed in this research.

Accordingly, the main questions of this research are as follows:

1. What is the semantic structure resulting from the co-word analysis in the field of distance education studies?

2. What is the distribution of the keywords of distance education studies based on the amount of co-word occurrence?

3. Results of the co-word cluster analysis led to the formation of which clusters and with what subjects in the field of distance education studies?

4. What is the situation of the clusters derived from the co-word analysis in the field of distance learning from the point of view of maturity and development?

METHODS

This applied research is a type of scientometric study that has been carried out using co-word analysis and network analysis method and includes all the documents that have been published with the subject of distance education from 1985 to 2014 in journal indexed in the Web of Science Database. The following search strategy was used to extract the data:

TS＝("distan* educ*") OR TS＝("distan* learn*") OR TS＝("distan* teach*") OR TS＝("e-learning") OR TS＝("eLearning") OR TS＝("electronic learning") OR TS＝("virtual learning") OR TS＝("virtual education") OR TS＝("distributed learn*") OR TS＝("online learning") OR

TS = ("online education") OR TS = ("Multimedia education") OR TS = (" Web network education") In order to perform co-word analysis in the field of distance education studies, the keywords used in the documents were extracted which were 41331 keywords. In the next step, these keywords need to be reviewed and edited carefully. Because some words were written in different ways or were synonyms. So the keywords were shared by a few experts in the field and, after receiving their comments, editing, modifying, deleting, and matching the keywords were applied. For example, singular and plural terms have been converted into one form or phrases such as on-line learning and online learning and e-learning and eLearning, technologies and technology and academic library and academic libraries were synchronized and some words that did not make meaning alone were deleted. The names of countries and some terms were also excluded from the analysis.

In the next step, by selecting the threshold 42, i.e. the keywords that were repeated at least 42 times, 163 keywords were identified with the highest frequency, which were studied in the final co-word analysis.

The co-word matrix was prepared using the BibExcel software, then converted to correlational matrix with the help of the UICNet Software, and saved to Excel format in order to enter the SPSS software. Using the hierarchical clustering method which is resulted by Ward method and the Squared Euclidean, the co-word clusters and dendrogram are formed. It should be noted that in many co-word analyzes, the Ward method has been used for analyzing hierarchical clustering (5).

RESULTS

What is the semantic structure resulting from co-word analysis in the field of distance education studies?
A.   How is the distribution of the keywords of the field of distance education studies based on the amount of co-word occurrence?
Table 1 shows the twenty most commonly used keywords. As shown in the table, the keyword "e-learning" with the frequency of 6543 times was the most frequent among all keywords. Keywords "blended learning", "Online learning" and "Distance learning" have been ranked second, third and fourth with frequencies of 1595, 1392 and 961, respectively.
B.   The results of the co-word cluster analysis led to which clusters and with which subjects in the field of distance education studies?
In terms of co-word pairs, as presented in table 2, the pairs "e-learning-blended learning", "e-learning-education" and "higher education-e-learning" were ranked first to third with frequencies of 446, 328 and 302, respectively in the field of research on distance education studies. Also, according to the data in Table 2, among twenty co-word pairs, e-learning is most widely seen, in such a way that it is one of the parties among fifteen pairs.
The dendrogram created by the hierarchical clustering is shown in Figure 1. Given that the number of the studied keywords was high, the developed dendrogram chart is cut in three pages. As shown in the dendrogram, the analysis of the results of the related led to the formation of 13 subject clusters. It is worth mentioning that in some clusters, in addition to the main keywords, there are sometimes keywords that do not have meaningful relationship with that cluster. Because the mentioned keywords have attracted a small amount of attention from the researchers, and in terms of co-word occurrence abundance as well as correlation coefficient had a lower rank as compared to other keywords of that cluster (5). In the following, we study the formed clusters:
Cluster 1: Quality of learning and education. The results of co-word analysis showed that 5 keywords formed this cluster. As shown in the dendrogram, the keywords are "improving classroom teaching", "interactive learning environments" and "teaching/learning strategies". The subject of this cluster can be referred to as the quality of learning and education.
Cluster 2: Curriculum Planning. This cluster consists of 4 keywords. One of the most important keywords in this cluster is the "curriculum", "innovation" and "nurse education", which indicates that this cluster is related to curriculum planning.

