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Visualization Analysis of Researches on Digital Storytelling Based on Mapping Knowledge Domain

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The development of the information age and globalization has challenged the training of technical talents in the 21st century, and the information media and technical skills are becoming increasingly important. As a creative sharing form of multimedia, the digital storytelling is being concerned by more and more educators because of its discipline applicability and media technology enhancing ability. In this study, the information visualization software, i.e. CiteSpace was applied to visualize and analyze the researches on digital storytelling from the aspects of key articles and citation hotspots, and make a review on the research status of the digital storytelling in the education fields, such as promoting language learning, and helping students develop the 21st century skills.

Keywords: digital storytelling, mapping knowledge domain, visualization analysis

Introduction

The information age has changed the way in which the knowledge is created, communicated and connected, and has posed new challenges to education. The application and introduction of software and hardware technologies as well as various social media tools has driven the society into the media era, where everyone may connect with the digital media and global knowledge system, create and share knowledge and information based on which. To master the 21st century skills, the new generation of learners must have information, media and technology skills in addition to the solid discipline knowledge, and should be capable of accessing, analyzing, evaluating and creating information through technical means (Trilling & Fidel, 2011). The digital storytelling, as a form to create and share multimedia, has increasingly been widely used in various fields, playing an ever more important role in the training of the 21st century skills on the learners.

Digital storytelling was originated from the American art field in the late 20th century (Tucker, 2006). The multimedia autobiography created by the artist Dana Winslow Atchley, caused a strong reaction after it was openly published. Thereafter, the digital storytelling was applied to various fields. Constructivism sees learning as a social and cultural process that occurs in learners' interaction with material tools and others (Vygotsky, 1978). As a new teaching methodology, the digital storytelling can help learners build knowledge, and promote collaboration and sharing (Daily & Eugene, 2013), and its creative process can enhance the students' information and communication technology (ICT) literacy as well, which is applicable to both children learners and adult learners (Alston & Ellis-Hervey, 2015; Shelby-Caffey, Ubeda, & Jenkins, 2014). In order to

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understand the current situation of digital storytelling, a visualization analysis based on the method of Mapping Knowledge Domain was performed on the digital storytelling-related literatures published in the world in this article.

Methods

Research Objectives and Search Strategy

During the study, the citations (from 2000 to 2016) related to the topic of Digital Storytelling were searched by limiting the citation index to Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI) in the Web of Science Core Collection, the fine Articles were further selected from the 313 citation records, with the language set as English, and finally we obtained 267 citations as the research objects.

Data Source and Retrieval

The Mapping Knowledge Domain belongs to the category of scientific metrology. It shows the evolution and structural relationship of scientific knowledge via the visualization technique, revealing the knowledge resources and the carriers obtained by human beings over the time (CHEN & LIU, 2005). With the Mapping Knowledge Domain, people can sort out the evolution process, development trend, present status, frontier and hotspot direction of disciplines or fields.

In this study, CiteSpace was used as a software tool for drawing the Mapping Knowledge Domain. It was developed by Dr. Chen Chaomei of Drexel University in the United States. As a knowledge analysis and information visualization software for dynamic and complex network analysis based on Java environment, CiteSpace belongs to the citation analysis software in the Mapping Knowledge Domain and uses annual rings to represent the citation frequency of the object in different time periods. This article makes a review on the characteristics and hotspots of international researches on digital storytelling through the co-citation and co-occurring keyword analysis.

Results

The Number of Articles Published in Digital Storytelling in the Past 17 Years

The publication times of the 267 articles were summarized, and made into a line chart by year. It can be identified from Figure 1 that the publication time of digital storytelling articles shows a trend of rising year by year. Thus, it was in 2000 when the digital storytelling appeared as a research topic in an international journal. In the initial research related to digital storytelling, McLellan (2000) explored how drama, digital storytelling, and so on were used in the design of online learning experience, while Harris (2000) focused on the development of new media such as e-mail and digital stories when studying the mutual fusion in the transition period of the printed and electronic media.

