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A Bibliometric Retrospective of the Journal Eurasia Journal of Mathematics, Science and Technology Education between 2012 and 2017

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ABSTRACT

This study carries out a bibliometric retrospective of the journal *Eurasia Journal of Mathematics, Science and Technology Education* (*EJMSTE*) between 2012 and 2017 by using the bibliometric analysis and visualizing approaches. A series of bibliometric indicators, such as *H-Classics* publications, major prolific authors, institutions and countries and research themes etc., were included. With the help of 655 structured data retrieved from the *Web of Science*, we found a rapid growth trend of published productions. The most prolific authors, institutions and countries (territories) are mainly from Turkey and Taiwan, and this indicates this journal was dominated by these two countries (territories). Analysis of research themes showed science education, teacher education, mathematics education, attitude/attitudes research, problem solving and professional development were the main research themes for this journal. The citation impact analysis of research theme showed that three themes (i.e., student teacher, Technology Acceptance Model and animals) attracted more citations than others. Six clusters were identified which formed the main knowledge base of this journal. Analysis of cited and citing journals presented the knowledge commutation status of *EJMSTE* between other journals. These findings will help the readers to get a quick and intuitive overview and may be useful for helping the possible authors in deciding if their papers should be submitted to *EJMSTE*.

Keywords: EJMSTE, bibliometric analysis, knowledge commutation, research theme, scientific visualizing

INTRODUCTION AND BACKGROUND

EJMSTE, established in 2005, is an international open access peer-reviewed journal and every month published by Modestum. The journal addresses the important issues concerning Mathematics Education, Science Education, Environmental Education, Engineering Education, Technology Education and Educational/Instructional Technologies. It publishes research articles, reviews, editorials and selected meeting papers. Today, *EJMSTE* is a leading *Education & Educational Research* journal with an impact factor (IF) of 0.903, according to the 2017 Release of *Journal Citation Reports* (*Clarivate Analytics*).

The aim of this article is to provide a retrospective review of *EJMSTE* based on publications published between 2012 and 2017. Bibliometric analysis methods and scientific mapping procedures were employed to achieve this aim. Previously, a number of published studies reported the application of these methods to retrospectively analyze the performance of some other journals (Bharvi et al., 2003; Garg et al., 2015; Prathap, 2014). For example, Heck and Jensen (2007) studied the evolution of research contributions of the *Accounting Review*. By employing data from Web of Knowledge (*WoS*) and Elsevier's open-access Scopus, Bickers and Modlin (2012) provided an overview of metrics to measure and compare the performance of *Journal of Investigative Dermatology*. Merigó et al. (2015) analyzed the *Journal of Business Research* between 1973 and 2014. Blažun Vošner et al. (2016) retrospected the *Journal*

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Contribution of this paper to the literature

- A single journal bibliometric research of the journal *EJMSTE* was performed on its publications over the past six years.
- The characteristics and history of *EJMSTE* have been analysed based on the following bibliometric indicators: the publication years, the document types, *H-Classics* publications, major prolific authors, institutions and countries, main research themes, 'intellectual structure' or 'knowledge base' and knowledge commutation status.
- This study expanded the application range of single journal analysis. And, the findings will help the readers to get a quick and intuitive overview and help future authors decide if their papers should be submitted to *EJMSTE*

Computers in Human Behavior during the period 1991–2015. Iefremova et al. (2016) studied the internationality of *Current Science* based on the internationality of its authors. Restrepo and Willett (2017) described the bibliometric characteristics of 2398 articles published in the *Journal of Mathematical Chemistry.* Córdoba et al. (2012) compared *European Journal of Information Systems* and *Management Information Systems Quarterly* between 1995 and 2008. Coupé (2003) studied the performance of economists and economics departments based on several economics journals. In general, these works usually present an overview of the publication years, the document types, *H-Classics* publications, prolific authors, institutions and countries, main research themes, 'intellectual structure' or 'knowledge base' etc. In some further studies, visualization tools were employed to give a visual map of the bibliometric results (Li and Hale, 2016). Interestingly, almost all the works above were published in the journals, which were the ones they analyzed.

The significances of our research can be summarized as follows: First, this study would fill in the gap, that no such analysis has been performed for the Journal *EJMSTE.* Second, this research can help the readers to get a quick, intuitive and deep overview of *EJMSTE.* Meanwhile, potential authors may also learn more about this journal, and decide if their papers should be submitted to it. Last, we hope to explore the research status of *EJMSTE* by bibliometric analysis, through which some meaningful information may be provided to improve the visibility of *EJMSTE*.

