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Coaching teachers to integrate technology: The effects of technology integration on student performance and critical thinking

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Abstract. This article presents the results of a mixed-methods study that investigated effects of coaching fifth grade teachers to integrate technology while teaching a science unit. The purpose of the research was to capture how technology integration with or without coaching in a science unit effect teachers' technology integration practices and their instruction, and its results of the instruction on student outcomes and student critical thinking. The participants were 132 fifth-grade students and four teachers in elementary public school. The study used an experimental research design by having a control and research group (68 students were in the teachers' classrooms that were using technology without coaching intervention, and 64 were in the other teachers' classrooms, with coaching intervention to integrate available technologies). Data were collected through classroom observations, tests and semi-structured interviews. The results showed that coached teachers integrated technology more frequently, more purposefully and more diversely. Additionally, the results indicated that the teachers who were coached for technology integration had a positive effect on student performance, and the observance of students critical thinking behaviors were more frequent in the classroom compared to the no-coaching group of teachers' classroom.

Keywords: Technology integration, coaching teachers, critical thinking, student performance, elementary science

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INTRODUCTION

After the end of the war in 1999 and establishing the independence of Kosovo in 2008, the education system was reformed at all levels to prepare future generations of the new Republic (Sommers & Buckland, 2004). These reforms were focused on adjusting the education in Kosovo according to contemporary global standards. The first step of the reforms was the establishment of the Department of Education and Science**,** which facilitated the fundamental reformation of the education system. In 2012, the Ministry of Education, Science and Technology (MEST) of Kosovo approved the Core Curriculum Framework for the pre-primary and primary education system (MEST, 2012). Since then, adjusting to new standards, training teachers, dealing with large class sizes, and implementing continuous improvements to schools have been a big challenge for the education system in Kosovo (KFOS, 2014).

Before the adjustments to the contemporary global standards through the above-mentioned reforms, teachers in Kosovo used direct instruction by using textbooks as the main source of course content. The educational reforms that took place also aimed to adapt teaching and learning processes to contemporary developments and aimed to integrate technology for enhancing the quality of teaching and learning. The reforms and challenges in the education system were also addressed by the European Commission (EC, 2018) as they suggested

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integration of technology into the teaching and learning processes were essential to keep up with the global developments and preparing future generations.

To address this and to build the future generations of Kosovo competitively, MEST has been focusing on providing the schools in Kosovo with up to date technology (MEST, 2016). Since the reforms, most of the primary and secondary schools in Kosovo have been equipped with one or more computer labs in schools, and technology tools in classrooms. These labs and classroom technologies were either a direct investment of the Government of Kosovo, or donations from various donors who have invested in educational projects in Kosovo. Since these labs and technologies were established at the school sites, it became a requirement by the MEST that the labs and various classroom technologies become a daily part of school education, and also these technologies were to be used to develop and foster critical thinking of students (MEST, 2012). Based on Ennis (2011) these skills are: focus on a question, analyze arguments and ask and answer clarification and/or challenge questions. For the purposes, critical thinking skills are defined as those mental processes that allow students to develop factual, procedural, conceptual and metacognitive knowledge within creative and critical domains described by Andreson and Krahwohl (2001).

The study was guided by the following research questions:

1. Were there any differences in student performance and critical thinking, when teachers were coached to integrate technology during a fifth-grade science unit?
2. How did teachers integrate technology in the fifth-grade science unit when coached versus not coached?
3. What were the perceptions of teachers for integrating technology in science curriculum?

LITERATURE REVIEW

The previous research findings support the vision of MEST and the European Commission regarding the benefits for integrating technology and student learning (Gokalp, 2010; Ojose, 2009) and on student critical thinking (Bagdasarov, Luo & Wu, 2017; Bybee, Carlson-Powell & Trowbridge, 2001; Ismajli, 2008; Jonassen, Carr & Hsiu-Ping, 1998; Rumpagaporn & Darmawan, 2007). Technology integration for student learning and critical thinking in science has been a specific area of focus in Kosovo. Previous studies showed the use of Information and Computer Technology in science helps teachers in concretizing abstract knowledge by making content more attractive for students' learning (Jarosievitz, 2012). For example, in a study by Ozmen (2011) integration of computer-based simulation improved student learning outcomes more than traditional instruction. In other studies, student learning showed improvement when science content was delivered to elementary and middle schools by integrating technology while explaining science concepts with multiple representations (Aslan & Demiricioglu, 2014; Reisslein, Moreno & Ozogul, 2010).

In addition to improving learning in science courses, integration of technology also showed promising results for improving critical thinking of students. As teachers have limited time in the classroom to master learning outcomes and cover in-depth content knowledge, innovative use of technology may be a tool to promote critical thinking (Mandernach, 2006). Researchers emphasized the use of technology to support student inquiry, collaboration, and reformed practice, whereas many teachers tend to focus on using technology for presentations, websites, management tools to enhance existing practice (Lowther, Inan, Strahl & Ross, 2008) and encouraging classroom discussions (Boyle & Nicol, 2003; Jeong, 2003; Miri, David & Uri, 2007). Using technology showed positive results for improving student asking questions (Lawless & Pellegrino, 2007; Rivard & Straw, 2000) and encouraging students reflective thinking (Kim, Grabowski & Sharma, 2004; Nanjappa & Grant, 2003; Seale & Cann, 2000; Xiao, Clark, Rosson & Carrol, 2008). Thus, to meet the goals of technology integration and critical thinking of students that were set forth by MEST for the new Kosovo education system, it is important to find ways to encourage and support teachers to integrate technology in their classes.

Pre-service and In-service teacher training in Kosovo

In line with education reforms that have been taking place in the post-war period, the Faculty of Education was established to prepare teachers in all subject areas for the country of Kosovo. The pre-service teacher bachelor's degree is 240 credits (according to Bologna system) and six-credits are allocated to pre-service teacher technology training. Pre-service teachers are required to take this six-credit class in their third semester and this is the only technology integration course throughout their pre-service teacher training. After they graduate and become in-service teachers, MEST provides them with various stand-alone training offered via European Computer Driving License ECDL, E-learning, E-mature, Learning Management System called SITOS, School Me platform. Teachers have to complete a certain number of training hours per year. These trainings are offered by MEST and topics range from curriculum, evaluation, e-portfolios and similar. These professional development options are offered in a generic manner not customized for each teacher (MEST, 2016).