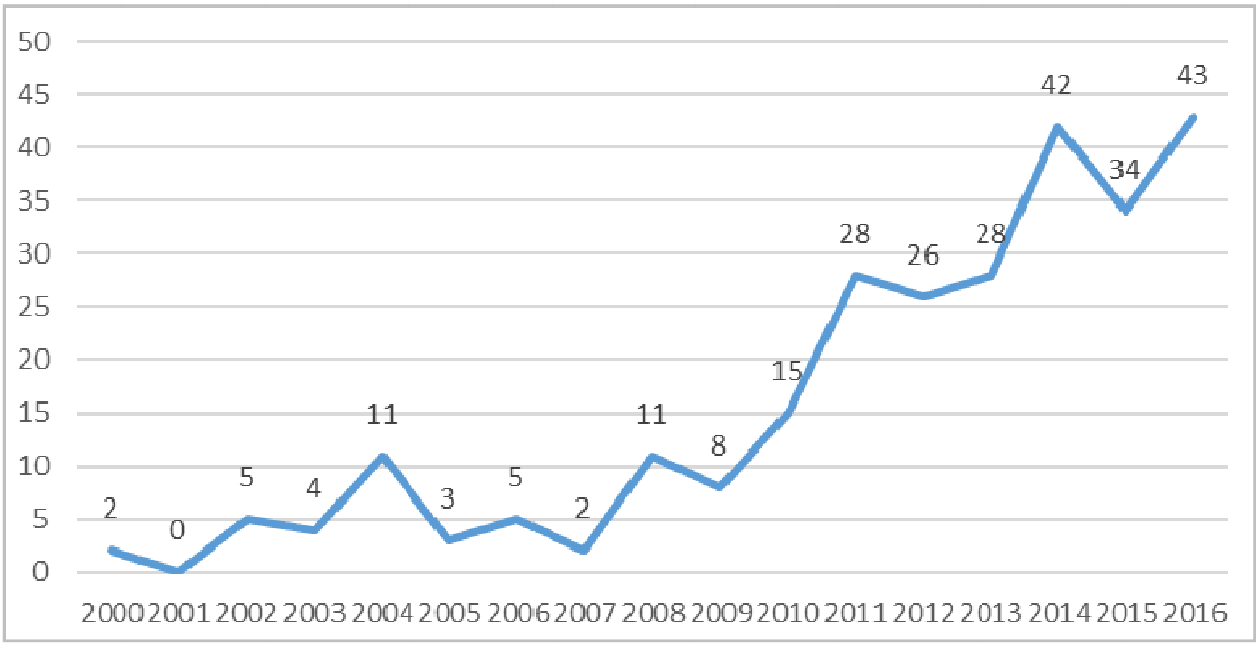

Figure 1. Distribution chart of number of digital storytelling articles by year.

Since 2010, the number of digital storytelling studies has grown fast. Among them, the number of the literatures with the research direction of education increased rapidly. From 2000 to 2009, there were only six educational research literatures, while from 2010 to 2016, the number of educational research literatures was up to 67. The use and research of digital storytelling has been gradually promoted in the field of education and research. It is not only applied in the conventional teaching, assisting teaching and learning, but also has a positive effect on facilitating preservice teachers' pedagogical competencies and pedagogical content knowledge (Starcic, Cotic, Solomonides, & Volk, 2016).

Publication Source Analysis

According to the statistics, 267 articles were published in 182 journals, showing a dispersed feature. Of which, 9 journals contain more than three articles. As can be seen from the statistical table (Table 1), the research direction of the main sources of digital storytelling is concentrated in the fields of computer science, education, art and communication. In addition, it is also found in the process of the overall analysis of the articles that the fields with the research direction accounting for the top five are respectively education (73 articles, 27.34%), computer science (47 articles, 17.60%), communication (40 articles, 14.98%), linguistics (19 articles, 7.12%) and art (15 articles, 5.62%).