Therefore, in this study, we draw a bibliometric retrospective review of the journal *EJMSTE* between 2012 and 2017. In order to retrospect the journal clearly, we posed the following five research questions:

1. What is the distribute status of *H-Classics* publications?
2. What are the major prolific authors, institutions and countries (territories)?
3. What are the main research themes?
4. What is the 'intellectual structure' or 'knowledge base' of EJMSTE?
5. What is the status of knowledge commutation between EJMSTE and other journals?

The rest of our study is structured as follows. The next section deals with the Methodology. Section 3 analyses and visualizes the results of the bibliometric analysis. Finally, the last section summarizes the main conclusions and discussions of this study.

METHODOLOGY

We used the search terms: "*Eurasia Journal of Mathematics, Science and Technology Education*" in the Publication Name in *WoS* online database (developed by *Clarivate Analytics)* to search our research data on 1 August 2017. A total of 655 publications were retrieved from *WoS.* The dynamics of the publications in *EJMSTE* was shown in **Figure 1** in one-year block. As we can observe, it is from 2012 that *WoS* started to include *EJMSTE* data. Meanwhile, there is a rapid growth trend from the year 2012 to 2017. Both of these mean, just from 2012, *EJMSTE* has become a worldwide recognized high-quality academic journal. And the 655 publications (from 2012 to 2017) could represent the evolution of this journal and can be used as the data to answer our research questions efficiently.