Table 1. Ranking the keywords of the field of distance learning studies based on frequency					
Rank	Keyword	Frequency	Rank	Keyword	Frequency
1	E-Learning	6543	11	Virtual Learning Environments	447
2	Blended Learning	1595	12	Collaborative Learning	378
3	On-Line Learning	1392	13	Mobile Learning	368
4	Distance-Learning	961	14	Information Technology	336
5	Distance Education	925	15	Modular Object Oriented Dynamic Learning Environment	336
6	On-Line Education	764	16	Web Based Education	305
7	Educating	548	17	Technology	278
8	Information And Communication Technology In Education	509	18	Web 2.0	276
9	Learning Management System	506	19	Teaching	273
10	Higher Education	485	20	Virtual Education	273

Rank	Co-word Pair		Number of Co-word Occurrences
	Table 2. Frequency distribution of 20 co-word pairs in the field of distance education studies		
1	E-Learning	Blended learning	446
2	E-Learning	Education	328
3	Higher Education	E-Learning	302
4	Moodle	E-Learning	198
5	E-Learning	Distance education	154
6	Online learning	E-Learning	135
7	Online learning	Blended learning	126
8	Training	E-Learning	119
9	Web 2.0	E-Learning	113
10	E-Learning	Cloud computing	108
11	Evaluation	E-Learning	106
12	Higher education	Blended learning	103
13	Technology	Innovation	102
14	E-Learning	Collaborative learning	101
15	Online learning	Distance education	98
16	Knowledge management	E-Learning	97
17	Online learning	Higher education	95
18	Learning management system	E-Learning	94
19	E-Learning	Assessment	94
20	Internet	E-Learning	91

Cluster 3: Individual Learning Style. This cluster includes four keywords of "learning style", "recommender system", "personalization" and "adaptive learning". The subject of this cluster can be referred to as the individual learning style.

Cluster 4: Human interaction in the virtual environment. This cluster consists of 3 keywords, which are "second life", "virtual world" and "social presence" and can be placed in the field of human interaction in the social environment.

Cluster 5: Educational Network. This cluster includes three keywords, too. With keywords "virtual learning environment", "multi-agent system" and "learning analytics", this cluster can be referred to as educational network.

Cluster 6: Educational scenario. This cluster consists of 5 keywords. "Learning Design", "E-Learning Platform" and "Self-Regulated Learning" are among the key keywords of this cluster.

Cluster 7: Educational feedback. This cluster is also composed of 3 keywords "Learning Outcomes", "Adult Education" and "Interaction," and this cluster can be referred to as educational feedback.

Cluster 8: Electronic Literacy. This cluster consists of 7 keywords. The most important keywords in this cluster are "Mobile Learning", "Facebook" and "Social Media." It is therefore appropriate to refer to this cluster as electronic literacy.

Cluster 9: The Role of Information and Communication Technology in the Education and Learning Process. This cluster consists of 6 keywords and has a meaningful relationship with the electronic literacy cluster. The keywords include "learning communities", "information and communication technology", "online teaching" and "virtual learning".

Cluster 10: Educational System. This cluster consists of 3 keywords. The keywords in this cluster are "Web2", "Moodle" and "Engineering Education", which is referred to as educational system.

Cluster 11: Miscellaneous. This cluster consists of 2 keywords and is the smallest cluster which is made in the dendrograms in terms of the number of keywords, and is composed of "flipped classroom" and "augmented reality" keywords.

Cluster 12: Strengthening the virtual education and learning process. This cluster consists of 5 keywords. The "learning environment," "open educational resources,", "E-Assessment" and "massive open online course" are the keywords of the cluster that are focused on strengthening the virtual education and learning process.

