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Research Article

Overview of elementary students knowledge creation using dynamic geometry environment

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Abstract

Education now requires knowledge creation to find out how meaningful the learning is applied by the teacher so that it helps build understanding in students. This study aims to analyze how the development of knowledge creation of elementary school students when using ICT learning media, namely dynamic geometry environment. In this study using descriptive correlational research with quantitative and qualitative approaches. The results of the descriptive correlation analysis revealed that the use of DGE by elementary school students increases knowledge creation by positively influencing the processes of socialization, externalization, combination, and internalization. The data collection tools used in this study are the knowledge creation observation sheets in the Dynamic Geometry Environment, Spatial Ability Test, and Interview Sheets. The results of this study show positive results on aspects of combination and internalization. The results of this study also indicate the importance of adopting an appropriate ICT orientation if knowledge creation. This is consistent with the idea that individuals using DGE can search for data and turn it into information but may not be involved in learning unless the data is structured appropriately.

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Introduction

The process of knowledge creation in the digital age requires knowledge creation capabilities to be very basic. Without students in schools, schools are not able to carry out their duties in creating the knowledge they need to conduct various innovations (in the form of conceptual or empirical education). The process of knowledge creation that starts from access to information and experience, the reflection of individuals on past actions, the ability to absorb knowledge, the motivation of students to learn in perceiving the activities that lead to the creation of new knowledge (Chen et al. 2019; Koloniari et al. 2018). In knowledge creation also often occurs the acquisition of knowledge. The information obtained is the result of filtering perceptions of information heard and received by students. Information is also not only obtained intentionally, sometimes information is obtained accidentally by students.

Thus educational institutions can not do the usual response in dealing with these problems, this means a shared commitment is needed that educating and learning requires the condition of educational institutions that can synergize the knowledge in it and integrate it in the process of education and learning in schools, and that means institutions education needs to be a Learning Organization (Koloniari et al. 2018). How students will survive in a world full of risks in the future. This question is relevant because Indonesia today and in the future are entering a year full of unpredictable risks and problems.

Not many people have researched elementary students 'knowledge creation because at this stage the students' knowledge of creation is not yet clearly seen. With knowledge creation, it can determine how students receive information by constructing that information or only receiving information from learning sources. Knowledge creation is defined as bringing forth new insights, new ideas, or new routines (Farnese et al. 2019; So & Tan, 2014). Nonaka described knowledge creation as an interaction between tacit and explicit knowledge such as a spiral that

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continues to develop as well as knowledge that continues to move between various levels of individuals, groups, and organizations (Nonaka et al. 2001). There are four aspects to knowledge creation, namely socialization, externalization, combination, and internalization.

Education now requires knowledge creation to find out how meaningful the learning is applied by the teacher so that it helps build understanding in students. Some OECD countries provide technology for learning, but according to World Bank 2018 data Indonesia does not have data on how much technology plays a role in education, which means that Indonesia has not fully applied technology in the learning process (Afzal & Lawrey, 2012). Whereas having the right technology infrastructure can facilitate knowledge creation. However, that does not always mean that this knowledge is created and transformed into a Learning Organization, because knowledge will not always circulate freely throughout the company just because accurate ICT to support such circulation is available (Brown & Duguid, 2002; Marbán & Mulenga, 2019). Here, the use of ICT consists of three orientations: informative, communicative, and workflow.

Dynamic Geometry Environment (hereinafter referred to as DGE) can fulfill all three orientations of the use of ICT in learning. DGE is a specific technological tool used in the process of teaching and learning geometry material to assist students in moving a line specifically so that it generalizes across figures (Jones, 1999; Kuzle, 2013). There are various DGE-based applications, but there are differences in the function of their use and have similarities that can only be used in learning geometry. The DGE used in this study is Geogebra, especially in construction boxes. This construction box has 4 student activities that allow integration into all four aspects of knowledge creation. Four student activities are building objects in applications, talking about objects, representation objects abstractly, draw objects in pictures.