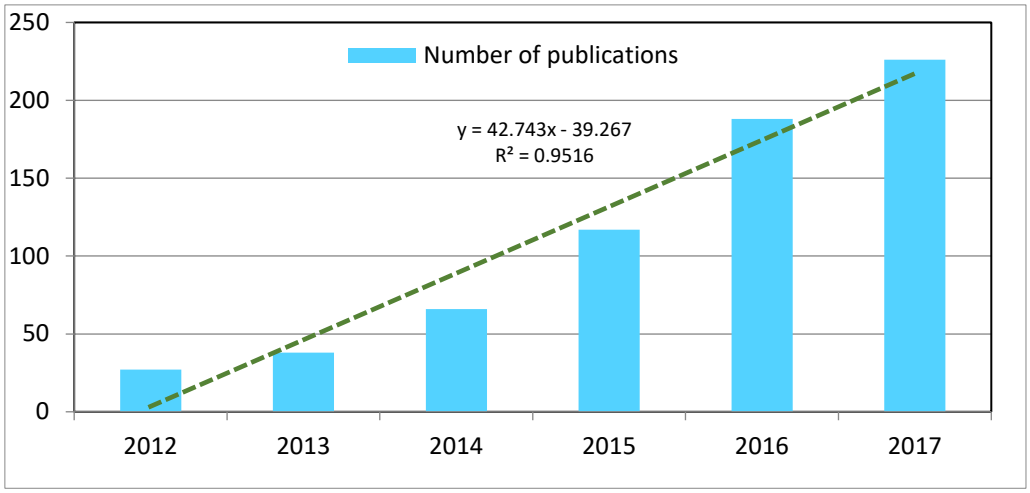

Figure 1. Trend of number of publications

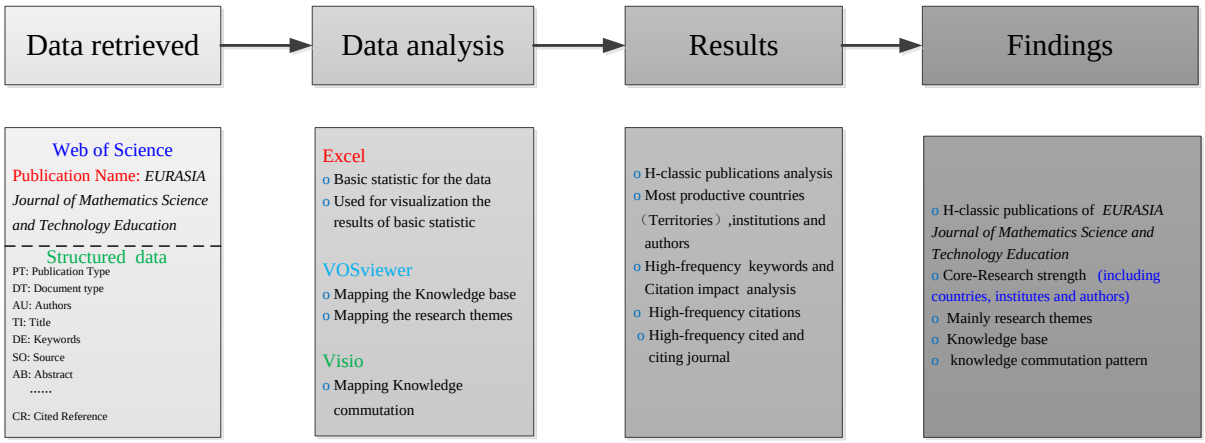

Figure 2. Overview of the research methodology

Among the 655 publications, each data including the Publication Type, Document type, Authors, Institutes, Title, Keywords, Abstract and Cited Reference was downloaded. *WoS* categorizes these data into 4 different publication types, namely articles (643), editorial materials (8), reviews (4), proceedings paper (1).

We employed bibliometric analysis and visualizing methods to detect the features of *EJMSTE*. Bibliometric analysis can be defined as the statistical method to explore the quantitative characteristics of bibliographic information, literature, articles and journals (Narin and Hamilton, 1996). In this study, a series of bibliometric analysis indicators were used as follows: *H-Classics* publications, most productive authors, countries (territories) and institutions, keywords for research theme analysis, citations for knowledge base and knowledge commutation analysis. Bibliometric visualizing method is usually used to present a structural overview of an academic field or a journal by using the visualize technique (Garfield, 2009). Some widespread visualizing techniques have been designed and developed as computer programs like *CitNetExplorer*, *Sci² Tool*, *VOSviewer* and *Citespace* (Eck and Waltman, 2014; Börner 2014; Eck et al., 2017; Chen, 2009). In this research, *VOSviewer* was used for creating, visualizing and exploring bibliometric features. Meanwhile, we also used *Excel* (developed by Microsoft, USA) to display the tables and draw the bar chart based on the number of publications. *Microsoft Visio* was also used to draw the overview of the research methodology and show the results of knowledge communication between *EJMSTE* and other journals (Li et al., 2015). The methodology is displayed in **Figure 2**.

ANALYSIS RESULT

H-Classics Publications Analysis

H-Classics publications, which are composed of *H* highly cited papers with more than *H* citations, were introduced by Martínez et al. (2015). By now, *H-Classics* indicator has become one of the most popular indicators to

Table 1. *H-classic* publications published by *EJMSTE*

Rank	Title	Authors	Year	Citations	Country / Territory
1	Effect of Technology-Embedded Scientific Inquiry on Senior Science Student Teachers' Self-Efficacy	Calik, M	2013	25	Turkey
2	The Relationship between Teachers' Knowledge and Beliefs about Science and Inquiry and Their Classroom Practices	Saad, R; BouJaoude, S	2012	21	Lebanon
3	Design and Assessment of Joyful Mobile Navigation Systems based on TAM and Integrating Learning Models Applied on Ecological Teaching Activity	Wang, TS	2013	16	Taiwan
4	Moodle as a Learning Environment in Promoting Conceptual Understanding for Secondary School Students	Psycharis, S; Chalatzoglidis, G; Kalogiannakis, M	2013	15	England
5	Using Problem-Based Learning to Stimulate Entrepreneurial Awareness Among Senior African Undergraduate Students	Swart, AJ	2014	11	South Africa
6	Perceived vulnerability to disease predicts environmental attitudes	Prokop, P; Kubiatko, M	2014	11	Slovakia
7	Perceived Disgust and Personal Experiences are Associated with Acceptance of Dissections in Schools	Fancovicova, J; Prokop, P; Leskova, A	2013	11	Slovakia
8	In-service Teachers' Implementation and Understanding of STEM Project Based Learning	Han, S; Yalvac, B; Capraro, MM; Capraro, RM	2015	9	South Korea
9	A Study on Identifying the Misconceptions of Pre-service and In-service Teachers about Basic Astronomy Concepts	Kanli, U	2014	9	Turkey

Table 2. Most prolific authors

Rank	Authors	Number of articles	Percentage
1	Chang CY	7	1.07%
2	Eilks I	7	1.07%
3	Yang DC	6	0.92%
4	Shieh CJ	6	0.92%
5	Prokop P	6	0.92%
6	Wu YW	5	0.76%
7	Su CH	5	0.76%
8	Sorgo A	5	0.76%
9	Mansour N	5	0.76%
10	Kubiatko M	5	0.76%
11	Kim MK	5	0.76%

highlight the high-quality publications of scientific knowledge domains, researchers and journals (Cobo et al., 2014). Thus, the *H-Classics* indicator is employed to explore the high-quality publications of *EJMSTE*. In the consideration of the time period 2012 –2017, *EJMSTE* published 9 *H-Classics* publications, as shown in **Table 1**.