Cluster 13: The process of designing e-learning environments. This cluster is the largest cluster in the dendrogram, and most of the keywords presented in table 2 are in this cluster. It consists of 113 keywords. The most important keywords in this cluster are "online learning", "machine learning", "education", "intelligent tutoring system", "virtual environment", "knowledge sharing", "learning management system" and "online learning environment", which are very important keywords in researching distance education studies.
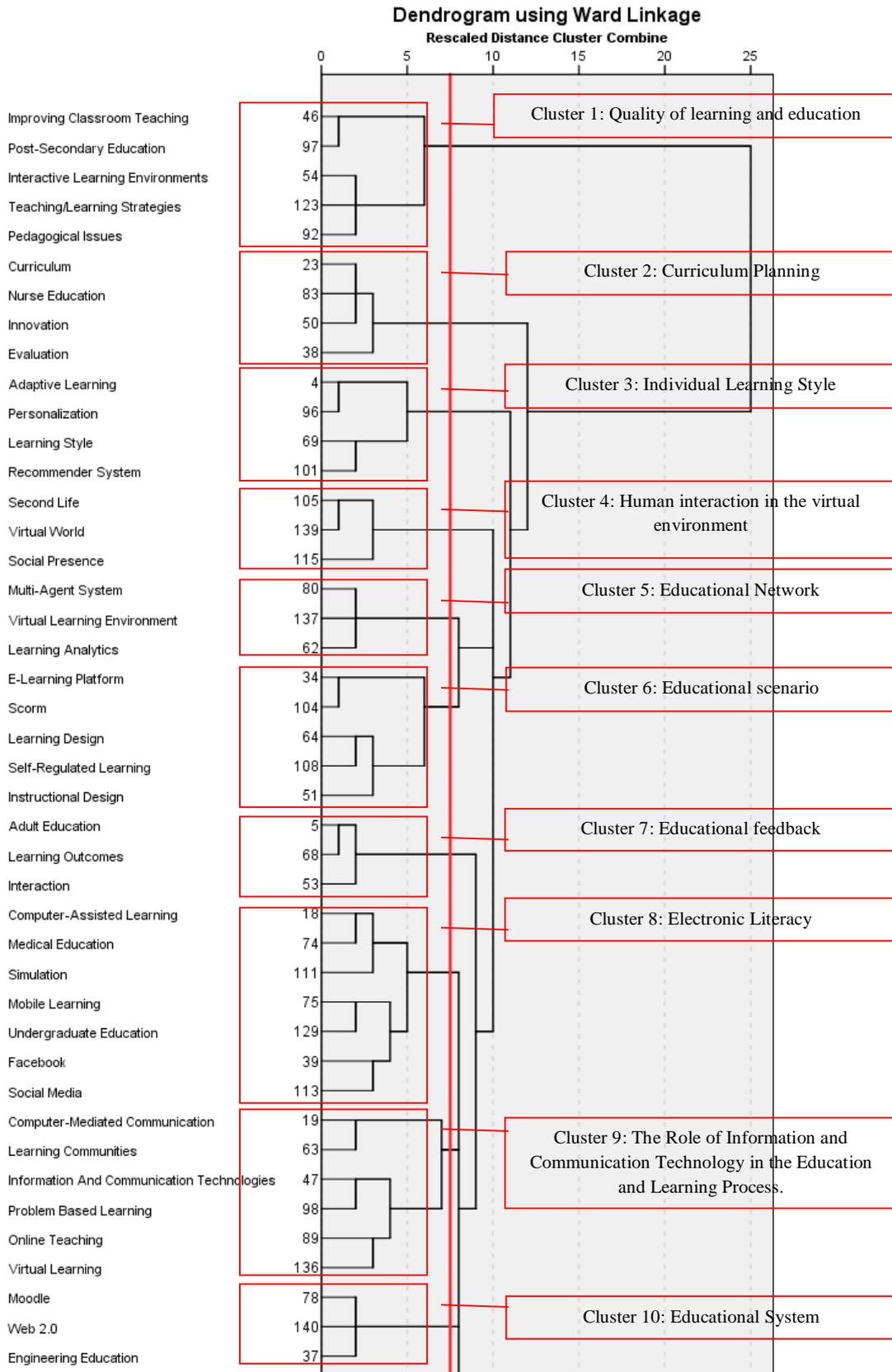
Figure 1. Dendrogram derived from hierarchical clustering using co-word method
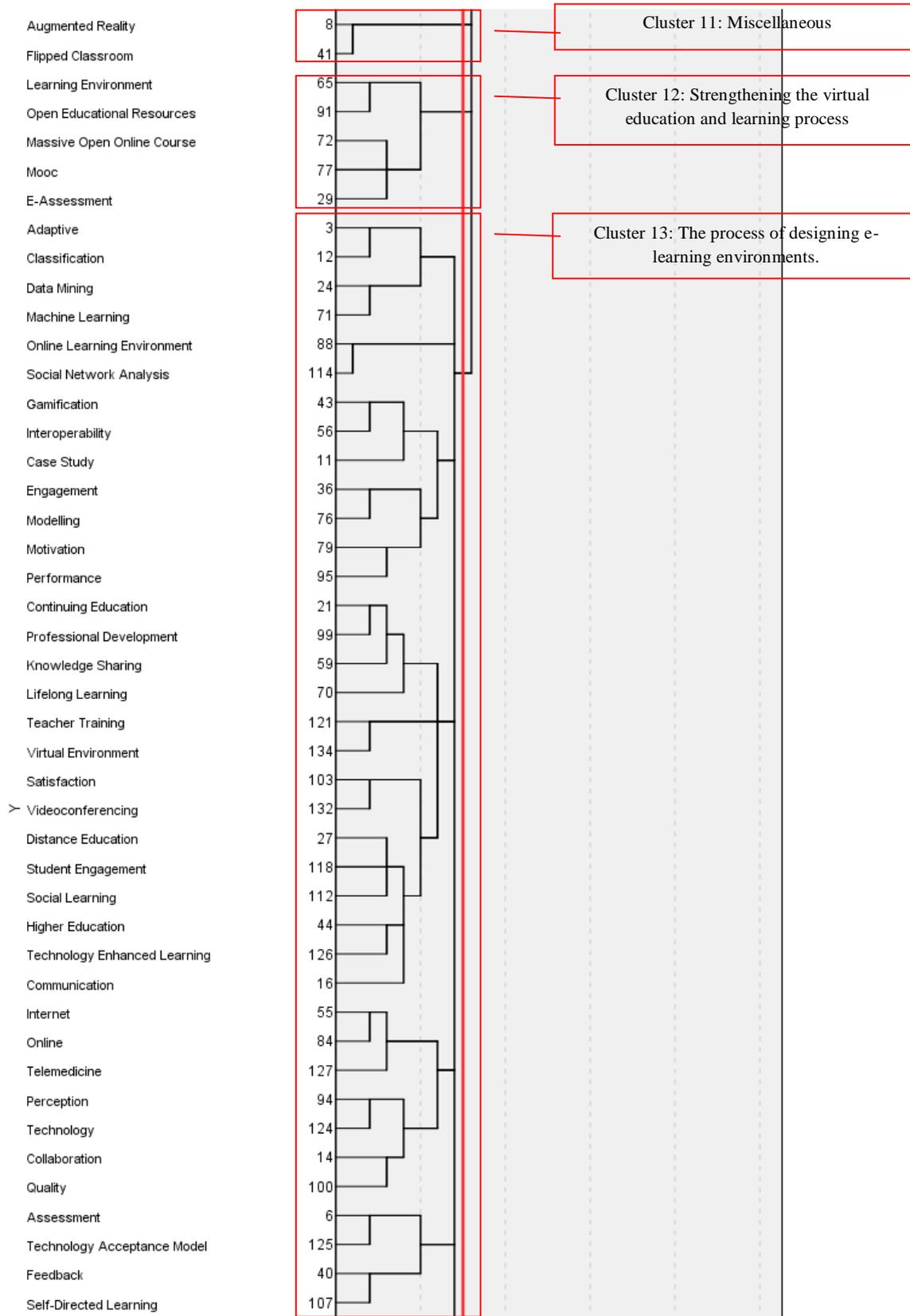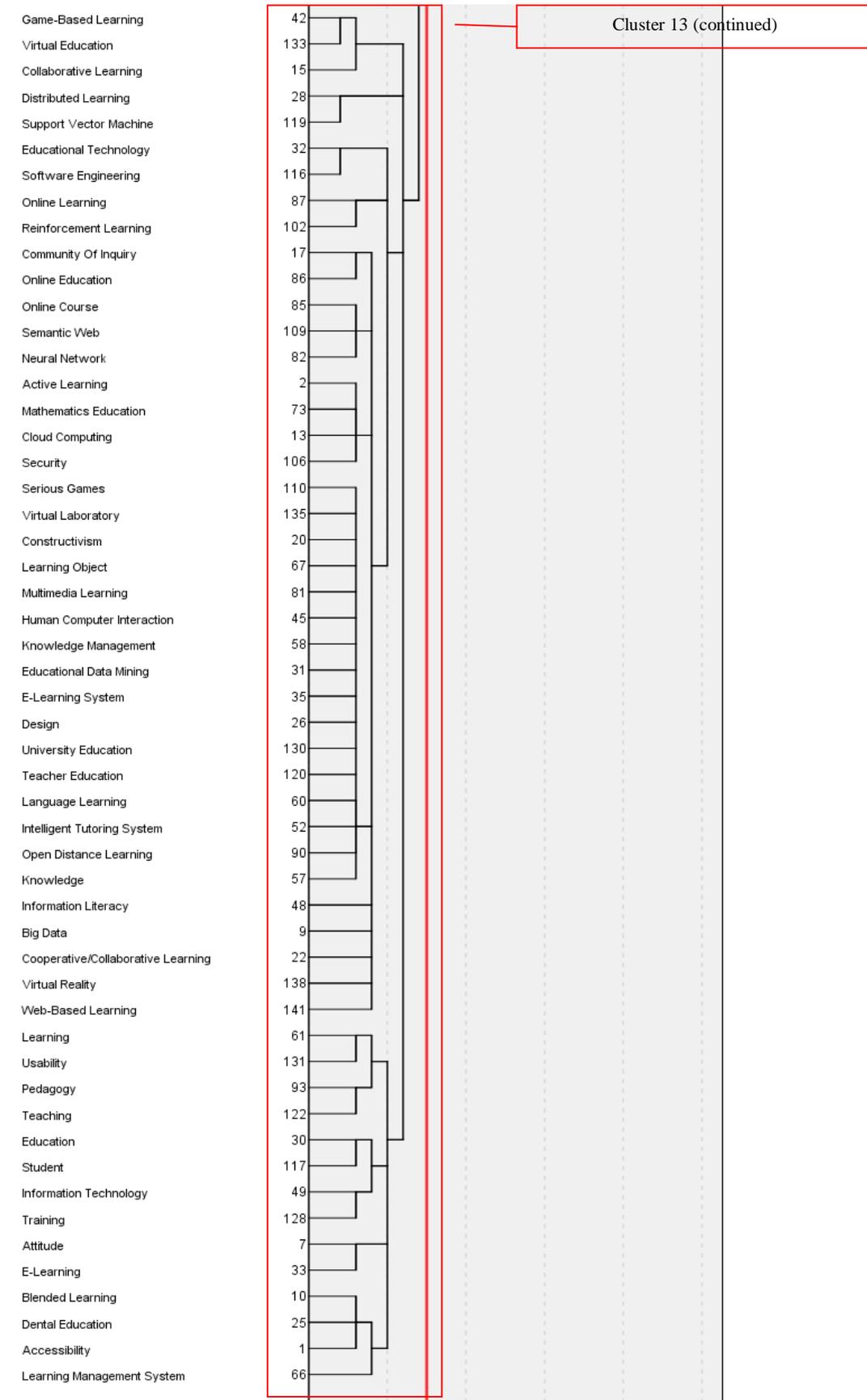
Figure 1. Continued