The actual use of ICT makes the benefits of technology an important link to the Learning Organization. With the use of DGE, this can help the implementation of knowledge creation that can develop cognitive aspects of elementary school students. Therefore, this study aims to analyze how the development of knowledge creation of elementary school students when using ICT learning media, namely dynamic geometry environment. The results of this analysis used as input for decision-makers to provide dynamic geometry environment software as a method of teaching and learning new education in elementary schools to foster the knowledge creation of elementary school students.

Problem of Research

Researchers analyzed how the development of knowledge creation of elementary school students when using ICT learning media, namely dynamic geometry environment, the problem formulation in this study is as follows:

- What is application of dynamic geometry environment to knowledge creation?
- How students knowledge creation when using dynamic geometry environment?

Methods

Research Model

In this study using descriptive correlational research with quantitative and qualitative approaches. Correlation descriptive research is research that is intended to gather information about the status related to a phenomenon that exists (Steedle, 2017). Quantitative research to measure the relationship between knowledge creation and DGE. Qualitative research to analyze aspects of SECI knowledge creation on the use of DGE. The content in this study focuses on measuring and analyzing the SECI aspects of knowledge creation when using DGE. 4 aspects of SECI are socialization, externalization, combination, and internalization.

Participants

Participants in this study were 43 students from Lemahputro 1 Sidoarjo Elementary School. The subjects of this study were selected by purposive sampling technique. There are several criteria in the selection of research subjects, namely: 1) students already have proficiency in using technology, 2) have not received geometry learning before, 3) there is at one level of primary school classes, grades 4, 4) has the value of the initial spatial ability test with a value range of 0-60.

Data Collection Tools

Observation Sheets on Dynamic Geometry Environment:

This study uses several instruments namely knowledge creation observation sheets on DGE students adapted from Brown and Rogers (Brown & Rogers, 2014) and interview sheets about the use of DGE to overview knowledge creation of elementary school students. 4 main DGE activities are observed for each student using the Knowledge

Creation in DGE Observation Sheet which is used by mathematics and science evaluators of professional development projects to observe the implementation of class content, class culture, and student participation. This instrument has five subscales and is calibrated with four indicators from value 1 which means' never happened 'to value 4 which means 'very competent and descriptive' each student is observed while using DGE. Because this study requires a lot of data collectors, so conducted interrater so that between the authors and data collectors have the same in the assessment, so the interrater value is 8.89 which is classified as good. Thus, there are a total of 15 pre-learning spatial ability test items, 8 lesson observation items, 12 interview items, and 15 spatial ability test items after the lesson.

Spatial Ability Test

This study uses a spatial adaptation test from Amir et al. (2018) which is used to measure students 'geometry abilities and to understand students' tacid and explicit knowledge when working on problem solving in geometry material. This spatial ability test consists of 15 questions with 5 questions about geometry representation, 5 questions about talk about objects, and 5 questions about draw objects in a picture (see figure 2.). This spatial ability test has a reliability value of 0.89, which is a reliable instrument.

Interview Sheets

The interview sheet is used as a qualitative instrument to find out the inside of students' knowledge creation when using DGE so that the results of the research can be objective and in-depth or the results of the study can be described in detail. Interview questions are not far from how tacid knowledge and explicit knowledge of students when using DGE. This interview is classified as unstructured and follows the flow of students' answers to get pure student opinions. The interview sheet consists of 12 main items as a basis for questions to students, 3 questions about Socialization, 3 questions about Externalization, 3 questions about Combination, and 3 questions about Internalization.

Data Analysis

The quantitative data of this study were analyzed using a single sample t-test technique with calculations using SPSS software. If the p-value associated with the t-test has a value that is not small ($p > 0.005$), then the null hypothesis is not rejected and you can conclude that the mean does not differ from the hypothesized value so that it is concluded that the use of DGE can shape the knowledge creation of elementary school students. The qualitative data of this study were analyzed through video and audio recordings of the learning process and student interviews using the constant comparative method (Merriam, 1998), where several themes would emerge as coding from qualitative analysis data. Data collection and analysis is carried out at the same time brackets to carry out time-efficient and relevant data collection (Baxter & Jack, 2008). The results of interviews with students about the use of DGE to students' knowledge creation are linked to the analysis code which is then conducted a retrospective analysis of whether the interview results are following coding data analysis. Each difference identified shows with the expectation that students make a good contribution to knowledge creation with the coding hypotheses of data analysis listed in table 1.