Table 1

Source Publications Statistics of Digital Storytelling Articles

Publication	Research direction	Numbers of articles	Percentage
LECTURE NOTES IN COMPUTER SCIENCE	Computer Science	16	5.993%
TECHNOLOGIES FOR INTERACTIVE DIGITAL STORYTELLING AND ENTERTAINMENT	Computer Science	9	3.371%
DIGITAL CREATIVITY	Art	8	2.996%
NEW MEDIA SOCIETY	Communication	7	2.622%
COMPUTERS EDUCATION	Computer Science; Education & Educational Research	6	2.247%
CONVERGENCE THE INTERNATIONAL JOURNAL OF RESEARCH INTO NEW MEDIA TECHNOLOGIES	Communication	6	2.247%
EDUCATIONAL TECHNOLOGY SOCIETY	Education & Educational Research	5	1.873%
LEONARDO	Art	5	1.873%
MEDIA INTERNATIONAL AUSTRALIA	Communication	4	1.498%

Regional Analysis

In the statistics on the researchers, it is found that among the authors who had published more than two articles, Couldry (2008), MacDonald et al. (2015), Clark et al. (2015), and Dickens et al. (2015) carried out research on digital storytelling from the perspectives of social, political and communication. Whereas, Burgess, Klaebe and McWilliam (2010) studied the digital storytelling cases in the history, culture and communication field. In the rank of researchers by the number of their publications, few researchers in the field of education rank the top, which indicates the education field is lack of experts and scholars who are engaged in digital storytelling research for a long term.

Through the analysis on the country and region of the researchers, it is found that the research of digital storytelling is mainly concentrated in Europe and the United States. The countries with the largest number of articles include the United States (86 articles, 32.21%), the United Kingdom (36 articles, 13.48%), Australia (31 articles, 11.61%), Canada (18 articles, 6.74%), Germany (14 articles, 5.24%) and Italy (11 articles, 4.12%).

Reference Co-citation Analysis

By performing the citation analysis with the information visualization software CiteSpace, the citation situation of the literatures may be presented in the visualized form, based on which, the degree of the effect and the quality of the literatures may be inferred. Highly-cited literatures, which are namely the key node literatures for the development of discipline or field, are helpful to explore the path of research evolution, explain the background of the development of the discipline and the dynamics of evolution (LIU, DON, & HAN, 2012). In this study, CiteSpace software was used to analyze the 267 citation records of the related research on the digital storytelling. The set time span for the analysis was 2000 to 2016, the annual slice was 2 years, and the node type was the common citation. The first 30 of each slice was selected, and the others were set as the default. The minimum spanning tree was used (a network simplified algorithm) for analysis. There were a total of 225 nodes and 229 lines in the obtained mapping. As shown in Figure 2 (each node in the figure represents a document, the thickness of the circle is proportional to the number of citations in the corresponding year).