According to the *H-Classics* indicator, *EJMSTE* has a good performance compared with the general rule of citation behavior in the year 2013. Regarding the author distribution of the *H-Classics* publications, only one author, Prokop from Slovakia, published two *H-Classics* publications and 17 authors have only one *H-Classic* publications. Considering the geographic distribution of *H-Classics* publications, we must highlight the important countries, Turkey and Slovakia, which published 2 *H-Classics* publications, respectively.

Prolific Authors, Institutions and Countries (Territories)

655 publications published in *EJMSTE* were coming from 1302 authors distributed in 61 different countries (territories) and 589 institutions. Concerning the core-strength of publications, the most prolific authors are listed in **Table 2**. The most prolific authors were Chang and Eilks (7 publications), followed by Yang, Shieh and Prokop (6 publications). And Wu, Su, Sorgo, Mansour, Kubiatko and Kim (5 publications) win the third place.

The main prolific productive institutions were listed in **Table 3**. Among them, National Taiwan Normal University is the most productive institution with 21 publications, followed by Gazi University (16 publications) and Middle East Technical University (14 publications).

Table 3. Most prolific institutions

Rank	Institutions	Number of articles	Percentage
1	National Taiwan Normal University	21	3.21%
2	Gazi University	16	2.44%
3	Middle East Technical University	14	2.14%
4	National Chiayi University	12	1.83%
5	Kazan Federal University	12	1.83%
6	Hacettepe University	12	1.83%
7	University of Bremen	11	1.68%
8	Universiti Malaya	11	1.68%
9	Near East University	11	1.68%
10	Southern Taiwan University of Science and Technology	10	1.53%
11	Karadeniz Teknik University	10	1.53%

Table 4. Most prolific countries (territories)

Rank	Country / Territory	Number of articles	Percentage
1	Turkey	157	23.97%
2	Taiwan	136	20.76%
3	Peoples R China	91	13.89%
4	USA	55	8.40%
5	South Korea	46	7.02%
6	Germany	25	3.82%
7	South Africa	25	3.82%
8	Malaysia	20	3.05%
9	Spain	19	2.90%
10	Cyprus	13	1.98%
11	Russia	13	1.98%

Table 4 shows the most prolific Countries (Territories) by the number of publications. The most productive countries (territories) are turkey (157 publications), followed by Taiwan (136 publications) and Peoples R China (91 publications). It is interesting to highlight that, the total numbers of top 3 counties (territories) publications were more than 58.6% in *EJMSTE*. This suggests that *EJMSTE* is dominated by Eurasia countries (territories) and need further internationalization.

Mainly Research Themes

Scholars usually consider author keywords analysis as one of the main means for identifying research themes within a given area or journal. Based on the density visualization drawn by *VOSviewer*, the scientific landscape of main research themes in journal *EJMSTE* was drawn. And keywords were colored depending on the occurrence frequency (shown in **Figure 3**). In this research, the larger the occurrence frequency of keywords associated with *EJMSTE*, the closer the color of keywords is to red. Conversely, the smaller the occurrence frequency of keywords associated with *EJMSTE*, the closer the color of keywords is to blue.

Table 5 displays the main research themes ranked by the frequency of occurrence. As can be seen, science education (30 occurrences), teacher education (20 occurrences), mathematics education (17 occurrences), attitude/attitudes(17 occurrences), problem solving (16 occurrences), professional development (13 occurrences), higher education (12 occurrences), science (11 occurrences), mathematics (11 occurrences), self-efficacy (11 occurrences), technology (11 occurrences), practical work (11 occurrences), gender (10 occurrences), nature of science (10 occurrences), physics education (10 occurrences), motivation (9 occurrences), mathematics achievement (8 occurrences), pedagogical content knowledge (8 occurrences), virtual reality (8 occurrences), creativity (8 occurrences), learning effectiveness (8 occurrences), and engineering education (8 occurrences) were the main research themes of the journal.