Table 1.

Coding Analysis

Coding	Categories
Socialization	Build an object New knowledge Never seen this before
Externalization	Talk object Write down in numbers If you don't write it down, you can forget it
Combination	Representing Combining something new
Internalization	Learning by doing If I don't do this I won't know

Results

Application of Dynamic Geometry Environment to Knowledge Creation

The application of DGE has a significant effect on students' knowledge creation. Students experience the stages of knowledge creation. Therefore from the data from the observation knowledge creation sheet, quantitative data is taken

and then analyzed using the SPSS application to indicate whether the knowledge creation and DGE have a statistically significant relationship.

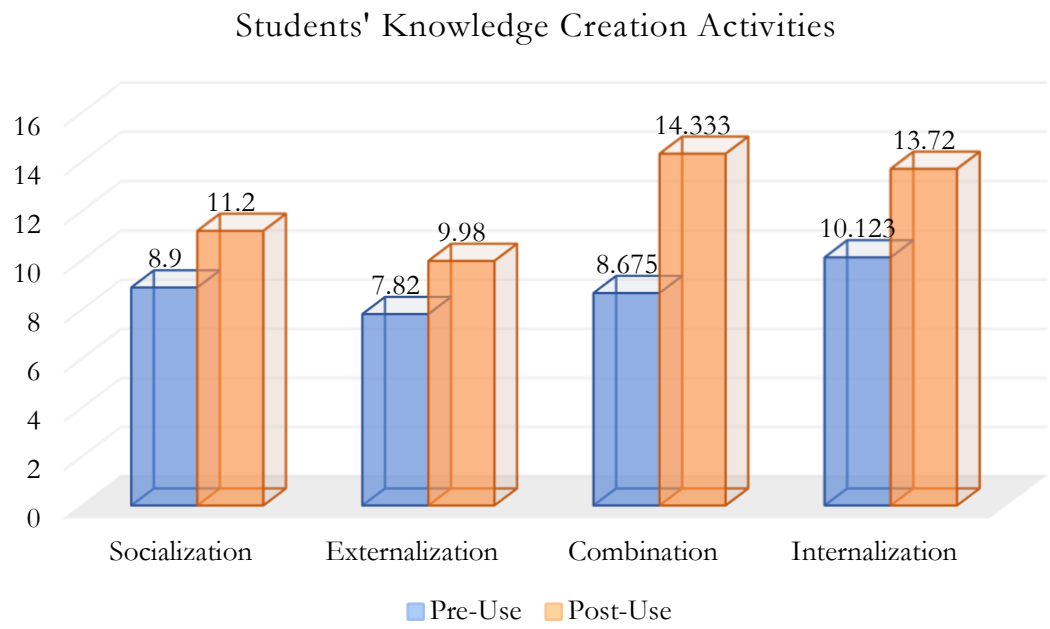

Figure 1.
Student Knowledge Creation Activities

Figure 1 shows that students have increased in all four aspects of knowledge creation. There has been an increase in the socialization aspect before the use of DGE in learning geometry. The most significant improvement was shown in the Combination and Internalization aspects. The increase in the combination before the pre-use shows the results of the students' knowledge creation activities showed the results of 8,675, whereas after the use of DGE the students experienced an increase in the activity of knowledge creation which is worth 14,333. In the aspect of externalization, the increase in the pre-use of DGE students 'knowledge creation activities was not so obvious at a value of 7.82. Then in the use of DGE students' knowledge creation activities increased to 9.98. The results of the increase are recalculated in the SPSS program to find out the correlation of students' knowledge creation with DGE-based learning media shown in table 2 and table 3.