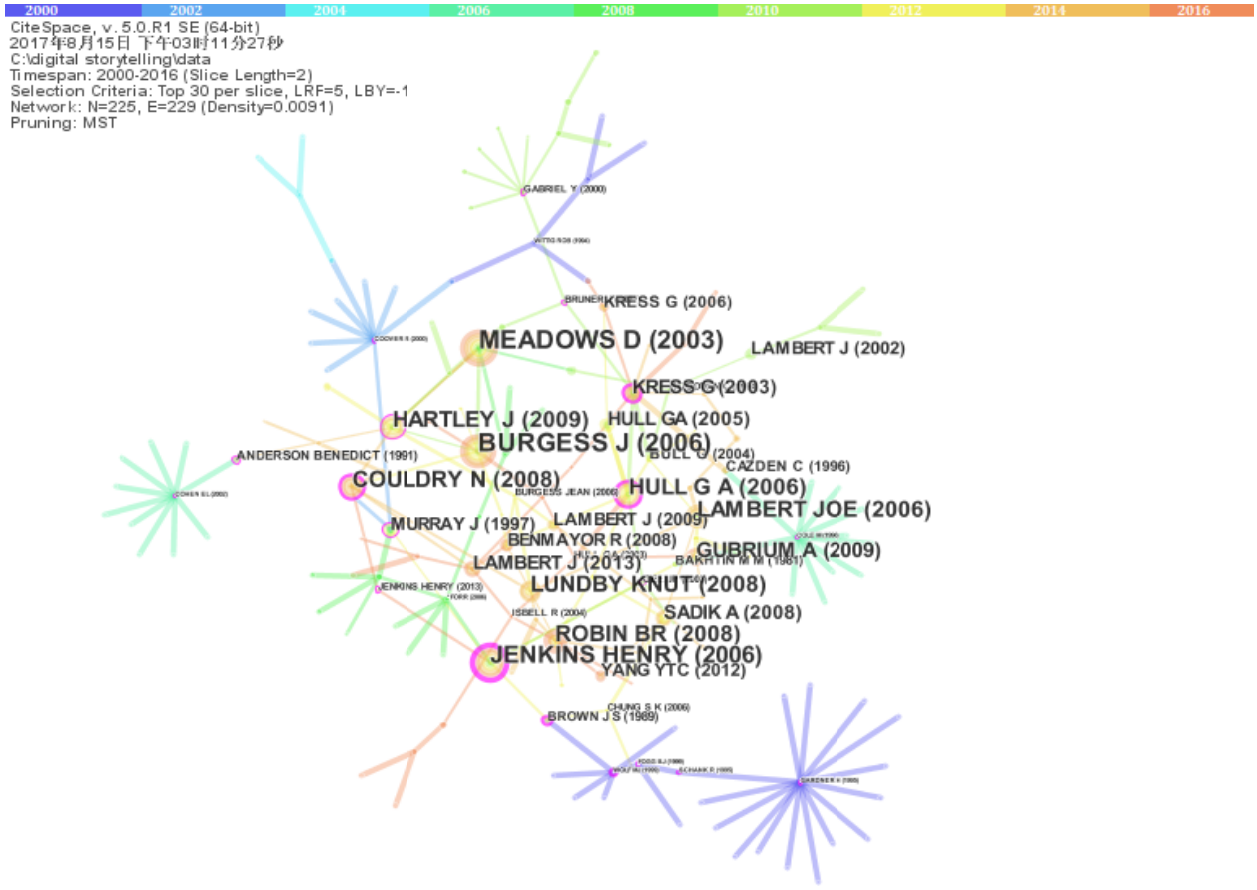

Figure 2. Co-citation mapping knowledge domain for analysis of international research on digital storytelling.

In the analysis of the co-citation mapping, the importance of the literature can be evaluated according to the citation frequency or centrality. Where, the centrality is an important indicator to determine the importance of nodes in the network, it refers to the number of the shortest paths passing this node in the network, and is used as a measurement to determine the connecting role of the network node in the overall network. In the CiteSpace mapping, this indicator is used to indicate and measure the importance of literature, and this type of literature is marked in the purple circle. The important literatures in the mapping constitute a key basis for the research of digital storytelling.

In this study, the important literatures were analyzed according to their ranking by the centrality. In the ranking, the top five were respectively Meadows (2003), Couldry (2008), Lambert (2006), Burgess (2006) and Murray (1997), of which, the research conducted by Meadows, Couldry and Burgess tended to the perspective of communication. Janet Murray presented how the computer technology could change people's lives, and combined digital environments with traditional narration, imagining a possibility of future storytelling. In the research of education field, Joe Lambert described the role of digital storytelling in promoting communication and information dissemination, as well as development of literacy, and that the digital storytelling was used as a critical tool to improve the quality of writing and thinking. Lambert is the founder and executive director of the Center for Digital Storytelling (located in California, USA). The Center carries out the creation and sharing of community and personal stories, and is dedicated to helping K-12 and college educators improve the students' literacy ability via digital storytelling and community sharing.

Visualization of Research Hotspots

Through the visualization analysis on the keywords of the digital storytelling research article, the research frontier and hotspot may be presented. We conducted a visualization analysis on the digital story research hotspot using the settings same as above, with the node type selected as keyword, and drew the minimum spanning tree for the research keywords (see Figure 3). The keywords ranking the top five were recorded according to the ranking of node frequency and centrality. The keywords with the highest centrality are respectively multimodality (0.33), perspective (0.28), narrative (0.24), media (0.22) and animation (0.19), and the keywords with the highest frequency include narrative (13), technology (11), media (10), multimodality (10) and education (10) indicating that language learning, technology, narration, media, animation, education and multimodality are more concerned in the research of digital storytelling.