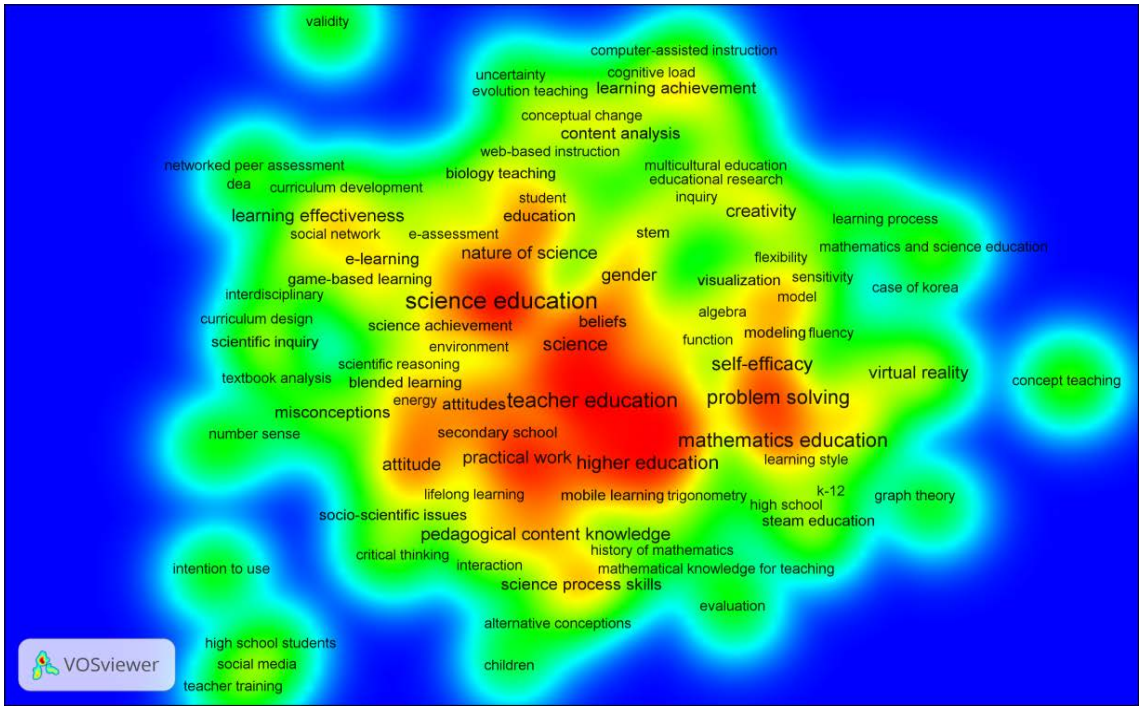

Figure 3. Visualizing the main research themes based on author keywords co-occurrences network

Table 5. Mainly research themes

Rank	Research theme	Frequency	Rank	Research theme	Frequency
1	science education	30	8	practical work	11
2	teacher education	20	13	gender	10
3	mathematics education	17	13	nature of science	10
3	attitude/attitudes	17	13	physics education	10
5	Problem solving occurrences)	16	16	motivation	9
6	professional development	13	17	mathematics achievement	8
7	higher education	12	17	pedagogical content knowledge	8
8	science	11	17	virtual reality	8
8	mathematics	11	17	creativity	8
8	self-efficacy	11	17	learning effectiveness	8
8	technology	11	17	engineering education	8

An in-depth study on the research themes citation impact was shown in **Figure 4**. The research themes are represented with colored frames to mirror the average citation impact. And, this was getting by taking the average of the normalized citation scores of all research themes appeared in. Similarly to **Figure 3**, research themes in **Figure 4** also has a color range from blue to red corresponding to normalized citation scores from 0 to 5. In this research, the larger the citation impacts of research themes, the color of keywords is to red. Conversely, the smaller the citation impact of research themes, the closer the color of keywords is to blue.

As can be observed in **Figure 4**, student teacher (15.5 Average citations scores), Technology Acceptance Model (TAM, 15.5 Average citations scores), animals (8.67 Average citations scores), Moodle (7.5 Average citations scores), inquiry (7 Average citations scores), socio-scientific issues-based science education (7 Average citations scores), beliefs (6.67Average citations scores), three-tier test (5.67 Average citations scores), attitudes toward science (5 Average citations scores), educational reform (5 Average citations scores), hands-on science (5 Average citations scores), problem-based learning (5 Average citations scores) ,blended learning (4.6 Average citations scores) and scientific inquiry (4 Average citations scores) were the most impact research themes. These reflected the above themes attracted more citations than other themes and made a significant contribution to expand *EJMSTE* journal's influence.