Coaching teachers to integrate technology

Much of the current research literature maintains that the most effective professional development for teachers is ongoing and job-embedded, rather than provided through one-off trainings (Croft, Coggshal, Dollan & Powers, 2010). One-on-one coaching for professional development needs may provide teachers with more customized, supportive and just-in-time training. The Technology Coach Program for public schools is highly needed for in-service teachers' continuous professional development in terms of effective use of technology (Sugar, 2005). As such, instructional coaching has emerged as a major strategy for improving teaching practices and, in turn, student learning and achievement. Good coaching helps teachers to move from where they are to where they want to be (Aguilar, 2013). Also, coaching motivates teachers to integrate technology in order to change their teaching during curriculum development (Guha & Leonard, 2002) and is the important factor to promote changes in teacher attitudes and sustained technology integration in their teaching processes (Kopcha, 2012; Sorcinelli, Austin, Eddy & Beach, 2006). Coaching programs are designed to improve teacher knowledge and support through collaborative apprenticeships (Glazer & Hannafin, 2008; Glazer, Hannafin & Song, 2005; Niess, 2005), and also to provide ideas to teachers to integrate technology tools in science classes (ChanLin, 2008; Jang, 2010). As a popular form of job-embedded professional development for teachers, coaching has risen to the forefront as a highly effective approach to new learning where experienced educators share knowledge and skills in real-time situations with newer teachers in a school setting (Van Tryon & Schwartz, 2012). In a study by Barron, Dawson & Yendol-Hoppey (2009), the authors also suggested investigating student achievement as a method of evaluating the impact of peer coaching strategy for technology integration of K12 teachers. Thus, the authors of this study investigated the effects of coaching teachers to integrate technology for student learning outcomes and student critical thinking.

Technology's effects on student performance and critical thinking

Student's performance is an essential area for assessment school performance, as it reflects the school's effectiveness in realizing its core mission. According to Framework for Quality Assurance of School Performance in Kosovo (Kosovo Pedagogical Institute, 2016), one of the basic students' performance indicators is that the proper use of technology, the surrounding environment and other resources enrich teaching and learning. Research shows that technology improves student performance (Spears, 2012) and student academic achievements (Harris, Al-Bataineh & Al-Bataineh, 2016). Cavanaugh, Dawson & Ritzhaupt (2011, p. 360) note that "the primary motivation for laptop classroom technology and accompanying teacher professional development is the belief that the new learning environment will support engaged students an increases in academic achievement". Technology should be used in all classrooms to enhance student performance on authentic applications and be integrated into core aspects of the daily curriculum (Miranda & Russel, 2012; Monserate, 2018). The use of technology that includes

many types of learning tools, including computer and internet resources, changes the traditional way of teaching and learning. Students express more interest when they improve the results achieved by reducing their memorization of procedures (Sousa, 2008).

Research findings shows that the use of technology significantly influences high-level thinking, as the cognitive skills permit learners to perform at the analysis, synthesis and evaluation levels of Bloom`s Taxonomy (Hopson, Simms & Knezek, 2001; Lee & Choi, 2017) Researchers examined the effects of a technology-enriched classroom on student development of higher-order thinking skills (Carmichael & Farrel, 2012; Yang & Wu, 2012) and on learning effectiveness of elementary students (Chauhan, 2017). Therefore, technology places the students in the center who increase learning by expressing their inner potential. Research results have also come to the conclusion that educational technology improves critical thinking and offers new learning practices for students (Bakir, 2016; Dogan, 2010; Gelder, 2001).

METHODS

The study used an experimental research design (Creswell, 2013) by having a research and control group. The authors chose this research approach as experimental studies in elementary science programs and practices are rare at all grade levels (Slavin, Lake, Hanley & Thurston, 2014). The research methodology is mixed. The data was processed through the statistical method by extracting the values of mean, standard deviation and *t–test.* Research objectives were: a) to analyze the results obtained by the pre-test and the post-test related to knowledge from the science curriculum in a fifth-grade; b) to compare the results obtained in the control and the experimental group on the effects of technology on student performance and critical thinking; c) to examine the opinions of coaching teachers for the integration of technology in the classroom.

Participants

Data was collected from a public school located in the city center of the capital of Kosovo that has been piloting the new curriculum framework and also received the technology equipment from the government. The participants were 132 fifth-grade students (age range from 10-11 years old; 58 female and 74 male) and four teachers. Teachers were all female with average age of 39 years old. The teachers had an average of 15 years of teaching experience. In Kosovo, apart from the subject English Language, elementary school teachers teach all subjects without any teacher assistant from the first grade up to the end of the fifth-grade. Before the intervention took place, two of the four teachers were randomly assigned to the control group (using technology without coaching intervention) and the other two teachers were randomly assigned to the experimental group (using technology by coaching). Based on this randomization, there were 68 students total in the control group and there were 64 students total in the experimental group. The total numbers of participants are presented in Table 1.

Table 1. *The research student population sample*

	Group	Number of students
Total Pre-test	Control	68
	Experimental	64
	Total	132
Total post-test	Control	68
	Experimental	64
	Total	132

Instruments

Knowledge tests. The pre-test included ten multiple choice questions with one correct answer to assess students' prior knowledge on the unit called "Matter and Phases of the Matter" as it presented the foundational knowledge for the next unit on natural sciences. The post-test was used to assess student performance on the "Nature and Science Unit". The post-test also contained ten multiple choice questions with a single correct answer. The questions were

developed based on the learning outcomes of the unit, and in collaboration with the teachers as the subject matter experts and checked for content validity. The test items were also designed based on Bloom's taxonomy (20% low order thinking skills, 30% application and 50% higher order thinking skills). In total the test had thirty-five points. The lower order questions were scored with 2 points, application with 3 points and the higher order with 5 points. The Cronbach alpha reliability coefficient was .45. The test had this modest reliability as it had fewer than 20 test items and it was used for the first time (Dall'Oglio et al., 2010). Two students who took the pre-test were absent on the day of the implementation of the post-test, so they were removed from the data analysis.