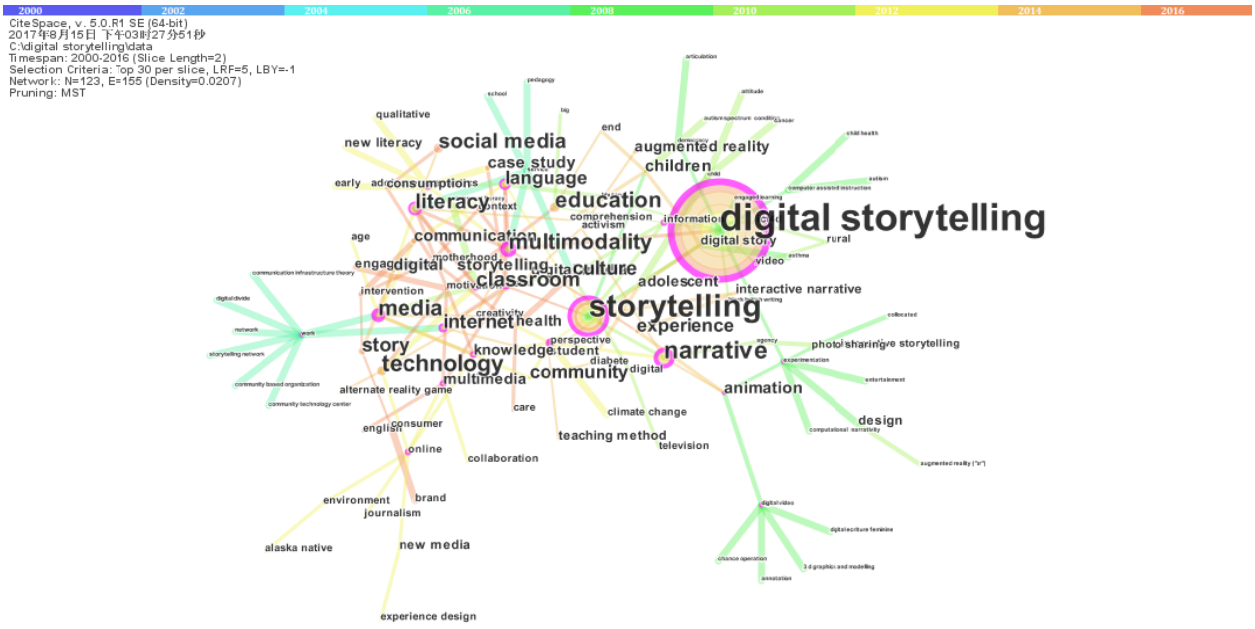

Figure 3. Mapping knowledge domain for international research hotspots of digital storytelling.

The chart was changed to the Timeline view (see Figure 4) in order to obtain a more intuitive understanding of the time distribution of the research hotspots. It can be seen from the figures and the articles that the field of education has paid more attention to the application of digital storytelling in multiliteracy, language learning (including the second language), subject teaching, participation and collaboration since 2005. In addition, it is found through the analysis on the visualization results that the application of mobile devices in the digital storytelling has been concerned about since 2003. Cole and Stanton (2003) studied the application of mobile device in children's storytelling cooperation. Reitmaier, Bidwell and Marsden (2011) performed a study on the mobile devices in rural communities of South Africa and found that the situational digital storytelling had strong social and identity features. Tebeau (2013) combined the digital storytelling with oral history using the mobile devices, transforming the digital storytelling into museums that promote community identity.