Figure 1. Continued

C. What is the situation of the clusters derived from the co-word analysis in the field of distance learning from the point of view of maturity and development?

Continuing co-word analysis, using the concepts of degree centrality and network density, the strategic diagram of the clusters derived from the co-word analysis were designed. First, for each of the thirteen clusters, a matrix was created. Then, frequency matrix was converted to correlation matrix using the UCINet software. The degree and density of each cluster was calculated and the mean of each cluster was obtained (table 3).

The clusters 1 (quality of learning and education), 4 (human interaction in the virtual environment) and 12 (strengthening the virtual education and learning process) have the highest levels of centrality respectively, and clusters 1 (quality of learning and education), 4 (human interaction in the virtual environment) And 3 (individual learning styles) have the highest density, respectively. The strategic diagram of the clusters derived from the co-word analysis in the field of distance education is shown in Figure 2. In the strategic diagram, the horizontal axis shows the degree centrality the rank and the power of interaction of each cluster. The more centered a cluster is, the more important the position of each cluster would be. On the other hand, the vertical axis shows the density and the internal relation in a particular research field.

One of the interesting findings regarding the distribution of clusters in the strategic diagram in this study is that none of the clusters are in 4th part of the diagram. Generally, the clusters that appear in the 4th part of the graph, though central, are not developed or mature. For this reason, it can be argued that none of the co-word clusters derived from the field of distance learning has such a feature.

Also, in cluster distribution, in the 2nd part of the diagram, only the cluster 7 (educational feedback) is located, indicating that the concepts of this cluster are developed but distinct, and also in the third part, only the cluster 13 (the design process of e-learning environments) is located which indicate that the cluster and its keywords are being emerged or degraded.

As shown in Figure 2, eleven out of thirteen clusters including cluster 1 (education and learning quality), 2 (educational planning) 3 (individual learning style), 4 (human interaction in the virtual environment), 5 (educational network), 6 (educational scenario), 9 (the role of information and communication technology in the process of education and learning), 10 (training system), 11 (miscellaneous), 12 (strengthening the learning process and virtual learning) are located in the 1st part of the strategic diagram. These clusters have high density and are well-developed.

DISCUSSION

In this research, using co-word analysis and social network analysis methods as well as science visualization software, the attempt was made to provide an appropriate representation of the intellectual structure of distance education in a 30-year period. The findings of the research showed that the key word "e-learning" is the most frequent among researches in the field of distance education. Also, the keyword "Blended Learning" has been ranked second, each of which has an important place in this field, which suggests that researchers are studying more and more in order to achieve superior and complete methods. It is possible to conclude that the tendency of researchers to design electronic learning environments is one of their research

| Table 3. Density and Degree centrality clusters resulting from co-word analysis		
Cluster's Name	**Degree Centrality**	**Density**
1. Quality of learning and education	5.04	1.52
2. Curriculum Planning	0.17	0.056
3. Individual Learning Style	0.79	0.262
4. Human interaction in the virtual environment	1.31	0.655
5. Educational Network	0.16	0.079
6. Educational scenario	0.28	0.071
7. Educational feedback	-0.22	0.109
8. Electronic Literacy	0.93	0.155
9. The Role of Information and Communication Technology in the Education and Learning Process.	0.48	0.097
10. Educational System	0.03	0.014
11. Miscellaneous	0.15	0.149
12. Strengthening the virtual education and learning process	0.89	0.222
13. The process of designing e-learning environments	-2.01	-0.019
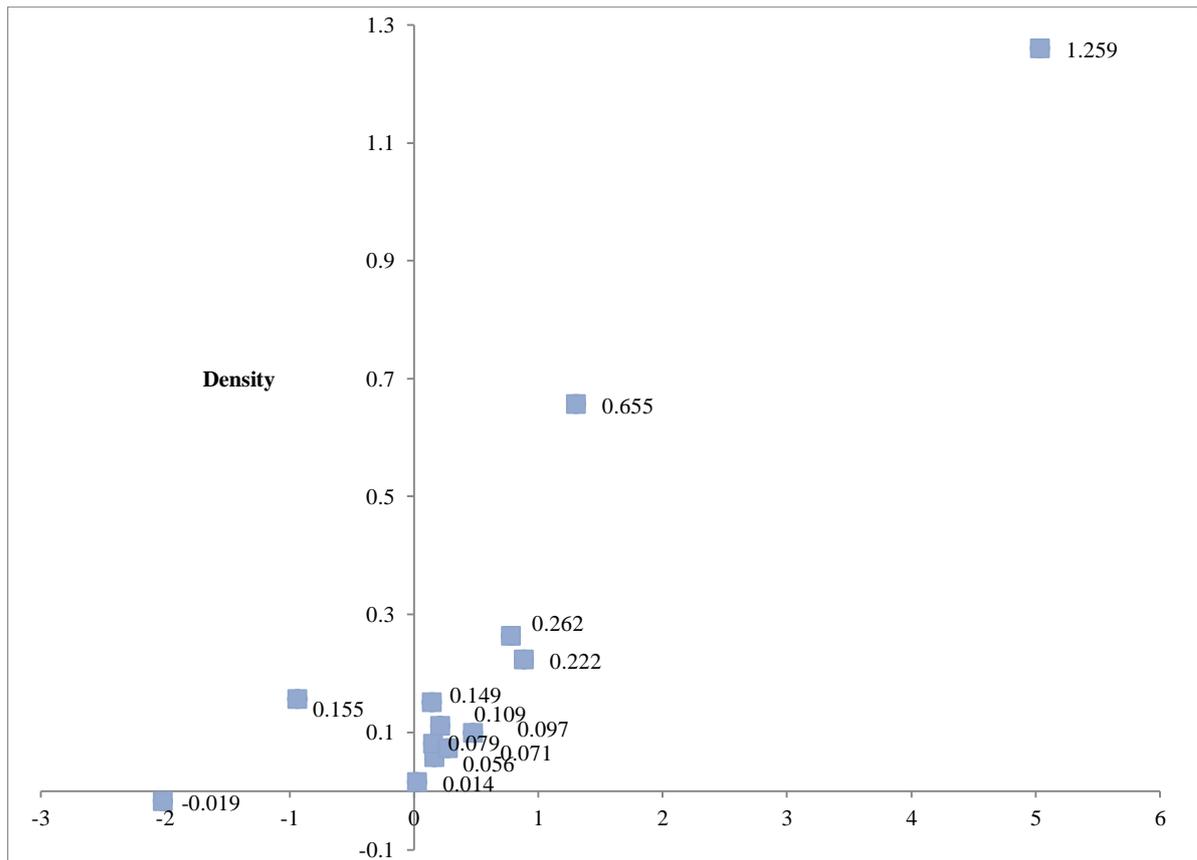
Figure 2. Strategic diagram of clusters derived from co-word analysis