Observation record sheet. An observation record sheet was used during classroom visits. The record sheet captured all the available technologies in the classroom. This observation record sheet was used during all observations to guide the process of observations and to facilitate detailed note-taking on technology integration and critical thinking behaviors occurred during class visits. Researchers visited both the experimental and the control group classes for a total of 24 times (for 45 minutes each) during the six-week implementation of the unit. All researchers observed the same classes twice by using the observation record sheet, and later debriefed and calibrated their observation frequencies and detailed notes. After calibrations, they continued visiting and observing classes alone by using the observation record sheets.

Teacher interviews. The semi-structured interview protocol was used as a data collection instrument with the four teachers. Table 2 shows the teacher distribution across conditions and table 3 displays the demographics of the teachers who participated in this research study.

The teachers in the experimental group were all females, between 29 and 32 years of age, they had 10 to 12 years of work experience, and with regard to their qualification one of them was a graduate of the Faculty of Education and the other one had a Master's degree in Education. In the control group, teachers were also all females, over 41 years old, within 18 and 22 years of work experience, both of them being graduates of the Faculty of Education. The interview protocol consisted of 14 questions and developed by the researchers. The interview protocol was used to capture teachers' opinions about technology integration in the natural sciences unit and the fostering of student critical thinking.

Table 2. *The teacher research population sample*

	Total number of teachers
Control group	2
Experimental group	2
Total	4

Procedures

Data collection took place in a public school located in the center of the capital of Kosovo that has been piloting the New Curriculum Framework and was equipped with technology. Initially the permit was obtained from Municipal Directorate of Education, and afterwards the school's directorate distributed the approved research form the students 'parents. In this public school there were a total of four fifth-grade science classes taught by four different teachers. All fifth-grade classes in this public school were included in the study on the first term of 2018/2019 educational year. According to the New Kosovo Curriculum, nature and science for the fifth-grade unit are taught twice a week for a total of 90 minutes per week and all teachers were required by the Ministry to integrate technology and foster students' critical thinking skills. This public school where the research took place offered two school day shifts in one-day morning shift and afternoon shift. The first grades who were the participants of this study attended to school from 1 pm to 5 pm daily.

Table 3. *Demographic statistics of the teachers*

		No.	%
Gender	Male	0	0%
	Female	4	100%
Age	22-30	1	25%
	31-40	1	25%
	41-50	2	50%
	51-60	0	0%
	Over 60	0	0%
Work experience:	0 - 10 years	1	25%
	11 – 20 years	2	50%
	21 – 30 years	1	25%
	over-30 years	0	0%
	Undeclared	0	0%
Education:	Faculty of Pedagogy	0	0%
	Teachers' Faculty	0	0%
	Faculty of Education	3	75%
	Master in Education	1	25%

Four fifth grade teachers from the same public school participated in the research. The researches randomly assigned two teachers' to the experimental conditions (coaching teachers to integrate technology) and two other teachers' to the control conditions (availability of same technology and no coaching). For the duration of this unit (six weeks) the researchers met with the two teachers from the experimental group systematically while the teachers from the control group taught without any intervention or support. The researchers met with the experimental group teachers for a total of 18 hours for coaching (one hour at the beginning of the week, and half an hour before each class). The researchers who served as the coaching team were experts of pedagogy, technology integration and science education.

Kosovo uses a standardized curriculum developed by the Ministry of Education, Science and Technology in all public schools, thus the learning outcomes for the nature and science fifth-grade unit were prepared by the Ministry of Education, Science and Technology. Teachers were tasked to break these unit learning outcomes into weekly outcomes and then further tasked to break them into activities for each class session to attain these outcomes. During the weekly meetings with the experimental group teachers, the coaching team and the teachers went over the weekly learning outcomes, then brainstormed the preparation of the class activities with various technologies to foster student learning and to foster critical thinking while mastering those weeks' objectives.

The coaching team encouraged teachers to investigate materials such as; photos, illustrations, simulations suitable for those weeks' lessons and also to foster students' curiosity. The research team and the teachers also explored videos from the Internet for different representations of the content and for diversifying the examples. After the coaching sessions, the two teachers worked independently from the coaching team and on their own to develop their own lesson plans and activities for that week. On the day of the classes the coaching team met with the teachers for an hour before their teaching to go over the lesson plan. Since the school started at 1 pm, the coaching team met with the experimental group teachers at 12 pm to review the daily lesson and technology integration plan. During this review process, the two teachers shared their lesson plans and technology integration ideas to support learning outcomes and students' critical thinking in the natural sciences course. Weekly lesson plans ranged from integrating PowerPoint, to hands-on science experiments to simulations.

Data analysis

Once the qualitative and quantitative data were collected they were analyzed by using the following procedures. Knowledge test data was scored based on the answer key, and later transferred to SPSS for conducting further analysis. In order to check the appropriateness of

using the *t*-test on the student test data, the collected data set was checked against four assumptions required to produce a valid independent *t*-test result (Kirk, 2008). Those assumptions were, the two groups are independent from each other. The dependent variable is normally distributed and homogeneity of the variances. In this study, the samples were independent from each other, the dependent variable was a continuous variable. For the assumption of normality, with a degree of freedom of 132, the distribution is regarded as equaling the normal distribution (Kwak & Kim, 2017).

Researchers wrote down the teachers responses during the interviews. Later, they debriefed with each other, to increase trustworthiness in a qualitative data collection (Lincoln & Guba, 1985). Afterwards they analyzed the interview notes for emerging themes (Fereday & Muir-Cochrane, 2006). Observation record sheet was used during observations. At the first sessions when two researchers observed the same session, they calculated the inter-rater reliability scores on the frequencies, recalibrated on the disagreed items, and once the agreement reached to .90 and above each researcher conducted their own observations. Data from the observations were analyzed by calculating the frequencies, and summarizing the examples observed in the sessions.