Table 2.
Statistic Descriptive About Students Knowledge Creation

	N	Mean	Std. Deviation	Std. Error Mean
Knowledge creation	43	12.3082	9.47859	.67024

Table 3.
One Sample Test of Knowledge Creation to DGE

	Test value = 16					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Knowledge creation at DGE	4.140	33.3	.002	3.4287	4.4333	15.0967

From table 2 and table 3 shows the t-value in the formula can be calculated or found in any statistics book with the degree of freedom is N-1 and the p-value is 1-alpha, where alpha is the level of confidence and by default is 0.67. Thus it can be concluded that the p-value sig. 2 tailed shows 0.002 results of a p-value, where the results <0.05 thus the null hypothesis is not rejected so that the use of DGE is related to the knowledge creation of elementary school students.

Students Knowledge Creation when Using Dynamic Geometry Environment

Quantitative data is not enough to analyze elementary school students' knowledge creation at the time of using DGE. In this study, students' knowledge creation was seen from all four aspects through the use of DGE. When using DGE some activities help students in their knowledge creation illustrated in Figure 2, namely Socialization refers to the process of changing tacit knowledge into new tacit knowledge through social interaction and sharing experiences among other students. Externalization refers to changing tacit knowledge into new explicit knowledge. Combination aspects refers to the creation of explicit new knowledge by combining, categorizing, reclassifying, and synthesizing existing explicit knowledge. Internalization refers to the creation of new tacit knowledge that comes from explicit knowledge.

In the aspect of knowledge creation socialization students socialize with DGE by building objects in the application. In the aspect of "externalization" students change their understanding of building space by representing it in symbolic representations. In the "combination" aspect, students redraw the object in DGE into a picture which is a combination of virtual objects changed in real-life objects. In the aspect of "internalization" students represent objects abstractly, that is, students represent how the top view, front view, and side view of the construction box.

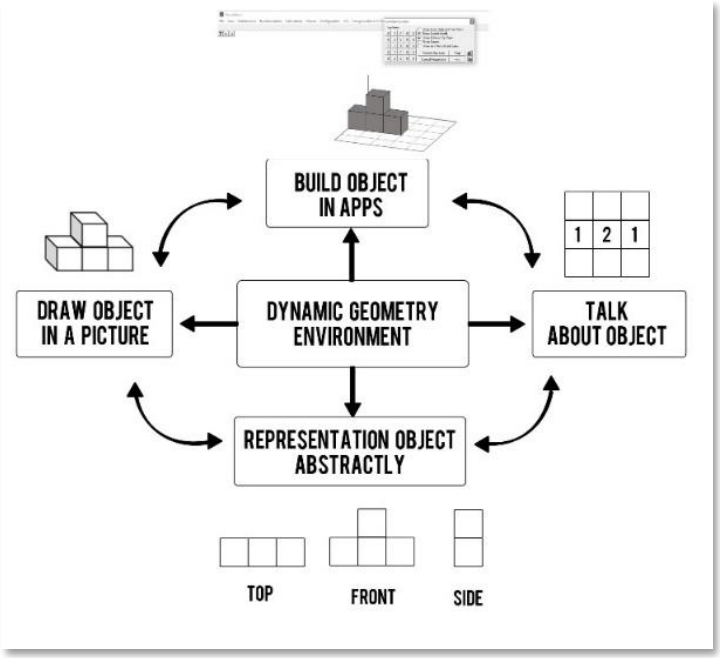

Figure 2.

Dynamic Geometry Environment Activities

The four DGE activities in this study are representations of DGE into the four aspects of knowledge creation. In the aspect of socialization, students interact with DGE in building objects in the application so that the emergence of an old tacit knowledge to a new tacit knowledge. This is evidenced by the results of an interview with one of the students as follows

> *"Before using this application I was confused about how to make shapes in space, after using this application I understood how to draw space shapes in a non-complicated line order. This application provides new knowledge for me"*

From the interview results show that initially students had tacit knowledge that drawing and constructing space was very confusing. Then the existence of this DGE help tool makes students understand individually how to start drawing up space. The process of socialization in knowledge creation between elementary school students and their schools can be done through face-to-face meetings. Through this face-to-face meeting, students can share their knowledge and experiences so that new knowledge is created for them. In this socialization aspel, students come face to face with the application so that interaction of the two things occurs so that new tacit knowledge appears about drawing up space.

