UDK 371.3
Izvorni znanstveni rad

SURVEY ABOUT THE DURABILITY OF LEARNT CONTENTS IN TRADITIONAL AND IN INTERACTIVE LEARNING ENVIRONMENTS

Dr Žolt Namestovski
University of Novi Sad, Hungarian Language Teacher Training Faculty,
Subotica, Serbia
Dr Dragana Glušac
University of Novi Sad, Technical Faculty „Mihajlo Pupin“,
Zrenjanin, Serbia
Mr Branka Arsović
University of Kragujevac Teacher Training Faculty of Užice, Serbia

Abstract:

The purpose of this was to investigate the variance of traditional and interactive learning environments in durability of learnt contents. The research took place in Vojvodina, Northern Province of Republic Serbia, during school year 2013. The survey included 186 students learning in traditional learning environment (using mostly printed teaching tools) and 193 students learning in interactive learning environment (using interactive whiteboard). The survey included two learning environments based on school subject from toys to computers (a facultative subject), in their third year of elementary school. The study examined the forgotten teaching contents in both environments, which was obtained using questionnaire after lessons, after 1 month and after 3 months. After analysing and processing the results, it could be determined that students of an interactive learning environment forgot significantly less teaching materials than students of traditional environments.

Keywords: durability; interactive environment; interactive whiteboard learnt contents; traditional environment

INTRODUCTION AND BACKGROUND

It has become apparent that new technologies have transformed many areas of our lives and contributed to significant pedagogical shifts in schools worldwide. Information and communication technologies (ICT) have opened up opportunities for unprecedented access to information, global communication and created learning contexts that provide students with opportunities for developing new ideas and training new models of communication and collaboration. (Namestovski, 2013; Hennessy, 2011; Johnson, 2011; Beetham and Sharp, 2013).

Students' effective learning methods, forms and teaching aids are to be concluded from the preferred strategies that belong to learning style. The teaching strategies which elicit the most preferred learning strategies are also to be defined, based on which the learning environment or the learning process are to be designed (Tóth, 2014).

From the point of view of our research, the theory examining the learning preferences of the individual is to be highlighted. The most significant theory in this group is associated with the name of David Kolb, who has been studying learning style for more than 40 years. His Learning Style Inventory (LSI) is one of the most widespread measuring instruments in the examination of learning styles. His experimental theory of learning amalgamated the relevant and decisive movements of the 20th Century (John Dewey, Kurt Lewin, Jean Piaget, William James, Carl Jung, Paulo Freire, Carl Rogers, etc.)

His theory rests on six principles:

- Learning is interpreted as a relationship between the individual and the environment.
- Learning is interpreted as the holistic process of adaptation to the environment.
- Learning is to be regarded rather as a regulated process than an outcome condition.
- The student's existing knowledge and experience play a decisive role in processing new information.
- Piaget's adaptive theory is regarded as the basis of learning. Adaptation has two forms, namely assimilation and accommodation.
- Learning is a process of constructing knowledge, the result of which presents itself as a relationship between community knowledge and individual knowledge (Tóth, 2014).

Curiosity, the educational environment and the quality of educational materials are all connected with each other, and they have direct effect on the durability of learnt contents. In our research, students are motivated using modern educational technology.

The extent to which technologies can facilitate dialogue is the extent to which they succeed as educational tools (Johnson, 2011).

The IWB is here regarded as any board connected to a PC, capable of displaying a projected image which allows the user to control the PC by touching the board or with the computer mouse. One additional feature of the IWB is the accompanying 'native' software which provides the facility to write by hand on blank 'pages' and includes tools for controlling features, such as font colour and line thickness, as well as resources for classroom use, such as lined and squared paper of different sizes, clip art and ready-made lesson materials (Beauchamp, 2004). On the other hand there is more complex put-up education materials, which are usually enriched with multimedia, interactive contents and collaborative tasks. This material are prepared by teachers and sharing on the social media or in other virtual communities (such as SMART Exchange).

The purpose for using IWBs in the classroom is to enable access to and use of digital resources for the benefit of the whole class while preserving the role of the teacher in guiding and monitoring learning (Hall & Higgins, 2005).

IWBs offer the opportunity to better match learning to different student learning styles (Glover et al., 2005a, 2005b, 2007; Schuck & Kearney, 2007; Slay et al., 2008; Thompson & Flecknoe, 2003; Wall et al., 2005; Weimer, 2001).

Interactive white boards allow teachers and students to interact with content projected from a computer screen onto a white board surface. Virtually anything that can be done on a computer can be done on an interactive white board, with the advantage that interaction involves fingers and pens and so is more kinaesthetic, drawing, marking and highlighting of any computer-based output is supported, a whole class can follow interactions, and lessons can be saved and replayed (Swan et al., 2008).