RESULTS

The results of the pre-test and post-test

Fifth-grade students completed the pre-test and the post-test the science unit which consisted of ten multiple-choice questions with one correct alternative. The results showed that there were no significant differences on the pre-test performance of students between the experimental and the control groups [$t(131) = .59$, $p = .557$]. However, in the post-test significant differences were found between the experimental and the control groups $t\ (129) = -3.37$, $p = .001$ (see Table 4).

Table 4. *The differences between the experimental and the control groups*

	Mean	Std. deviation	Std. Error Mean	*t-test*
Control group	6.69	1.77	.213	
Experimental group	7.58	1.22	.152	
Pre-test				.59
Post-test				-3.37

Table 5. *The differences in the pre-test and the post-test performance of students*

	Sum of Squares	Df	Mean	F	Sig.
Pre-test	376.361	132	2.865	.347	.557
Post-tests	326.046	132	2.326	11.187	.001

The experimental group students (Mean=7.58, Standard deviation=1.22) scored significantly higher in the post-test compared to the control group (Mean= 6.69; Standard Deviation = 1.77) (Table 4).

The results from classroom observations

The researchers observed 24 sessions for 6 weeks (for 45 minutes each), by using the observation record sheet. Analysis of the all observation record sheets showed that in the experimental group teachers integrated the following kinds of technologies with the following frequencies: during seven class sessions PowerPoint presentations were used for content delivery, three times online simulations were used to demonstrate concrete relationships between concepts, and twice YouTube videos were used to explain concepts in natural occurrences. In the control group during 12 observations none of the integration of the above-listed technologies was observed. Instead observation, data showed that teachers in the control group integrated paper posters four times for introducing natural science concepts and did

actual experiment demonstration in front of the classroom four times. Data obtained from class 'observations are presented in Figure 1.

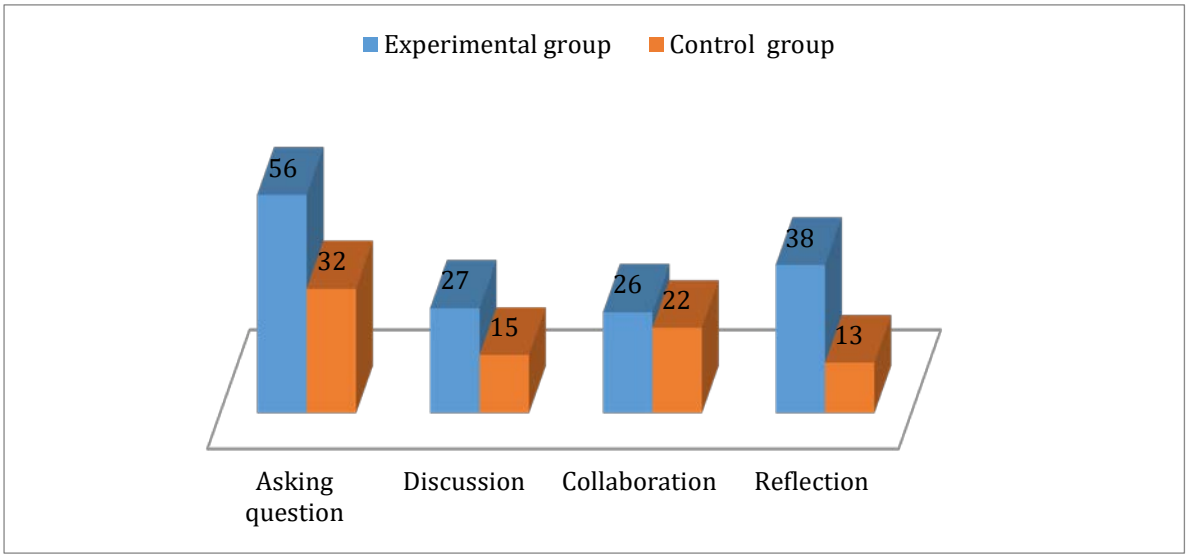

FIGURE 1. *Observation of critical behaviors in the experimental and control groups*

In terms of critical thinking, more instances in all four aspects of critical thinking behaviors were observed in the experimental group compared to the control groups. Results showed that in the experimental group, students observed asking questions in 56 instances, students participated in classroom discussion in 27 instances, collaborated in 26 instances, verbally reflected in 38 instances. Data analysis revealed that in the control group in terms of critical thinking behaviors students observed asked questions in 32 instances, collaborated in 15 instances, participated in classroom discussions in 22 instances, verbally reflected 13 times.

In terms of analysis of the detailed observation notes, the following examples of technology integration were observed. For example, students in the experimental group were observed working together in collaborating with each other after the presentation of a simulation while learning about phases of the matter. They were observed sharing ideas aloud while working on the simulation and discussing their ideas. Also, in another session, while the teacher presented the physical and chemical changes that occur in the matter through YouTube videos, students were curious to learn more about the processes in the nature. Students often raised their hands and asked questions. An example question that was observed and noted by the researchers was: *When a candle is burned is there a chemical or physical change?* The teacher instructed the students to discuss amongst them, and try to come up with an answer. Since students had experienced the visualization through the YouTube video presented, they were able to reflect about the phenomena and make a logical argument.

Students in the control group were not provided with a dynamic visualization and observation opportunity with simulators or videos during the presentation of this topic, thus they had to remember and relate phenomena from their life experiences through the verbal cueing of the teacher. Sometimes students asked questions just to verify themselves if they were relating to the underlining concepts correctly. Collaboration was not naturally occurring or was not observed. In the lesson about the water cycle when compared to students in the experimental group, students in the control group were not able to come up with examples about evaporation and condensation of water from their daily life. The teacher taught about water cycle with a paper poster that showed the cycles. After the teacher explained the concepts by going over the poster and verbally explaining the concepts to students, the teacher provided an example to students that was related to boiling water at their homes where evaporation and condensation also can occur.