In the externalization aspect, the process of forming students' knowledge from tacit knowledge becomes explicit knowledge through student activities in DGE, namely talk about objects, which means conducting activities where students write in writing the composition of a construction box in symbol representation, namely numbers. In this

activity the students' tacid knowledge in the form of a construction box is formed into an explicit knowledge in the form of numberic coding. This is evidenced by the results of an interview with one of the students who stated that:

"Teacher, I can write this construction box with numberic coding."

"It turns out there is a way that can make me convey how much the contents of the construction box that I built so that I can mention the volume of a construction box"

The results of the interview show that students originally had tacit knowledge that this construction box has a complex arrangement so that it cannot be calculated. Then switch to explicit knowledge when students use DGE by seeing that the construction of the construction box has a symbol that represents the arrangement. Support for this externalization process can be provided by documenting numberic coding (an explicit form of knowledge created during meetings) in electronic form to be published so as to form explicit students that a construction box has different numberic coding.

In the combination aspect it can be seen that referring to the creation of explicit new knowledge by combining, categorizing, reclassifying, re-synthesizing existing explicit knowledge. In the knowledge creation activity at DGE, students make a representation of the view coding from the construction box. This was stated by one of the students in the interview results as follows:

"This DGE helps me to combine boxes with various construction boxes, I can make small balls by combining numbers and boxes in DGE "

The interview results show that the process of converting knowledge through a combination is to combine different explicit knowledge to be compiled into a knowledge management system. Likewise content management which has the function to manage organizational information both structured (database) and unstructured (documents, reports, minutes) can support this combination process.

In the aspect of internalization it can be seen that it refers to the creation of new tacit knowledge that comes from explicit knowledge. In activities with the use of DGE students are invited to redraw the object construction box on paper so that students can create new tacit knowledge for them from explicit knowledge that has been done. This was stated by one of the students in the interview results as follows:

"From this drawing activity, it helps me to have new knowledge that drawing is easier if done alone"

"The existence of learning by doing using DGE makes me have new knowledge, I show my results to my friends and they can answer that"

The results of the interviews show that all documented data, information and knowledge can be read by others. In this process an increase in human resource knowledge. The trigger for this process is the application of "learning by doing".

Discussion and Conclusion

This study aims to analyzes the knowledge creation of elementary school students at the time of using DGE, in the case of the SECI model which is four processes for knowledge creation that is incorporated by Nonaka and Takeuchi (in Paavola & Hakkarainen, 2005). The results of the descriptive correlation analysis reveal that the use of DGE by elementary school students increases knowledge creation in the processes of socialization, externalization, combination, and internalization. The results of this study show positive results on aspects of combination and internalization.

One of the processes of changing explicit knowledge into more complex and systematic sets of explicit knowledge is a combination wherein the process requires activities that can change students 'explicit knowledge deeper so that the presence of DGE can help by influencing the activity of change or development of students' knowledge creation. After going through the combination phase students will go through an internalization process there explicit knowledge has the aim to share to the whole learning organization and convert that knowledge into tacit knowledge by students so that this tacit knowledge is accumulated at the individual level and can then trigger a new spiral of knowledge creation when shared with others through outreach (Cheng, 2019; Lopez-Nicolas & Soto-Acosta, 2010). Farnese et al. (2019) also Kao and Wu (2016) stated that students can embed new knowledge they get into technology for their knowledge creation activities and processes so that IT-based learning media can automate the knowledge

process in the process of internalization knowledge creation. The findings presented here are consistent with this idea in the sense that the orientation of DGE has a significant positive impact on aspects of internalization.