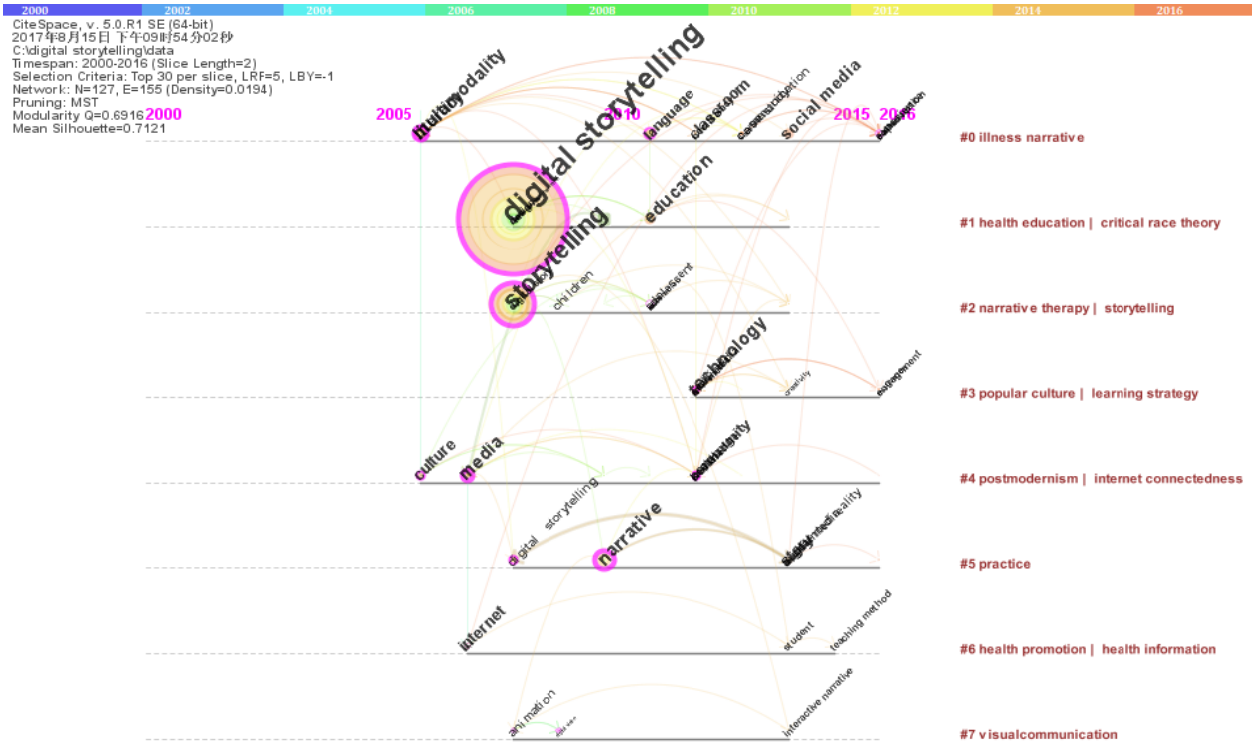

Figure 4. Timeline mapping for research keywords of digital storytelling.

Discussion

Digital Storytelling Promoting Language Learning

The digital storytelling, combining the story telling with multimedia elements such as pictures, audios, videos and animation, has been widely concerned and studied as a language learning tool. It can not only promote the development of language skills, but also promote the improvement of related abilities, such as cooperation and problem-solving ability. The research on the application of digital storytelling in language teaching mainly focuses on multi-literacy and the second language learning. Cordero et al. (2015) developed a tablet-based interactive digital reading, painting and writing tool (Read the Create Share, RCS). Through the design-based research, it was proved that the RCS not only has the characteristics of interaction, collaboration, and construction, but also can build a bridge for the students' literacy. The study on the student Riley's digital storytelling works shows that the digital storytelling provides the students with the diverse perspectives and visual media elements for their literacy about location, so that the students become the creative readers and authors (Chisholm & Trent, 2013). In addition, the digital storytelling can also assist teachers to combine traditional literacy with new media technologies, changing and reconstructing the literacy teaching (Shelby-Caffey, Ubeda, & Jenkins, 2014).