Among the potential applications are:

- using web-based resources in whole-class teaching
- showing video clips to help explain concepts
- demonstrating a piece of software
- presenting students' work to the rest of the class
- creating digital flipcharts
- manipulating text and practising handwriting
- saving notes written on the board for future use

- quick and seamless revision (Hall & Higgins, 2005).

However, questions remain as to whether this perception is simply related to the novelty factor (Glover et al., 2005b, 2007), or whether it is more long lasting. Many of the studies in this review were not longitudinal, and were done shortly after the IWB has been introduced to the school (Digregorio & Sobel-Lojeski, 2009).

Common themes on IWBs include effects on perception, motivation, attention, behaviour, level of interaction between student, teacher, and IWB, learning, pedagogy, and achievement. Early evidence suggests that IWBs can have a positive effect on teaching and learning (Glover, Miller, Averis, & Door, 2007).

In our research project, one of the most significant factors of extending the durability of learnt contents is in obtaining higher level of motivation through interactive way of learning, where students have direct contact with and they can influence the educational material. Educational software confirms or rejects every action of the student. The material to be learnt is divided into small parts and every step of the learning process is assessed, which thus creates an overall picture of the accuracy of learnt contents. Beside interactive learning environment, there are other significant factors of good-quality and efficient education, such as information about own learning results in an experimental group (rapid interaction and feedback information in the form of multimedia). In the educational software, the contents to be learnt are divided into small modules; therefore success appears in every learning stage. Available time for learning and solving tests is not defined, so every student works and learns at his/her own pace. This has an additional motivating effect.

For these purposes was designed an interactive learning environment, where implemented interactive whiteboard, computer, projector and learning materials, created in software of interactive whiteboard (SMART Notebook 10).

RESEARCH METHODS

These researches lead to our present scientific research, where the subject of research is examining the durability of learnt contents in two parallel groups, one in a traditional and the other in an interactive learning environment. For this purpose, a traditional learning group and learning environment was designed, which included materials of the school subject *From toys to computers* (a facultative subject in the lower grades of elementary school in Republic of Serbia), its teaching unit titled *Electronic messaging* and teaching content *E-mail – Rules of communication on the Internet*, intended for the third class of elementary schools. This content was selected as suitable for digitalisation and presentation in both educational environments. The participants of the survey were students of third class in elementary school (9-10 years old students).

The research was done in primary schools in Northern Vojvodina, in North Backa district (6 elementary schools, varying number of classes). The control group (pupils who learned in a traditional environment) had 186 members, while the experimental one (students who learned in a modern environment) had 193 members.

The approximate equation of the control and the experimental groups was done based on the pupils' overall success in the first term, the parents' educational level, the pupils' gender, place of residence (city/village) and the suggestions of their teachers.

The traditional class was held using traditional teaching tools (mostly printed documents), such as blackboard, printed worksheets and application images. In parallel with the traditional model of learning, we also designed an interactive (experimental) learning environment. On this class, interactive and multimedia educational software was applied, as well as a computer (laptop), a multimedia projector, an interactive whiteboard for frontal

presentation of learning materials, repetition and confirmation of learnt contents, and printed worksheets for individual tasks and learning. In interactive environment was implemented mimio Xi interactive whiteboard (one of the most reliable model) and prepared and tested digital education material, because technical support is a critical contextual factor for a successful IWB implementation (Glover et al., 2005a, 2005b; Schuck & Kearny, 2007; Thompson & Flecknoe, 2003). Students do not like technical problems, which from their perspective cause disruption, delay, and frustration (Hall & Higgins, 2005).

In the interactive model of teaching, projected materials were used for frontal work; teaching at the interactive whiteboard was used for individual work (solving interactive lessons), for doing exercises and for revision. This powerful and increasingly prevalent technology opens up opportunities for learners to generate, modify, and evaluate new ideas, through multimodal interactions, along with talking. Thereby, using it can support numerous new forms of dialogue that highlight differences between perspectives, and make ideas and reasoning processes more explicit (Glušac, Namestovski, & Pinter-Krekić, 2012). The durability of learnt contents was measured with printed questionnaires a month and three months after the teaching, both in the traditional and the experimental teaching models.

Interactive whiteboards (IWBs) are generally perceived by students and teachers as a positive addition to the classroom learning environment. While there is support for links between IWBs and increases in student motivation, questions remain about the relationship between IWBs, student learning, and achievement (Digregorio & Sobel-Lojeski, 2009).

In framework same scientific research we proved the higher level of motivation level in interactive learning environment. Meanwhile, students' previous knowledge about this content is low (the known concepts are computer and the Internet); therefore the differences in their motivation levels depend on the used methods and educational tools. Higher motivation level was verified in two ways: analysing respondents' answers in the questionnaire and analysing the number of reactions on the same questions during the teaching process (Glušac, Namestovski, & Pinter-Krekić, 2012).

