European Journal of Computer Science and Information Technology
Vol.7, No.2, pp.1-11, April 2019
Published by European Centre for Research Training and Development UK (www.eajournals.org)

ANALYSIS OF HOT SPOTS AND DEVELOPMENT TRENDS OF GAMIFICATION LEARNING RESEARCH IN CHINA BASED ON CO-WORD CONTRIBUTION ANALYSIS

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ABSTRACT: *In order to analyze the research hotspots and development trends of domestic gamification learning, a co-word contribution analysis model was introduced. Using Bicomb and Spss tools, the co-word contribution analysis and cluster analysis of the 1738 articles related to gamification core database and gamification learning were carried out. The results show that the research hotspots of gamification learning mainly include theoretical basic research, the design and development of teaching games, the application of gamification learning, the educational application value of games and the role of gamification learning in teaching reform. The development trend in the next few years mainly focuses on the combination of gamification learning and hybrid learning, the combination of gamification learning and STEM, the combination of gamification learning and smart teaching, and the combination of gamification learning and new technology.*

KEYWORDS: Gamification learning; co-word contribution analysis; cluster analysis;

INTRODUCTION

With the rapid development of gamification learning, how to apply gamification learning for teaching and learning has become a research hotspot in the field of education, and has attracted more and more researchers' attention. Regarding the research status of gamification learning, Tang Lijie [1] combed the relevant literatures in the domestic gamification learning field for nearly 10 years, and analyzed and summarized from the aspects of theory, design and development, network technology, learning environment and gamification learning community; Xue Jing[2] reviewed the research status of educational games from three aspects: the definition, classification and current problems of educational games. Fan Miaoran[3] analyzed the hotspots and trends of gamification learning through high-frequency word analysis. The above research systematically expounds the research status of gamification learning at home and abroad from different angles, but there are still a single research method, the number of research articles is insufficient, and the research time is earlier, which can not reflect the current research hotspots and development trends. Hu Changping[4] and others through the word contribution and co-word analysis for normalization, improve the accuracy of co-word analysis. In view of this, based on the word contribution degree, this paper transforms the co-word analysis, introduces the concept of co-word contribution degree, and combines the cluster analysis method to sort out and analyze the hot spots and development trends of domestic gamification learning.

Word Contribution Model and Algorithm Construction

1. Co-word contribution analysis model

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The co-word contribution analysis model is a model for integrating the advantages of co-word analysis and word contribution analysis, and optimizing the co-word analysis. The analysis of co-words is essentially to find the relationship between each other through the co-occurrence relationship of words, and the degree of word contribution is to find the relationship between each other by obtaining the proportion of words between a single data set and the overall data set. These two models are essentially one of the models of <object, feature>. Therefore, The co-word matrix and the word contribution matrix can be unified in the data model, as shown in Figure 1, which is also the introduction of word contribution analysis. The basis of co-word analysis.

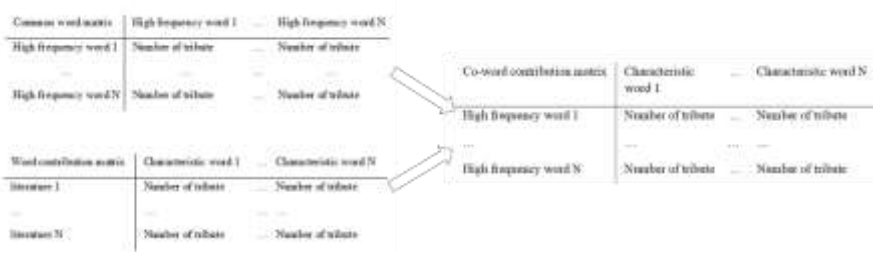

Figure 1 The unity of the common word matrix and the word contribution matrix

on the data model

2. Co-word contribution calculation formula

Word contribution is used to describe how much a word contributes to the similarity of the entire data set, As shown in formula 1:

$$\begin{cases} \mathrm{TC} = \sum_{i,j \cap i \neq j} f(t,d_i) * f(t,d_j) \\ f(\mathrm{t},\mathrm{d}) = \mathrm{tf} * \mathrm{idf} \end{cases} \qquad \text{formula 1}$$

f(t,d) represents the weight of the word d in the article t, where tf represents the number of words d in the document divided by the number of words d in the document set, and idf (inverse text frequency) represents the total number of documents collected divided by the words appearing The number of documents in d, take the logarithm.