Figure 4. Visualizing the citation impact of the mainly research themes

Table 6. Most important themes

Rank	Research theme	Average citations scores
1	science education	15.5
2	Technology Acceptance Model (TAM)	15.5
3	animals	8.7
4	Moodle	7.5
5	inquiry occurrences	7.0
6	socio-scientific issues-based science education development	7.0
7	beliefs	6.7
8	three-tier test	5.7
9	attitudes toward science	5.0
10	educational reform	5.0
11	hands-on science	5.0
12	problem-based learning	5.0
13	blended learning	4.6
14	scientific inquiry	4.0

Intellectual Structure Analysis

The intellectual structure of a journal can be represented with a network of cited-references. Our paper focuses on co-cited references networks with *VOSviewer*. **Figure 5** displays the Panorama intellectual structure of *EJMSTE*. The size of a node is proportional to the number of cited references. A node with high citation counts would be more valuable than others (Chen et al. 2009). It is easy to observe that a guideline, named *Principles and Standards for School Mathematics,* is the best influence publication in *EJMSTE*. Followed two articles, "*Those Who Understand: Knowledge Growth in Teaching*" and "*Knowledge and Teaching: Foundations of the New Reform*" both published by Shulman (1986, 1987) get a second position of the landmark articles. *National Science Education Standards (NSES)*, a guideline for *K-12* science education in United States schools, win the third place. This indicates that reports published by education organization play an important role in the knowledge base of *EJMSTE*.

Additionally, 6 groups have also been identified and integrated in **Figure 5** through a color-coding. This was realized through using the cluster method for grouping documents together based on their similarities. It is also easy to observe, cluster 1 with red color consists of 182 publications with strong ties to the educational psychology.

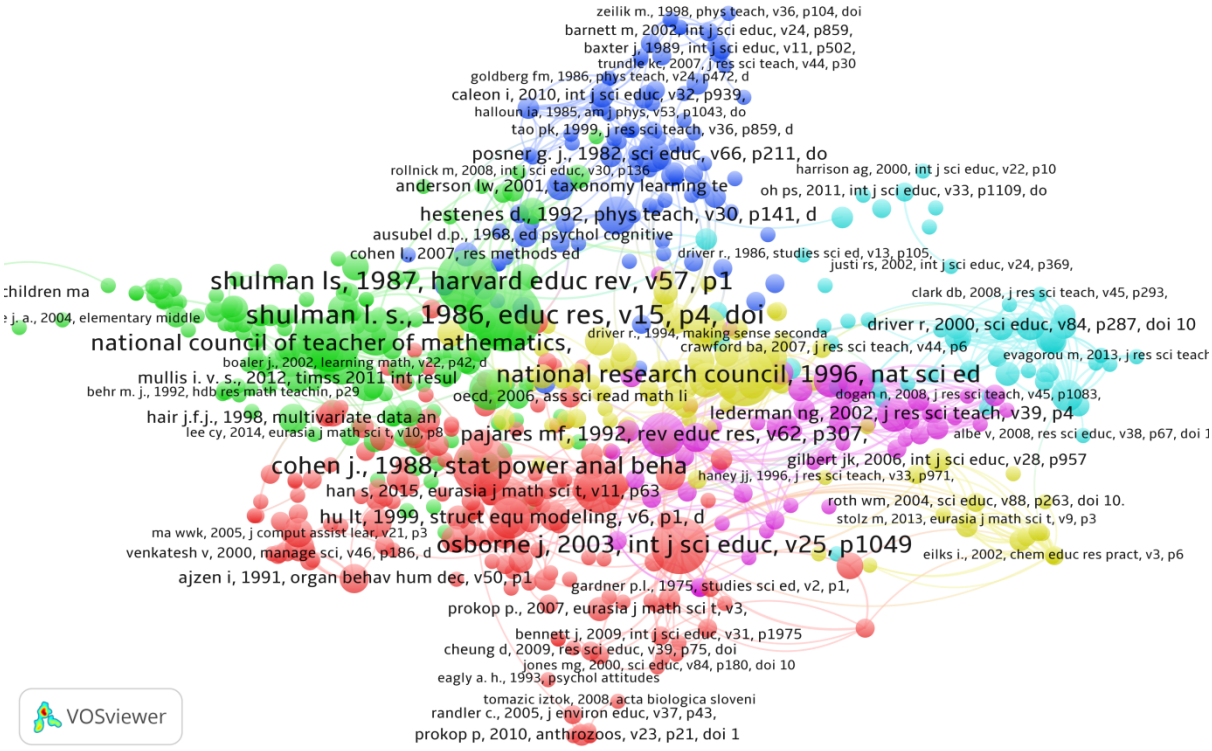

Figure 5. Panorama of intellectual structure

With green color, a second cluster consists of 177 publications and finds its roots in teacher education. A third cluster (blue color) groups a number of articles related to teaching and learning. Cluster 4 with yellow color consists of 92 publications with strong ties to the science education. Cluster 5 with purple color consists of 57 publications and finds its roots in nature of science. Cluster 6 seems to be the most heterogeneous. These six clusters formed the main knowledge base of *EJMSTE*.