Another example that was observed was when the teacher from the experimental group taught for separation techniques of mixtures, she used PowerPoint and also a relevant video

from YouTube. The teacher showed an animation of how filtration is done by using the auto play function of PPT to animate (gradually) and showed the changes. She then presented two YouTube videos. The first YouTube video showed how to separate water and mud in a muddy water situation with evaporation, decantation, and filtration. The second YouTube video showed how to separate a mixture of salt and iron by using a magnet. Because of these multiple opportunities of visualization, students were observed immediately discussing different examples they had known from their own lives. Following this eagerness on the part of the students, one experimental teacher gave them instructions to work in groups of four and to find out an example from their own life for each separate technique (filtration, decantation, evaporation, magnetism). One group shared an example of evaporation as they observed the tea kettle at their homes, another group mentioned sea salt production from the sea, relating to the sea salt used while cooking. These two were good examples that showed that students could understand the concept of separation techniques of mixtures, and they could transfer to come up with applications from real life once they were shown examples with technology.

In the other experimental class, for the same topic, the teacher showed a picture of a mixture of water, sand and iron in PowerPoint to gain students' attention and asked students to find out which techniques and in what order should be used to separate the mixture. Students worked in groups and reflected on the mixture shown on the PowerPoint and response to the teacher's question. Later, as students shared their reflections, they supported their reflection with logical argumentations about why those specific techniques should be used to separate the mixture.

In the control group, the teacher taught this unit with an experimental demonstration. She delivered an experiment demonstration on filtration and decantation by using kitchen supplies. She used a tea strainer and a glass to separate the water and sand mixture and did not mention about evaporation and magnetism during this demonstration. While the demonstration was going on, the students formed a big circle around the teacher in the front of the classroom, and due to a large number of students in the classroom, the researchers observed that not everyone was able to observe the demonstration or hear the teacher. The students asked the teacher a few questions such as if she could redo some parts because they could not see, or to repeat what the things were that she was mixing. The teacher made verbal attempts to relate with real life, students listened to the teacher during the demonstration but the researchers didn't observe students asking further questions. After the demonstration was over, the teacher asked if students had any examples from real life, after observation of a few minutes of silence, one student raised her hand to give the example of separating tea leaves from boiled water by using filtration. The students gave no other examples during that class period. Therefore, the teacher told the students that it would be their homework to search and find examples for each separating technique.

Data from interview with teachers

Data collection from the semi-structured interview with teachers in the experimental group (Teacher 1 & Teacher 2) and in the control group (Teacher 3 & Teacher 4) is presented in table no.5.

From the data collected shown in the table above, it can be seen that teachers' responses in the experimental group differ from those of the teachers in the control group. Teachers' interview responses are categorized into two themes:

Student centered: Responses of the teachers from the experimental group who were coached to use technology in natural sciences commented that technology made teaching more attractive and facilitated quizzes, projects and different tasks. Students were in the center of the instruction they were motivated to pose open-ended questions, and engage in discussions. Technology, according to these teachers also enabled students to explore new sources and to reflect relating to gained knowledge. Internet access and delivery of the science concepts through photos, animations, videos, online activities and presentations, encourages students to connect theoretical knowledge to their everyday life. Also, when teachers knew the subject well

and integrated technology, learners learned with desire (Neill-Hall, 2003). Based on the teachers' responses it is ascertained that only in some topics such as chemical changes education technology can be used, when textbooks do not provide sufficient information regarding chemical substances. By the use of technology, teachers design yearly, monthly, and daily plans, design tests and various tasks for students. Technology was also seen as support for the teachers in enriching their knowledge in their field and in the professional aspect regarding the teaching process and practice (Somekh, 2007). In this subject, software for simulation was used for the exchange of experience, reflection, and evaluation of the learning projects. According to Caruso & Kvavik (2005), students engage in critical discourse and exchange knowledge during the time they use technology. These arguments involved the need of students to become good citizens in the community, ability for lifelong learning and prepare for the workplace (Bowden et al, 2000).

The challenges of implementation of technology in the classroom: Responses of the teachers from the control group highlighted the need for the use of technology as well as their concerns regarding the lack of conditions and school infrastructure to support technology integration. If students had internet access at home; teachers could assign homework that required use of technology. Teachers pointed out that these challenges were related to the provision of online access for all students. They expressed readiness for the use of technology in the function of improving quality of teaching and learning in natural sciences.

Table 6. *Data collection from interviews with teachers*

1. Are students encouraged to submit open questions when learning takes place by means of ICT?	Teacher 1. Yes, because technology-driven learning makes the students ask more open-ended questions, the lesson is more attractive and contains illustrations, quizzes and various assignments or exercises and so on and is prompted for open-ended questions; Teacher 2. Students using technology in the classroom constantly ask open-ended questions, because with the use of technology, learning takes place more creatively. Teacher 3. Our school does not have teaching technology; Teacher 4. When students use technology at home, they ask questions at school.
2. Through technology do you fulfill lack of laboratory work to demonstrate chemical change?	Teacher 1. Yes, but not in every topic. In some topics, technology helps me to demonstrate chemical changes through special online programs, and students occasionally demonstrate them; Teacher 2. I think that technology implementation partially completes the lab work, because we are still not well informed about the full use of technology as a substitute. Teacher 3. Not willing to answer; Teacher 4. Not willing to answer.
3. Do you think that technology enhances students' interest for the subject human and nature?	Teacher 1. It is raising interest because students using technology can do more in-depth research on nature and this stimulates them to have more interest in natural subjects; Teacher 2. I think the proper use of technology and the constructive approach of using technology to serve the interest of students and also increase interest in the natural sciences and stimulate more detailed learning in every lesson. Teacher 3. If we used technology in the classroom it was certain that the students would like this subject more; Teacher 4. The use of technology in the natural sciences increases interest in deeper understanding of natural phenomena.
4. How does technology help the students understand the best mix and clean substances?	Teacher 1. Technology helps me a lot because through it I present examples in photos of the substance mix showing them step by step, and I suggest students to apply it in groups by following me. Utilizing technology enables the received information to be more stable and not superficial; Teacher 2. Technology helps me a lot because in addition to software that can be used throughout the subject, they can see through video and pictures different experiments on the separation of substances and can distinguish between them. Teacher 3. Chemical substances are missing and consequently, we cannot develop the experiments; Teacher 4. Not willing to answer.