According to the co-word contribution model, the high-frequency words are used as the row vectors, and the feature words of the high-frequency words are used to construct the co-word contribution matrix for the column vectors. Tf is the number of co-occurrences of a list of feature words and a high-frequency word of a row divided by the word frequency of the feature word, idf is the number of occurrences of the feature word divided by the number of rows, and then the logarithm. The tf-idf value is initialized to 0 when the row and column terms are the same. Therefore, the formula for calculating the contribution of the common word is as shown in Equation 2:

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$$\begin{cases} TC(t_k) = \sum_{i,j \cap i \neq j} f(t_{k,i} * idf_k) * f(t_{k,j} * idf_k) \\ tf_{i,j} = \frac{F_{i,j}}{F_i}, \ F_{i,i} = 0 \\ idf_i = \log(N/\{n: F_{i,n} > 0\}) \end{cases}$$ formula 2

3. Algorithm flow

The algorithm based on the co-word contribution matrix consists of four steps: preprocessing of data, generating candidate asymmetric co-word co-occurrence matrix, calculating tf-idf value and co-word contribution, and generating a formal co-word contribution matrix. Then cluster analysis is performed. The process of co-word contribution algorithm is as follows.

(1)Data preprocessing: reading keywords and merging similar and similar keywords， Construct FrequencyWordMatrix<high frequency word, frequency> matrix, and extract the co-occurrence relationship matrix between high frequency words RelationMatrix<high frequency word 1 & high frequency word 2, co-occurrence number>.

(2)A candidate asymmetric co-word co-occurrence matrix is generated: from the high-frequency statistics, the word frequency is greater than 7, the high-frequency words account for 38.9%, and the word frequency is greater than 3 for 54%. Therefore, in the high frequency word matrix FrequencyWordMatrix, the frequency ≥ m (m = 7) is selected to represent the high frequency keyword as the M row vectors of the matrix; the frequency ≥ n (n = 3) is used to represent the feature word as the matrix N Column vector； Construct an asymmetric matrix of M*N $\text{RelationMatrix}_{M*N}$。

(3)Calculate the tf-idf value and the contribution of the common word: Calculate the tf and idf of the row in the matrix RelationMatrix_(M*N) according to formula (2), generate the $\text{RtfidfMatrix}_{M*N}$ matrix, and calculate the contribution of each feature word column by column. degree. Calculate the contribution of each feature word column by column。

(4)Generate a formal co-word contribution matrix: obtain high contribution words, eliminate invalid contribution words, intercept the top M high contribution words, obtain high frequency keywords and high contribution words, and construct symmetric matrix $\text{RelationMatrix}_{M*M}$. Import the spss software for cluster analysis.

Research process and data analysis

1. Data Sources

This paper uses the core database of China Knowledge Network Journal as the data source. CNKI (China Knowledge Network) is the largest dynamically updated journal database in China. The articles included in the core database have clear viewpoints, novel research methods, and research conclusions can represent hot spots in this field. And trends. In the China Knowledge Network Advanced Search field, enter keywords such as "Theme = Gamification Learning" or "Theme = Game Learning" or "Theme = Game-Based Learning". The time setting is from 2008-2018, and a total of 1738 items are obtained. Data is required to be saved in the NoteFirst file format for subsequent data analysis.

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2. Data processing

The NoteFirst file is imported into the bicomb software, and the keyword information, the lexical matrix information, and the co-occurrence matrix information are extracted, and the data is preprocessed. A total of 2476 keywords are obtained, and the keyword distribution information is shown in Table 1.

According to the keyword information, the cumulative word frequency of the keyword is shown in Figure 2. When the secondary word frequency is greater than or equal to 7, the cumulative word frequency is 38.91%, close to 40%, and the word frequency is greater than or equal to 7. Seeing it as the main keyword.

Figure 2 Keyword word frequency accumulation graph

Table 1 Keyword Distribution Table

Word frequency interval	Number of keywords	Distribution ratio
1	1919	77.50%
2	274	11.07%
3-7	219	8.84%
8-10	23	0.93%
≥10	22	0.89%
≥20	19	0.77%
total	2476	100.00%

According to the co-word contribution model and algorithm flow, 79 high-frequency keywords are used as the row vector of the contribution matrix, and the word frequency is 3, as the feature word, the column vector of the contribution matrix is formed, and the feature is obtained by the calculation formula. The contribution degree of the words, the contribution degree is arranged in descending order, and the first 79 feature words are extracted. As the high degree words, the high contribution degree word information table (partial) is as shown in Table 2.