Knowledge Commutation Analysis

How does knowledge flow between *EJMSTE* and other journals? **Figure 6** shows the knowledge flow between *EJMSTE* and its related journals. The left side of the figures shows the top 15 journals which cited by *EJMSTE,* reflecting the knowledge from these journals flowing to *EJMSTE*. The right side of the **Figure 6** shows the journals, from those indexed by *WoS*, were citing *EJMSTE* in their articles. This reflects the knowledge flow from *EJMSTE* to other journals.

The dominant cited journals by *EJMSTE* are *International Journal of Science Education* (739 times), *Journal of Research in Science Teaching* (690 times), and *EJMSTE* (529 times). This indicates that *EJMSTE* do drove by the journals in its own research field. We must highlight that *Computers & Education* and *Computers in Human Behavior* are also present in the top 15 cited journals. This reflects that computer related researches are becoming increasingly important in the mathematics and science education.

Figure 6 also shows the top 15 most citing journals from a total of 493 journals by the number of citing times. Among them, *EJMSTE* is the most dominant journal (184 times), followed by *Journal of Baltic Science Education* (31 times), and *Anthropologist* (31 times). This indicates that *EJMSTE* exhibits a slight problematic self-citation behavior. Whilst, the appearance of *Anthropologist* strengthens the conclusion that *EJMSTE* and *Anthropologist* are very closely allied, and *EJMSTE* will set up an important bridge between its own academic knowledge domain and anthropology.

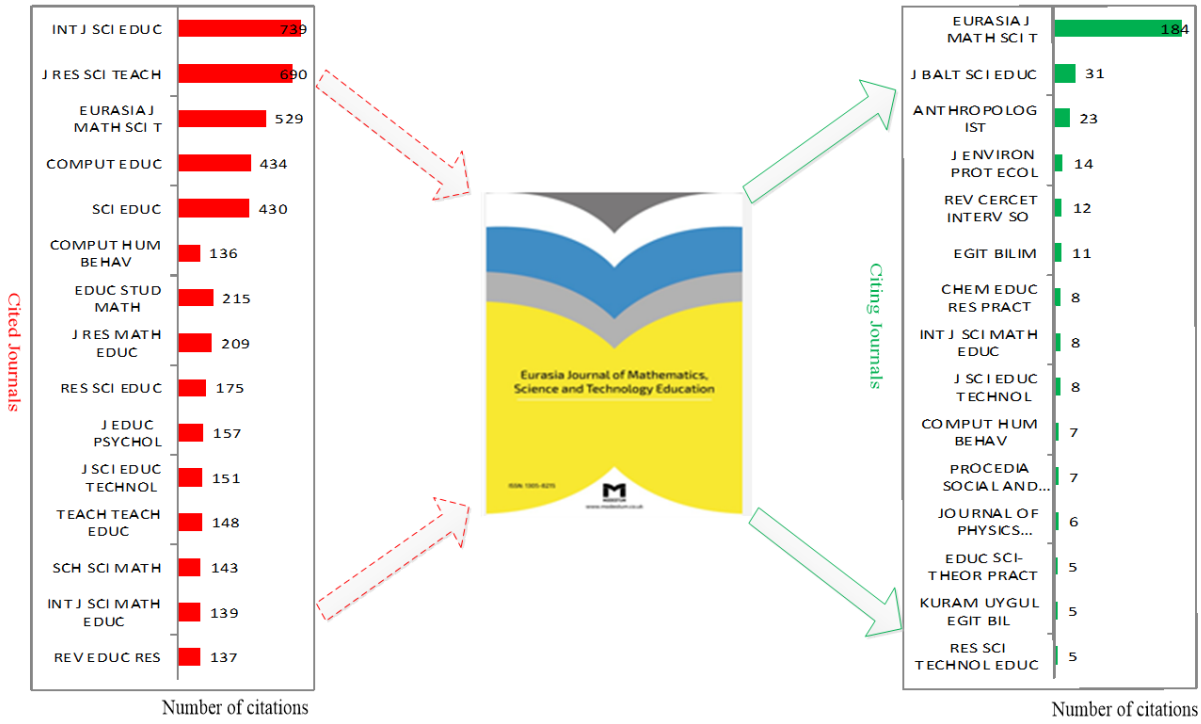

Figure 6. Knowledge communication between *EJMSTE* and other sources

DISCUSSIONS AND CONCLUSIONS

The aim of this study was to create a bibliometric profile of *EJMSTE* between 2012 and 2017 by using bibliometric analysis and visualizing methods. Considering this aim, we investigated the *H-Classics* publications, major prolific authors, institutions and countries (territories), main research themes, intellectual structure and knowledge commutation status. And then a spectrum of *EJMSTE* was posed, and this revealed the journal's bibliometric characteristics.