Table 6 Continued	
5. Do you create teaching materials using Microsoft Word?	Teacher 1. Yes, usually through MS Word we do the planning, annual, monthly, daily, various tests and exercises and project evaluation, and student success records; Teacher 2. As the contents of the books are often outdated, with MS Word I prepare additional materials and exercises to evaluate students' knowledge, I make plans, tests, and checklists. Teacher 3. Failure of internet connection in the whole school building presents a special and frustrating challenge; Teacher 4. Whole-class learning activities dominate such as the different presentations worked on a particular topic or lesson.
6. Do you create educational material using presentation software (Power point, Prezi, etc.)	Teacher 1. I create different materials through presenter software and this greatly facilitates understanding of the essential points of the topics explained to students in a more creative way by exploiting the possibilities of these programs; Teacher 2. I continuously create different presentations on topics and present them through these programs, and the students are more active during the class and try to be as creative as possible. Teacher 3. As far as software is concerned, their use is limited; Teacher 4. Non-functioning Internet connection in the entire school building presents a particular challenge.

DISCUSSION and CONCLUSIONS

Although both teachers in the experimental and the control groups were provided with the same technology tools in their classroom spaces and same requirements in terms of integrating technology in their classes on a regular basis by MEST, there were differences in the levels of its integration as reported by the results of this study. This mirrored what research in technology integration showed that only giving access to technology teachers does not make necessarily integrate technology in their classes naturally. Thus, teachers may need continued encouragement or further support by provision of trainings for integrating technology in their subject areas.

In this study, the authors investigated coaching as a strategy to support teachers to integrate the available technologies in the natural sciences unit, and found that coaching increased not only teachers' integration of more technologies into their courses, but also their student outcomes, and occurrences of student critical thinking behaviors, even though it may not be possible to attribute all student outcomes to solely use of technology.

Coaching is "one model of professional development that has shown the potential to improve the knowledge, skill, and practice of teachers, thus enhancing student achievement" (Beglau at al., 2011, p. 6). In this study the coaching intervention was effective because it was delivered one-on-one to the teachers, customized to their content and technology skills through an expert coaching team. Although this strategy was found to be effective in this research setting, it may not be sustainable in the long run to expand to other schools in Kosovo. Having a coaching team and having them visit each teacher's schools weekly will be expensive and may not be a sustainable way of continuous training of teachers to integrate technology.

Coaching came to be an effective strategy to increase teachers' technology integration. As shown by this study, coaching would be a worthwhile addition to other training efforts that might be offered by MEST. This may be done through peer to peer coaching of teachers, or pairing technology-savvy teachers with less technology savvy teachers, providing access to modeling of technology integration of teachers in subject areas (Frazier, 2011).

This study captured student performance and critical thinking behaviors, when teachers were coached to integrate technology versus not while teaching a fifth-grade science unit. Coaching teachers to integrate ICT was advantageous as it showed higher achievement of students and higher occurrences of student critical thinking behaviors. This was not surprising as the integration of technology in the natural sciences unit provided the opportunity to present abstract concepts in a concrete way through PowerPoint, or You Tube videos, thus provided students with real world examples and provided students direct observation opportunities of cause and effect relationships via simulations. Additionally, integration of technology increased

students' engagement with the content, which resulted in students formulating and asking more questions, higher levels of participation in class discussions, and collaboration among them that resulted in a more active classroom. This active classroom environment created by the integration of technology in the experimental group resulted in higher critical thinking behaviors, and might also be the reason for higher achievement in the experimental group.

Designing the science units and teaching them by considering how to develop critical thinking skills is the key to success of schools in Kosovo. The acquisition of teaching content aided by teaching technology increases the level of knowledge and critical thinking, decreasing at the same time the mechanical reproduction of facts. After the war in Kosovo, the MEST and other donors from around the world have been rebuilding schools, pilot testing and changing the curriculum and also have been furnishing schools with technology. From this study, researchers found out that having access to technology does not suffice in integrating technology successfully in the subject area to promote critical thinking. The MEST can provide further support to teachers for integrating technology and building generations with critical thinking skills. Support may be given by providing suggestions for specific units and learning outcomes as to what kind of technology tools to integrate and how to integrate them. Additionally, providing systematic training to in-service teachers in formats of seminars, workshops, coaching, and modeling may help achieve the mission of preparing the future generations of Kosovo. However, these require additional funding allocations to ensure the systematic implementation of teaching technology in various subjects and grades. The funding may be done by partnering with governmental and nongovernmental organizations. Changes in technology are rapid and ongoing and these changes should go hand in hand with the coaching of teachers aiming at promoting and developing critical thinking and providing good students' performance practices.

This research had three limitations that could be addressed in the future studies. The first limitation was that it was limited to one public school, one grade level and one subject area. Future research can expand to different school types and can include different subject areas or grade levels. Promoting critical thinking and technology integration is expected from all teachers across the new curriculum, in all schools and grade levels. Second limitation was that the psychometrics features of the content test used this study had room for improvement, it could be achieved by increasing the number of assessment items to the test, using it with higher number of participants by reaching out to fifth-grade science classrooms and doing an item analysis on the test to achieve a higher reliability coefficient. Third limitation was that the coaching only happened for the duration of one unit. A future study could focus on providing coaching to teachers for a semester long, and could capture the outcomes of longer term coaching, and possibly investigating the question of sustainability of one-on-one coaching from both the participating teachers' perspective and from the coaching teams' perspective.

REFERENCES

Aguilar, E. (2013). *The art of coaching: Effective strategies for school transformation*. John Wiley & Sons.

Anderson, L. W., & Krathwohl, D. R. (2001). A revision of Bloom's taxonomy of educational objectives. *A Taxonomy for Learning, Teaching and Assessing. Longman, New York*.