Table 2 High Contribution Word Information Table (Partial)

Serial number	High contribution word	Contribution	Serial number	High contribution word	Contribution	Serial number	High contribution word	Contribution
1	Gamification teaching	2.18	9	Game method	1.74	17	Flipping classroom	1.29
2	Information literacy education	2.05	10	Game teaching method	1.73	18	Serious game	1.28
3	Information quality education game	1.89	11	Instructional design	1.72	19	kindergarten	1.28

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4	Gamification learning	1.88	12	Early childhood education	1.71	20	Primary english	1.27
5	game	1.87	13	Game activity	1.69	21	RPG	1.26
6	Educational game	1.87	14	game design	1.64	22	Teaching Chinese as a Foreign Language	1.26
7	Primary school student	1.81	15	Gamification	1.62	23	teaching method	1.25
8	primary Mathematics	1.75	16	Classroom game	1.59	24	learner	1.25

3. Data analysis

By comparing the difference between the high frequency word and the high contribution word set, when the word frequency is 7, the difference between the high frequency word and the high contribution word is the smallest. Therefore, there is a high degree of similarity between high-frequency keywords and high-contribution words. When the word frequency is 7, the similarity is the highest, which indicates that at the critical point where the word frequency is 7, the most representative analysis based on co-word high contribution is the most representative. Sex. The difference between the equal-frequency high-frequency words and the high-contribution word sets is shown in Figure 3.

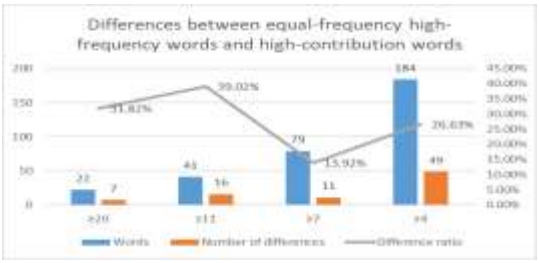

Figure 3 Difference diagram of equal-frequency high-frequency words and high-contribution words

According to the difference graphs of the equal-frequency high-frequency words and high-contribution words in Fig. 3, the difference between the first 79 high-frequency keywords and the high-contribution words is 11, which accounts for 13.92%. By comparing the differences between high frequency keywords and high contribution words，The first 79 high-frequency words focus on broad verbs or nouns such as design, application, learning, strategy, teaching, interest, education, research, development and status quo. They cannot clearly indicate research hotspots and development trends, and reflect high-contribution words. It is a specific term such as physical education, application strategy, mathematics learning, digital educational games, learning support, teaching effects, players, online educational games, game cases, etc., which can accurately express and reflect research hotspots and development trends. as shown in Table 3.

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Table 3 Difference words in high frequency words and high contribution words

High frequency word High contribution word	Frequency of occurrence	High contribution Non-high frequency words	contribution
design	34	physical education	0.75
application	27	Application strategy	0.70
learn	17	Mathematics learning	0.69
strategy	17	Digital educational game	0.64
teaching	16	Learning bracket	0.60
interest	15	Teaching effect	0.58
education	10	Player	0.55
research	9	Educational value	0.53
development	8	Online education game	0.52
development	7	Influencing factor	0.51
status	7	Game case	0.50

The above is to show the contribution of high-contribution words to research hotspots and development trends through statistical data. It only stays on the surface. We need to obtain the intrinsic structure and clustering between high-contribution words through statistical methods, and thus better. Understand the research hotspots and trends of gamification learning. The high-contribution lexical matrix is organized, imported into spss, and the correlation of each high-contribution word is obtained. The dissimilar matrix obtained after the meeting is obtained by clustering the dissimilar matrix to obtain a high-contribution clustering diagram as shown in Fig 4.

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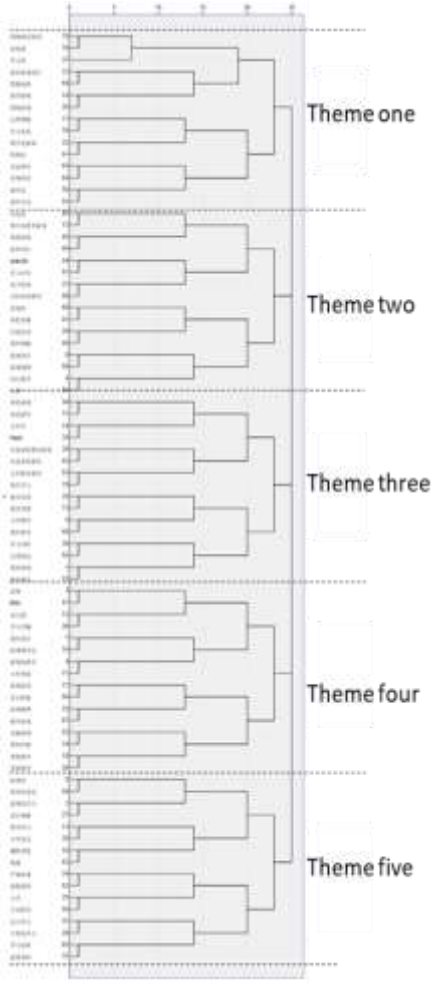