The approximate equation of the control and the experimental groups was done based on the students' gender, overall success in the first semester, the parents' educational level, place of residence (city/village) and the suggestions of their teachers.

Table 1. Socio-demographic characteristics of participants.

	Traditional learning environment	Interactive learning environment
Gender		
Female	54.30%	58.03%
Male	45.70%	41.97%
Place of residence		
City	79.57%	78.24%
Village	20.43%	21.76%
Parents' educational level		
Elementary school	40.86%	43.01%
Secondary school	47.85%	47.85%
Higher education	11.29%	11.29%

	Traditional learning environment	Interactive learning environment
Overall success		
>=4.50	24.19%	25.39%
3.50-4.49	42.47%	43.52%
2.50-3.49	24.73%	21.76%
1.50-2.49	5.38%	6.2%
<1.50	3.23%	3.11%

After the theoretical preparation and the analysis of international experience and results in this scientific field, we formulated the main hypothesis of this paper:

- The appropriate implementation of interactive whiteboard and digital education material in primary schools has positive impact on increasing the durability of learnt contents.

In the first phase of our research, we created two educational environments. In the traditional educational model, we implemented traditional teaching tools, while in the experimental model, modern ones.

Table 2. Comparison of implemented tools in two parallel educational environments

Traditional learning environment	Interactive learning environment
▪ traditional board ▪ printed pictures ▪ worksheets	▪ interactive whiteboard (+ computer and projector) ▪ projected pictures of educational software ▪ worksheets

After parallel teaching of balanced groups in different learning environments, the efficiency was measured with a final test (immediately after learning) and the measurement was repeated after one and three months. The questionnaires of the repeated tests contained the same questions in different sequence. The durability of learnt contents has been expressed in percentages in both environments, the way that we subtracted the results of the repeated test from the results of the final one.

forgotten contents (%) = results of the final test (%) – results of the repeated test (%)

The percentage of forgotten contents is inversely proportional to the durability of learnt contents. This measurement was carried out in both environments and the results were compared.

Results

The durability of learnt contents was obtained using questionnaire. 16 various type of question used after lessons to measured efficiently of two learning environment. After 1 and 3 month used same questions, in various sequence, for investigate of forgotten contents.

Table 3. Questions and question groups on questionnaire

1. Group: The meanings of English words
Q1: create mail
Q2: subject
Q3: to
Q4: send
Q5: receive
Q6: from
2. Group: Definitions
Q7: What is the Internet?
Q11: What is a computer network?
Q14. What is an e-mail?
Q15. What are the dangers of the Internet?
Q16. The sequence of activities during writing e-mails
3. Group: Conditions for sending E-mail
Q8 software
Q9 computer
Q10 Internet
4. Group: Purposes of Internet using
Q12 searching
Q13 communication

The first group of questions were related with English words. In Vojvodina, where the research was carried out, the languages of education are Serbian and Hungarian, but software is mostly used in English, so the recognition and understanding of English words are among the most significant factors of successful IT operations.

The second group of questions based on definition of most important concepts during lessons, such as Internet, computer networks, e-mail, etc. The third and fourth group of questions were related with process and conditions of sending E-mail and the purposes of Internet using, which were also one of major contents during the lessons.

After analysing and processing of data, we have proven that the level of knowledge durability was higher in an interactive environment, which is visible from Figure 1. and Figure 2., presenting the percentage of forgotten contents after one and three months in both learning environments for every question of the questionnaire used for testing.