Aslan, A., & Demircioglu, G. (2014). The effect of video-assisted conceptual change texts on 12 th grade student` alternative conceptions: The gas concept. *Procedia-Social and Behavioral Sciences, 116*, 3115-3119.

Bagdasarov, Z., Luo, Y., & Wu, W. (2017). The influence of tablet-based technology on the development of communication and critical thinking skills: an interdisciplinary study. *Journal of Research on Technology in Education*, *49*(1-2), 55-72..

Bakir, N. (2016). Technology and teacher education: A brief glimpse of th research and practice that have shaped the field. *TechTrends, 60*(1), 21-29.

Barron, A. E., Dawson, K., & Yendol-Hoppey, D. (2009). Peer coaching and technology integration: An evaluation of the Microsoft peer coaching program. *Mentoring & Tutoring: Partnership in Learning*, *17*(1), 83-102.

Beglau, M., Craig, J., Foltos, H.L., Gann, K., James, J., Jobe, H., Knight, J., & Smith, B. (2011). Technology, coaching, and community: Power partners for improved professional development in primary and secondary education. *Washington DC: ISTE*.

Bowden, J., Hart, G., King, B., Trigwell, K., & Watts, O. (2000). Generic capabilities of ATN university graduates. *Canberra*: Australian Givernment Department of Education, Training and Youth Affairs

Boyle, J.T. & Nicol, D.J. (2003). Using classroom communication system to support interaction and discussion in large class setting. *ALT-J, 11*(3), 43-57.

Bybee, R. W., Carlson-Powell, J., & Trowbridge, L. W. (2014). *Teaching secondary school science: Strategies for developing scientific literacy*. Pearson Education Limited.

Carmichael, E., & Farrell, H. (2012). Evaluation of the Effectiveness of Online Resources in Developing Student Critical Thinking: Review of Literature and Case Study of a Critical Thinking Online Site. *Journal of University Teaching and Learning Practice*, *9*(1), 4.

Cavanaugh, C., Dawson, K., & Ritzhaupt, A. (2011). An evaluation of the conditions, processes, and consequences of laptop computing in K-12 classrooms. *Journal of Educational Computing Research*, *45*(3), 359-378.

ChanLin, L. J. (2008). Technology integration applied to project-based learning in science. *Innovations in Education and Teaching International, 45*(1), 55-65.

Chauhan, S. (2017). A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Computers & Education*, *105*, 14-30.

Creswell, J. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage Publication.

Croft, A., Coggshall, J. G., Dolan, M., & Powers, E. (2010). Job-Embedded Professional Development: What It Is, Who Is Responsible, and How to Get It Done Well. Issue Brief. *National Comprehensive Center for Teacher Quality*..

Dall'Oglio, A.M., Rossiello, B., Coletti, M.F., Caselli, M.C., Ravà, L., Ciommo, V., Orzalesi, M., Giannantoni, P. & Pasqualetti, P. (2010) Developmental evaluation at age 4: validity of an Italian parental questionnaire."*Journal of Paediatrics and Child Health*,46(7-8), 419-426.

Dogan, S. (2010). Perceptions of Teachers about the Use of Educational Technologies in the Process of Instruction. *Odgojne znanosti*, *12*(2 (20)), 297-309.

EC. (2018). *Strategic framework-Education & Training 2020.* Retrieved from https://ec.europa.eu/education/education-in-the-eu/about-education-and-training-in-the-eu_en

Eisenberg, M. B., & Johnson, D. (2002). Learning and teaching information technology computer skills in context. *Eric*, 1-17.

Ennis, R. H. (2011, May). The nature of critical thinking: An outline of critical thinking dispositions and abilities. In *Sixth International Conference on Thinking, Cambridge, MA* (pp. 1-8).

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International journal of qualitative methods*, *5*(1), 80-92.

Frazier, T. C. (2011). The effects of peer coaching for technology integration on teachers' comfort, practice, and student technology literacy. *Dissertations, Theses and Capstone Projects*.

Glazer, E., & Hannafin, M. (2008). Factors that influence mentor and teacher interactions during technology integration collaborative apprenticeships. *Journal of Technology and Teacher Education*, *16*(1), 35-61.

Glazer, E., Hannafin, M. J., & Song, L. (2005). Promoting technology integration through collaborative apprenticeship. *Educational Technology Research and Development*, *53*(4), 57-67.

Gokalp, M. (2010). A study on the effects of information technologies on university students. *Procedia-Social and Behavioral Sciences, 9*, 501-506.

Guhal, S., & Leonard, J. (2002). Motivation in elementary mathematics: How students and teacher benefit from computers. *TechTrends*, *46*(1), 40..

Harris, J. L., Al-Bataineh, M. T., & Al-Bataineh, A. (2016). One-to-one technology and its effect on student academic achievement and motivation. Contemporary Educational Technology 7 (4), 368-381.

Hopson, M. H., Simms, R. L., & Knezek, G. A. (2001). Using a technology-enriched environment to improve higher-order thinking skills. *Journal of Research on Technology in education*, *34*(2), 109-119.

Ismajli, H. (2008). The impact of teaching technology on development of critical thinking. *Odgojne Znanosti, 10*(1), 97-112.

Jang, S. (2010). Integrating the interactive whiteboard and peer coaching to develop the TPACK of secondary science teachers. *Computers & Education, 55*(4), 1744-1751.

Jarosievitz, B. (2012). ICT in physics teaching for secondary schools and colleges. *New Perspectives in science education*.