Figure 4 high contribution word clustering tree

Research process and data analysis

Through the analysis of high-contribution clustering tree graphs, this study divides the hotspots of domestic gamification learning into the following categories:

1.Theoretical research on gamification learning

The topics related to online educational games, gamers, educational game design, influencing factors, teaching games, online games, operational strategies, learning support, digital games, gameplay, empirical research, applied research, teaching methods, teaching methods, etc. It mainly describes the concept, theory, and empirical application research of gamification learning. For the concept of gamification learning, the academic community has not given a clear definition of the concept. Bao Xueying [5] and others believe that gamification learning is to apply the design elements of the game to the learning scene. Liu Yan [6] and other believe that gamification learning is based on the game concept of "questioning, challenge, autonomy", allowing the game to penetrate all aspects of teaching, and formulating teaching content and strategies How to identify whether gamification learning belongs to educational attributes or game attributes. according to the personality characteristics of learners, so that students can Gain knowledge and improve skills in the game. These concepts are different, but they all reflect the learning and gameplay of gamification learning, and this leads to the characterization of gamification learning. In order to solve the problem of learning and education of gamification learning, gamification learning fusion learning theory, teaching theory, game theory and other theories enrich the connotation of gamification learning theory, which includes constructivist learning theory and situational learning. Theory, immersion learning theory and multi-cognitive theory; teaching theory includes instructional design theory and subject teaching theory; game theory includes ancient game theory and modern game theory. In the field of empirical application research, Zhang Lu [7] and so on, from the perspective of learning experience, constructs the theoretical framework of gamification learning experience, describes the content and characteristics of gamification learning experience, and systematically expounds the gamification learning experience to promote cognition and The principle of subjective development. These studies provide theoretical guidance and empirical evidence for the design and development of instructional games.

2. Design and development of teaching games

Topics include science museums, digital educational games, classroom games, software design, Unity3D, learning science, video games, teaching Chinese as a foreign language, gameplay,

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role playing, information technology, teaching strategies, game design, game rules, early childhood education, children and other keywords. From the perspective of teaching game design and development, the design of teaching games should conform to the principle of software design. While taking into account the gameplay and the rules of the game, we should integrate the appropriate teaching strategies into the teaching game, apply mainstream information technology, and render the engine (Unity3D). The game is optimized to take into account the teaching and gameplay of the teaching game. From the classification of teaching games, games can be divided into digital teaching games and electronic games. From the application scenes, they can be divided into classroom games. From the design of the games themselves, they can be divided into role-playing classes. From the application scene of teaching games, teaching games are mainly used in science and technology museums; from the perspective of audiences, the main audiences are children and children; from the perspective of subject classification, it has a wider application in teaching Chinese as a foreign language. From the specific content of the research, how the teaching game design combines education and gameplay is the focus of research.

3. Research on the application and effect of gamification learning

The theme involves sports games, physical education, primary school students, Flash, information quality education games, information quality education, primary school mathematics teaching, mathematics teaching, learning motivation, immersion theory, educational games, teaching modes and other key words. The application in teaching, and through the experiment, the relevant effect analysis. From the analysis of the syllabus, gamification learning runs through education, and it is widely used in low school such as children, primary and secondary schools. From the analysis of subject distribution, gamification learning is mainly applied to sports, mathematics, language and other abstract things or theories. The subject of figurative processing. For the study of gamification learning effects, the new teaching mode is constructed by applying appropriate learning theories, and the learning effects are monitored to qualitatively or quantitatively study the learning effects.

4. Educational application value of the game

The topics related to games, RPG, kindergarten, learning interests, instructional design, game teaching methods, gamification teaching, primary school English, game activities, multiple intelligences, game spirit, math games, computer games, educational values, classroom teaching, English teaching, etc. Keywords, mainly to explore the educational value of the game. Shang Junjie [3] and others believe that games can help students to learn motivation, help students learn knowledge, improve their ability, develop correct emotional attitudes and values, and promote learning methods such as self-directed learning, and help build attractive A constructivist learning environment. Therefore, the educational application value of the game lies in the different teaching through the gamification teaching method, the integration of the game spirit, the reorganization of teaching design, applied to the teaching process, improve the learning interest of learning, and thus improve the teaching effect.