As for the digital storytelling promoting the second language learning, the research subjects are mostly the learners with English as a second language (ESL). In one of Burke and the Hardware's studies (2015), the teacher guided the ESL students of Grade Eight to understand a novel with the theme of life and death by means of Multiliteracies Pedagogy (MLS). During the reading teaching, the digital storytelling linked life experiences with novels, helping the students read and understand based on their own cultural thinking. From

the perspective of teachers, Thang, Lin, Mahmud, Ismail and Zabidi (2014) conducted a study on the four Malaysian teachers who performed their ESL teaching using the digital storytelling. The results show that the teachers think the digital storytelling may bring benefits to the students to some extent, but it also raises a high demand for teachers' information and technical level. In the study, two of the teachers strongly resisted the technology, resulting in the failure of the application of digital storytelling.

Digital Storytelling Promoting the Development of Students' 21st Century Skills

The 21st century skills request the students to have life and career skills, learning and innovation skills, information, media and technology skills on the solid basis of subject knowledge. In addition to the role in the language teaching, the digital storytelling can also play a role in the subject teaching, promoting the reflective learning, and presenting the development potential in the field of STEM teaching.

In the study on the issue that the digital storytelling promotes learners' information and communication technology (ICT) literacy, Gyabak and Godina (2011)'s qualitative study showed that the digital storytelling creation activity with the animal theme bridged the digital gap for the Bhutan rural learners. The digital storytelling may be applied to the teaching of humanities subjects such as history and geography. With the aid of social cultural dialogue teaching method, it can promote the students' deep participation and collaboration, and even to help students establish their values. The digital storytelling not only can play a role in the process of learning, but also can be used as a reflective tool to help the student carry on the reflective learning (Sandars, Murray, & Pellow, 2008). For example, the visual media and audios provide creative opportunities for the students, and allow them to conduct in-depth study and practice, constantly reflecting on and improving themselves in the process of performing their work.

Because of the narrative characteristics, the digital storytelling is applied more in the themes of humanities and social culture, and less in subject like mathematics and science. In the STEM education study, however, some students have used Scratch (a simple graphical programming tool) to create the digital storytelling, thus promoting their empathy, self-awareness and computational thinking. This is also the necessary skills for them to adapt to the 21st century career (Daily & Eugene, 2013).

The Technical Studies of Digital Storytelling Need to Be Strengthened

When we straightened out the important literatures, it was found that there are more qualitative studies, but less experimental and quantitative studies on digital storytelling. As for the technical tools, the video editing software such as PowerPoint, MovieMaker and iMovie are used to carry out the practical activities in most of the studies. Although "technology" has a high centrality and frequency in the mapping keywords, there are few studies on the development of tools for the creation of student digital storytelling. Most of the studies focus on the application of technological tools and technology media literacy. The learners at different ages and learning stages have different characteristics, and the digital storytelling involves multiple expression elements like video, animation, audio, images and text, so the learners' characteristics should be taken into account during design, to meet their specific learning demands. In addition, the difficulty frequently encountered in the application of digital storytelling is the technology gap of the teachers and students. In the studies of digital storytelling, most tend to the information technology and media literacy ability of students, and few to the teachers' information literacy.

In general, the digital storytelling, as a form of using digital material for multiple expression, has been applied in the formal and informal learning environment, inside and outside school, on the basis of subjects like

communication and art. The studies show that the digital storytelling is an effective way to promote the integration of learning inside and outside school (Wales, 2012). The creative learning activities with learners as the center, have promoted the students' initiative and in-depth participation, stimulated their consciousness of share, enrich their learning experience, and create opportunities for the enhancement of solid academic foundation and information, media and technological literacy. However, the application of digital storytelling in teaching also faces some challenges, such as the high demand for teachers' information technology literacy and the lack of effective evaluation tools for the performance of digital storytelling.

Conclusion

The digital storytelling is being explored and tried by the educators of various countries in terms of its outstanding advantages in developing students' 21st century skills. This article conducted a visual analysis on the literature data with the theme of digital storytelling in the international academic journals, drew the Mapping Knowledge Domain and analyzed the key articles and research hotspots about the digital storytelling studies using the citation analysis tool, i.e. CiteSpace in the field of information visualization. In this article, the researches on digital storytelling in the field of education are discussed a lot, but there is less analysis on the fields of communication and art, which is a shortcoming of this study.

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