Jeong, A. (2003). The sequential analysis of group interaction and critical thinking in online. *The American Journal of Distance Education, 17*(1), 25-43.
Jonassen, D. H., Carr, C., & Hsiu-Ping, Y. (1998). Computers as mindtools for engaging learners in critical thinking. *TECH TRENDS-WASHINGTON DC-*, *43*, 24-32.
KFOS. (2014). *Brief Situation Analysis of The Education Sector in Kosovo.* Prishtina.
Kim, K., Grabowski, B. L., & Sharma, P. (2004). Designing a Classroom as a Learner-Centered Learning Environment Prompting Students' Reflective Thinking in K-12. *Association for Educational Communications and Technology*.
Kirk, R. E. (2008). Statistics: An introduction (5th ed.). Belmont, CA: Thomson Wadsworth.
Kopcha, T. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers & Education, 59*(4), 1109-1121.
Kosovo Pedagogical Institute. (2016). *Framework for Quality Assurance of School Performance in Kosovo,* Prishtina: IPK.
Caruso, J. B., & Kvavik, R. B. (2005). ECAR study of students and information technology, 2005: Convenience, connection, control, and learning.
Kwak, S. G., & Kim, J. H. (2017). Central limit theorem: the cornerstone of modern statistics. *Korean journal of anesthesiology*, *70*(2), 144-156
Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of educational research*, *77*(4), 575-614..
Lee, J., & Choi, H. (2017). What affects learner's higher-order thinking in technology-enhanced learning environments? The effects of learner factors. *Computers & Education*, *115*, 143-152.
Lee, Y. H., Waxman, H., Wu, J. Y., Michko, G., & Lin, G. (2013). Revisit the effect of teaching and learning with technology. *Journal of Educational Technology & Society, 16*(1), 133-146.
Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic observation. *Thousand Oaks, CA*.
Lowther, D.L., Inan, F.A., Strahl, J.D. & Ross, S.M. (2008). Does thenology integration "work" when key barriers are removed? *Educational Media International, 45*(3), 195-213.
Mandernach, B. (2006). Thinking critically about crtical thinking: Integrating online tools to promote cirtical thinking. *A Journal of Scholarly Teaching, 1*(1), 41-50.
MEST. (2012). *Core curriculum for pre primary grade and primary education in Kosovo.* Retrieved June 2018, from https://masht.rks-gov.net/uploads/2015/10/core-curriculum-for-pre-primary-grade-and-primary-education-in-kosovo.pdf
MEST. (2016). *Strategic plan in Kosovo 2017-2020.* Retrieved June 15, 2018, from http://www.kryeministri-ks.net/repository/docs/KOSOVO_EDUCATION_STRATEGIC_PLAN.pdf
Miranda, H. P., & Russell, M. (2012). Understanding factors associated with teacher-directed student use of technology in elementary classrooms: A structural equation modeling approach. *British Journal of Educational Technology*, *43*(4), 652-666
Miri, B., David, B. C., & Uri, Z. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research in science education*, *37*(4), 353-369.
Monserate, C. (2018). Impact of Technology on the Academic Performance of Students and Teaching Effectiveness. *International Journal of Interdisciplinary Research and Innovations , 6* (1), 47-87.
Nanjappa, A., & Grant, M. M. (2003). Constructing on constructivism: The role of technology. *Electronic Journal for the integration of Technology in Education*, *2*(1), 38-56.
Neill-Hall, J. (2003). *How to Help Your Child Succeed at School: Parenting and Primary Schooling Working in Partnership*. Hodder & Stoughton.
Niess, M. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education, 21*(2005), 509-523.
Ojose, B. (2009). Promising practice of technology integration in math and sciense instruction: A case of California charter high school. *International Education Studies, 2*(3), 3-17.
Ozmen, H. (2011). Effect of animation enhanced conceptual change texts on 6th grade students' understanding of the particulate nature of matter and transformation during phase changes. *Computers & Education, 57*(1), 1114-1126.
Reisslein, M., Moreno, R. Ozogul, G. (2010). Precollege electrical engineering insrtuction: The impact of abstrakct vs.contextualized representation and practice on learning. *Journal of Engineering Education, 99*(3), 225-235.
Rivard, L. P., & Straw, S. B. (2000). The effect of talk and writing on learning science: An exploratory study. *Science education*, *84*(5), 566-593.
Rumpagaporn, W.W. & Darmawan, I.G. (2007). A Pilot Project in Thai ICT Shcools to Promote Students Critical Things Skills. *International Education Journal, 8*(2), 125-132.

Seale, J. K., & Cann, A. J. (2000). Reflection on-line or off-line: The role of learning technologies in encouraging students to reflect. *Computers & Education*, *34*(3-4), 309-320.

Slavin, R. E., Lake, C., Hanley, P., & Thurston, A. (2014). Experimental evaluations of elementary science programs: A best-evidence synthesis. *Journal of Research in Science Teaching*, *51*(7), 870-901.

Somekh, B. (2007). *Pedagogy and learning with ICT: Researching the art of innovation*. Routledge.

Sommers, M. & Buckland, P. (2004). *Parallel worlds: rebuilding the education system in Kosovo.* (UNESCO, Ed.) Paris: International Institute for Educational Planning.

Sorcinelli, M. D., Austin, A. E., & Eddy, P. L. (2006). *Creating the future of faculty development: Learning from the past, understanding the present* (Vol. 59). Jossey-Bass.

Sousa, D. A. (2008). How the Brain Learns Mathematics . Thousands Oaks.

Spears, S. A. (2012). *Technology-enhanced learning: The effects of 1: 1 technology on student performance and motivation* (pp. 1-114). The University of West Florida.

Sugar, W. (2005). Instructional Technologist as a Coach: Impact of a Situated Professional Development Program on Teachers' Technology Use. *Journal of Technology and Teacher Education, 13*(4), 547-571.

Van Gelder, T. (2001, December). How to improve critical thinking using educational technology. In *Meeting at the crossroads: Proceedings of the 18th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (pp. 539-548).

van Tryon, P. J. S., & Schwartz, C. S. (2012). A pre-service teacher training model with instructional technology graduate students as peer coaches to elementary pre-service teachers. *TechTrends*, *56*(6), 31-36.

Xiao, L., Clark, S., Rosson, M. B., & Carroll, J. M. (2008, July). Promoting reflective thinking in collaborative learning activities. In *2008 Eighth IEEE International Conference on Advanced Learning Technologies* (pp. 709-711). IEEE.

Yang, Y. T. C., & Wu, W. C. I. (2012). Digital storytelling for enhancing student academic achievement, critical thinking, and learning motivation: A year-long experimental study. *Computers & education*, *59*(2), 339-352.