Likewise with our results, several previous studies have found that technology is an important element for knowledge creation (Chen et al. 2019; Huang, 2009), because DGE provides facilities for the process of gathering, storing, and exchanging knowledge quickly on a scale that was not possible in the past, therefore DGE helped the process of creating knowledge. Literature shows that the use of ICT-based learning media, one of which is by using DGE, supports all SECI processes, although the balance between them in certain organizations will depend on the knowledge creation strategy used (Hartner-Tiefenthaler et al. 2018; Koloniari et al. 2018; Wahid & Sudharatna, 2016). This can also explain our findings about the fact that the use of DGE influences various SECI processes for knowledge creation differently.

The results of this study indicate that DGE has a significant good effect on the combination and intenalization process and has a less significant impact on the process of socialization and externalization. This is known from the compilation process which is an explicit knowledge input process that is transformed into students' tacit knowledge. Previous research mentioned that some students had difficulty in using technology due to lack of tacit knowledge in students because they had never before used technology as a media learning so that the process of exchanging knowledge between students was hampered (Flanagin, 2002; Johannessen et al. 2001). The combination and internalization are influenced by ICT which is oriented towards communication and student activity flow, while externalization is only determined by the orientation of the ICT workflow, and socialization by both orientations of the use of ICT.

The results of this study also show the importance of adopting the right ICT orientation to be used in knowledge creation. This is consistent with the statement that students with the concept of structured learning and with the addition of DGE as a learning medium can help the search for data and change information in teaching materials (Sanz-Valle et al. 2011) and converted to new knowledge. In the case of externalization, the use of DGE to improve the knowledge process has an influence on the process of knowledge creation of elementary school students. The way works of DGE is that it provides a lightning process in making a space and allows students to make improvements in the process of drawing a space. DGE can support the externalization of student knowledge by explaining tacit knowledge that has accumulated in mathematics learning so that it can be widely explored (Farnese et al. 2019).

The results of the descriptive correlation analysis revealed that the use of DGE by elementary school students increased knowledge creation so as to have a significant influence on the processes of socialization, externalization, combination, and internalization. The results of this study show positive results on aspects of combination and internalization. The most significant improvement was shown in the Combination and Internalization aspects. The increase in the combination before the pre-use shows the results of the students' knowledge creation activities showed the results of 8,675, whereas after the use of DGE the students experienced an increase in the activity of knowledge creation which is worth 14,333. In the aspect of externalization, the increase in the pre-use of DGE students 'knowledge creation activities was not so obvious at a value of 7.82. Then in the use of DGE students' knowledge creation activities increased to 9.98.

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References

Afzal, M. N. I., & Lawrey, R. (2012). Investigating World Bank knowledge assessment methodology (KAM) using data envelopment analysis (DEA): a study in the ASEAN region. *Research Journal of Science & IT Management*, *1*(October), 33–38.

Amir, M. F., Chotimah, C., Afandi, R., Rudyanto, H. E., & Anshori, I. (2018). Design Research Study : Investigation of Increasing

Elementary Student ' s Spatial Ability Using 3Dmetric. *Journal of Advanced Research in Dynamical and Control Systems*, *10*(6), 1707–1713.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544–559.

Brown, C., & Rogers, S. (2014). Measuring the effectiveness of knowledge creation as a means of facilitating evidence-informed practice in early years settings in one London borough. *London Review of Education*, *12*(3), 245–260. https://doi.org/10.18546/LRE.12.3.01

Brown, J. S., & Duguid, P. (2002). *The Social Life of Information*. Harvard Business School Press. https://doi.org/10.1016/S0016-3287(00)00065-3

Chen, Y., Dellea, D., & Bianchi, G. (2019). Knowledge Creation and Research Production in Swiss Hotel Schools: A Case Study of the Ecole hôtelière de Lausanne. *Journal of Hospitality and Tourism Education*, *31*(1), 10–22. https://doi.org/10.1080/10963758.2018.1480960

Cheng, E. C. K. (2019). Successful Transposition of Lesson Study. In *Applying SECI Model for Creating Pedagogical Knowledge* (pp. 29–44). https://doi.org/10.1007/978-981-13-2472-7

Farnese, M. L., Barbieri, B., Chirumbolo, A., & Patriotta, G. (2019). Managing knowledge in organizations: A nonaka's SECI model operationalization. *Frontiers in Psychology*, *10*(December), 1–15. https://doi.org/10.3389/fpsyg.2019.02730

Flanagin, A. J. (2002). The elusive benefits of the technological support of knowledge management. *Management Communication Quarterly*, *16*(2), 242–248.