We found that, based on *WoS* database, 655 publications published in *EJMSTE (*from 2012 to 2017*)* can be divided into 4 different document types. This is much fewer than other journals, i.e. the findings performed by Blažun Vošner et al. (2016) (nine document types) and Fu and Ho (2015) (also nine document types). According to this, the attraction of *EJMSTE* to other document types is relatively limited. Therefore, *EJMSTE* could extend the document types. For example, the journal can publish more selected conference papers to improve journal's popularity.

By analyzing the dynamics and trends of published productions, we found an exponential growth trend in one-year block. The cause of this might be the rapid development of science and technology education research. Another cause might be due to the number of issues increased from 6 to 12. This change may do a favor for journal's prestige and visibility. Then, more submissions would be attracted by this journal. And, editor and reviewer also have more opportunity to select better papers. Similarly, *EJMSTE* also can increase the number of published papers in each issue. At the same time, a strict paper review process is also needed to promote paper quality.

By analyzing the *H-Classics* publications, we highlight the importance of Turkey and Slovakia, who published 2 *H-Classics* publications, respectively. Our findings showed that, the most prolific authors were Chang and Eilks (both published 7 articles). A more extensive investigation of the prolific authors revealed 11 authors who published more than five articles. Interestingly, two chief editors, Chang and Kubiatko, were both appeared in the top 10 prolific authors. The prolific institutions and countries (territories) presented that, publications in *EJMSTE* were dominated by Turkey, Taiwan, China and their institutions. This also suggests *EJMSTE* needs to go further internationalization.

To do this, *EJMSTE* may invite outstanding researchers from different countries to join the editorial board. Second, *EJMSTE*, currently, remits publication fees for editorial board member, reviewers, guest editorials, book reviews, and invited articles. Moreover, when doctoral students submit a manuscript stemming from their doctoral dissertations, they will be eligible for fully paid. In the same manner, we suggest that *EJMSTE* could make appropriate deductions of publication fees according to the quality of papers. Third, the reasonable use of new

media technology can also enlarge the influence of journals and published papers. Such as *Academy of Management Perspectives*, this journal starts to make a video for some papers to help readers understand the research deeply. This also will increase the influence of papers and journal.

Contrast with the geography distribution of *H-Classics* publications, there is no representation author from China emerges in *H-Classics* publications. The reason for this may due to the relatively late published time. It needs to take time for the papers from China to raise in the "citation" rankings. In addition, in the future, *EJMSTE* also need to pay attention to the review processes for these papers to ensure the papers' quality.

Analysis of research themes showed science education, teacher education, mathematics education, attitude/attitudes research, problem solving, professional development were the main research themes for the journal. The further analysis of research theme citation impact highlighted the positive contribution of student teacher, TAM and animals. These themes expand the influence of the journal. Therefore, *EJMSTE* could appropriately increase the publication of papers about these three topics. This will help to obtain more citations and improve impact factors of *EJMSTE.*

A network of cited-references enabled us to identify the knowledge base of *EJMSTE*. By using the clustering method based on the network of cited-references, six clusters consists of different publications were identified which formed the main knowledge base of *EJMSTE*. Analysis of cited and citing journals presented the knowledge commutation status of the journals. Cited journal analysis indicated that *EJMSTE* is drove its own academic knowledge domain. Citing journal analysis shows *EJMSTE* is the most dominant journal. This accords with the general law of journal citation, but it's also important to notice that a strictly control is necessary to avoid high self-cited.

Citing journal analysis also reflected *EJMSTE* is very closely allied with some other journals within in other academic knowledge domain, such as anthropology. Through the comprehensive analysis of the knowledge commutation status, we can easily draw the conclusion that *EJMSTE* will set up an important bridge between its own academic knowledge domain and some other academic knowledge domain, especially for anthropology. According to the theory of social network, the journals, acting as the bridges between different domains, will get an easier access to resources and high citations (Chen, 2011). Thus, *EJMSTE* need to maintain and consolidate this role. Not only closely connect with its own academic knowledge, but also actively promote the knowledge communication with other journals in different domains.

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