5. The role of gamification learning in teaching reform

The theme involves gamification, educational informationization, gamification learning, design strategies, mobile learning, primary school language, flipping classrooms, micro-courses, serious games, virtual reality, elementary school, action research, self-learning, personalized learning, learning quality, Keywords such as game cases mainly explain

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gamification learning and promote teaching reform. Li Zhenhua [8] and others applied the gamification learning concept to the flip classroom teaching, which stimulated the students' enthusiasm for learning and cultivated students' professional practice ability and innovative ability; Guo Liming [9] and others built the "SPOC + gamification learning" model to explore the application of gamification learning in cultural output. The above research shows that gamification learning promotes the development of teaching reform in both horizontal and vertical directions. The horizontal performance is in the field of gamification learning theory, content fusion into micro-course, flip teaching, mobile learning, etc., and infiltrate in various disciplines to achieve the unification of games and education; in the vertical performance in gamification learning applies to various sections, Early childhood education, primary school, middle school, specialties, undergraduate and adult teaching are conducive to the realization of individualized learning and independent learning of learners, and improve the quality of learning.

The development trend of gamification learning

Generally speaking, the current gamification learning mainly focuses on the theoretical research of gamification learning, the design and development of teaching games, the application and effect research of gamification learning, the educational application value of games, and the role of gamification learning in teaching reform. Wait for five aspects. Regarding the development trend of gamification learning in the future, Shang Junjie pointed out that gamification learning will combine with mobile learning, VRAR, STEM learning, programming learning, and brain science to promote education development. In summary, with the development of information technology and new teaching concepts, as well as the analysis of high-contribution words, the future development trend of gamification learning should focus on the following aspects.

1. Gamification learning combined with blended learning

Hybrid learning [10] is a combination of online learning and face-to-face learning. This learning mode not only plays a leading role in guiding, inspiring and supervising teaching, but also reflects the initiative of students as learning subjects in the learning process. Enthusiasm and creativity. With the rapid development of MOOCs, flipping classrooms, and the need for multi-campus teaching in major universities, mixed learning will play an important role in the future education field. However, there are inevitable defects in traditional teaching in mixed teaching, that is, how can In the process of weak supervision, the enthusiasm of students is mobilized, and passive teaching is transformed into active learning, self-learning, and improving learning efficiency. Based on this, gamification learning [11] can fully mobilize students' enthusiasm, initiative and participation, and transform boring passive learning into a fun process of actively acquiring, trying and exploring knowledge.

2. Gamification learning combined with STEM teaching

STEM education reflects the latest achievements of international science education. The Ministry of Education's "Thirteenth Five-Year Plan for Education Informationization" [12] defines STEM education as a new educational model; the "new curriculum standard" interprets STEM as a curriculum. Organizational methods, using project learning to solve problems, optimize the integration of science, technology, engineering, and mathematics, and cultivate students' innovative ability [13]. In order to promote STEM education, schools in the current school introduce children's programming, robot learning, 3D printing, AR/VR and other

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technologies in the curriculum system. Gamification learning plays an important role in STEM education.

3. Gamification learning combined with wisdom teaching

At present, the nation has set off a boom in classroom reform, and the wisdom teaching and wisdom teaching tools have developed rapidly, providing a software and hardware foundation for smart teaching. Facing such a trend, gamification learning is a smart teaching environment, smart teaching tools, teachers and students. Integrate with each other to promote a bridge of teaching.

4. Gaming learning new technology combined

Some new technologies that are currently emerging, such as adaptive learning technology, artificial intelligence, mixed reality, etc., are originally intended to enhance the sense of interaction and real experience, so that students have a better learning experience and gain in the learning process. Sense, to achieve the fun of the learning process, intelligent, immersive, digital.

CONCLUSION

In summary, the research hotspots of gamification learning mainly include theoretical basic research, design and development of teaching games, application of gamification learning, research application of games, and the role of gamification learning in teaching reform. Cross-integration will be the future of gamification learning. The combination of gamification learning and education models and new technologies will become a major trend in the future of gamification learning.

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Print ISSN: 2054-0957 (Print), Online ISSN: 2054-0965 (Online)