research concerns, and the design of electronic learning environments can be an important topic for the future in this field. Also, each of these keywords is consistent and the researchers should pay attention to the fact that these words are longitudinally complementary and should not be used instead of each other. This part of the research is consistent with the results of studies of Skinner (10) and Bozkurtet al. (26). The results of these researchers also showed that the issue of human interaction and virtual environment is one of the topics that has attracted more attention from researchers, and e-learning, distance learning and continuous learning are among the most important used concepts in their research population.

The use of hierarchical cluster analysis to identify the intellectual structure of distance education studies led to the formation of thirteen thematic clusters including "education and learning quality", "educational planning", "human interaction in the virtual environment", "E-literacy", "the process of designing e-learning environments" and several other clusters. In the clusters resulted from the dendrogram, it seems that the "process of designing e-learning environment " is of particular importance because most commonly used keywords in educational education studies including "e-learning", "online learning", "machine learning", "learning", "intelligent learning system", "virtual environment", "knowledge sharing", "learning management

system" and "online learning environment" are located in this cluster. The analysis of the clusters obtained in this study shows that the researchers in this area, in addition to traditional teaching methods, have not been ignorant of advanced educational systems, human interactions in the virtual environment, and learning with mobile and social media, and have studied all of them at the same time. The results of the strategic diagram also indicate that the thematic areas of "learning and teaching quality" and "human interaction in the virtual environment" are the most important emerging areas in this field; these clusters are of high concentration and well-developed. The results of this part of the study are in line with the results of the research of Durak et al. (27). Their cluster analysis showed that "distance education", "distance learning", "e-learning", "online education", "machine learning", and "mobile education" ranked the highest percentage of research keywords of distance education. It is also consistent with the results of Amoozegar et al. (28). The topics of "e-learning", "distance education" and "educational systems" are the subjects of research that are more commonly seen in researchers' co-word network (28).

Also, the findings are consistent with Skinner's (10). In the mentioned study, there are clusters such as "designing e-learning environments", "technology", and "interaction". One of the differences of the current research with Skinner's (10) is

that more clusters were identified (thirteen clusters) in the current research, some clusters such as "individual learning style" and "learning and educational quality" and " Educational scenario" has not been researched in previous studies. The analysis of the clusters obtained in this study showed that researchers in the field of distance education have studied the fundamentals of this field well and have gone through a lot of issues on the basis of rapid developments in this field. The results of the strategic chart also show emerging issues, such as the process of designing e-learning environments, educational feedback, and the educational network, which researchers in this field should focus their studies on these concepts in order to further enhance the field of distance education.

Given the abundance of keywords and clusters obtained in the field of distance education, distance education research seems to be closely related to research in the field of educational planning and educational management in medicine, and many distance education studies most likely has been done on these two areas.

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