Hartner-Tiefenthaler, M., Roetzer, K., Bottaro, G., & Peschl, M. F. (2018). When relational and epistemological uncertainty act as driving forces in collaborative knowledge creation processes among university students. *Thinking Skills and Creativity*, *28*, 21–40. https://doi.org/10.1016/j.tsc.2018.02.013

Huang, J. J. (2009). The evolutionary perspective of knowledge creation - A mathematical representation. *Knowledge-Based Systems*, *22*(6), 430–438. https://doi.org/10.1016/j.knosys.2009.05.008

Johannessen, J. A., Olaisen, J., & Olsen, B. (2001). Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology, and what to do about it. *International Journal of Information Management*, *21*(1), 3–20.

Jones, K. (1999). Student interpretations of a dynamic geometry environment. *European Research in Mathematics Education I*, *2*(May), 245–258. http://eprints.soton.ac.uk/41224/

Kao, S. C., & Wu, C. H. (2016). The role of creation mode and social networking mode in knowledge creation performance: Mediation effect of creation process. *Information and Management*, *53*(6), 803–816. https://doi.org/10.1016/j.im.2016.03.002

Koloniari, M., Vraimaki, E., & Fassoulis, K. (2018). Fostering Innovation in Academic Libraries Through Knowledge Creation. *Journal of Academic Librarianship*, *May*, 1–12. https://doi.org/10.1016/j.acalib.2018.09.016

Kuzle, A. (2013). Patterns of metacognitive behavior during mathematics problem-solving in a dynamic geometry environment. *International Electronic Journal of Mathematics Education*, *8*(1), 20–40.

Lopez-Nicolas, C., & Soto-Acosta, P. (2010). Analyzing ICT adoption and use effects on knowledge creation: An empirical investigation in SMEs. *International Journal of Information Management*, *30*(6), 521–528. https://doi.org/10.1016/j.ijinfomgt.2010.03.004

Marbán, J. M., & Mulenga, E. M. (2019). Pre-service Primary Teachers' Teaching Styles and Attitudes towards the Use of Technology in Mathematics Classrooms. *International Electronic Journal of Mathematics Education*, *14*(2), 253–263. https://doi.org/10.29333/iejme/5649

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education*. Jossey-Bass Publishers.

Nonaka, I., Toyama, R., & Byosiere, P. (2001). A theory of organizational knowledge creation: understanding the dynamic process of creating knowledge. In M. Dierkes, A. B. Antal, J. Child, & I. Nonaka (Eds.), *Handbook of organizational learning and knowledge* (pp. 487–491). Oxford University Press.

Paavola, S., & Hakkarainen, K. (2005). The knowledge creation metaphor - An emergent epistemological approach to learning. *Science and Education*, *14*(6), 535–557. https://doi.org/10.1007/s11191-004-5157-0

Sanz-Valle, R., Jime´nez-Jime´nez, D., Perez-Caballero, L., & Naranjo-Valencia, J. C. (2011). Linking organizational learning with technical innovation and organizational culture. *Journal of Knowledge Management*, *15*(6), 997–1015.

So, H.-J., & Tan, E. (2014). Knowledge Creation in Education. *Knowledge Creation in Education*, 123–142. https://doi.org/10.1007/978-981-287-047-6

Steedle, J. T. (2017). Descriptive Statistics. In D. Wyse, N. Selwyn, E. Smith, & L. E. Suter (Eds.), *The BERA/SAGE Handbook of Educational Research: Two Volume Set*. SAGE Publication. https://doi.org/http://dx.doi.org/10.4135/9781473983953.n36

Wahid, A. N., & Sudharatna, Y. (2016). Assessing Perceived Knowledge Creation: The Role of Organizational Knowledge and Market Environment. *International Journal of Management, Knowledge and Learning*, *1*, 57–79.