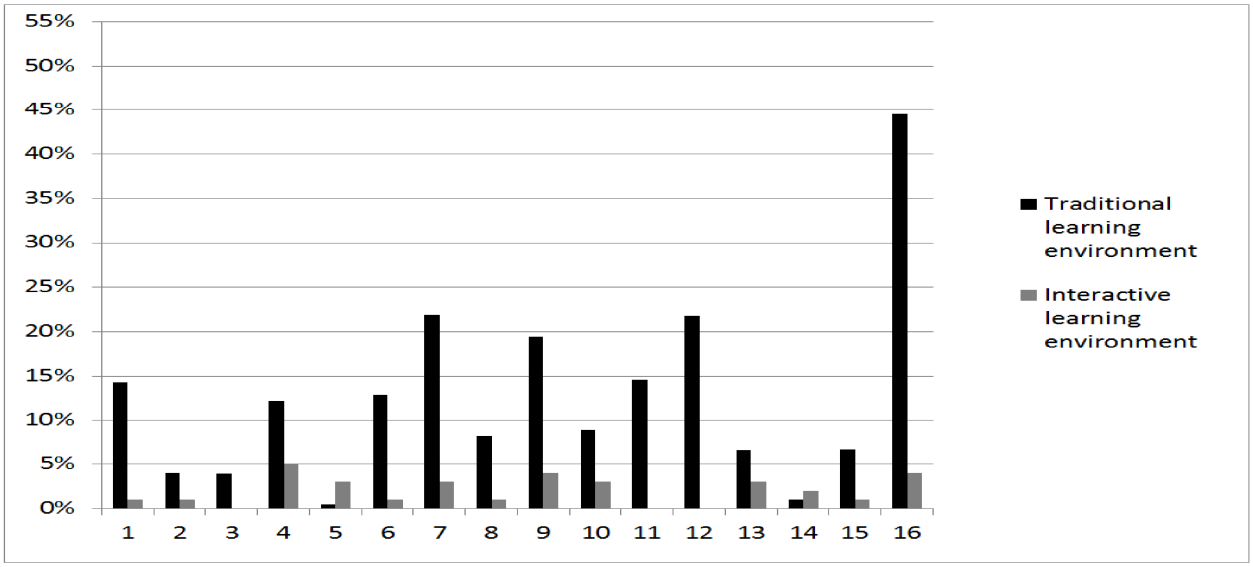

Figure 1. Comparison of the percentages of forgotten contents in traditional and interactive learning environments by questions of the test done after one month (y-axis: percentage forgotten contents, x-axis: question numbers)

Three months after the teaching, a durability analysis of learnt contents was performed in the same way.

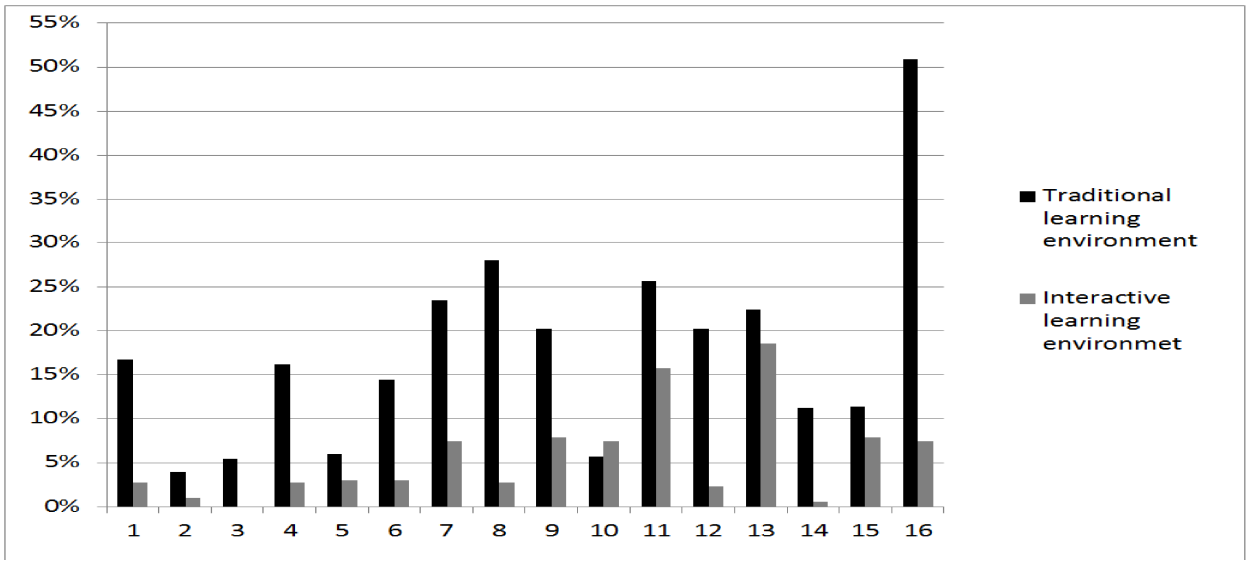

Figure 2. Comparison of the percentages of forgotten contents in traditional and interactive learning environments by questions of the test done after three months (y-axis: percentage forgotten contents, x-axis: question numbers)

The process of forgetting contents continued, but at a smaller extent than after the first month.

One month after the teaching, the results of the durability of learnt contents were 23% in the traditional environment and 28% in the interactive environment. If we summarise and express the durability of learnt contents based on our 16 questions, the percentages demonstrate that in the traditional environment forgetting is 13%, while in the interactive environment it is 2% of the learnt contents. Three months after the teaching this tendency continued. Pupils in traditional learning environment were able to reproduce 18% of the learnt contents,

while in the interactive one it reached 24%. Therefore, pupils of traditional learning environment have forgotten 18%, and those in the interactive environment 6% of the learnt contents in a time period of three months.

Observing the percentages of forgotten contents in more detail, we can see that students from the traditional learning group have forgotten mostly complex concepts, such as in question 7 (What is the Internet?), question 9 (For what purposes can the Internet be used?), and question 16 (The sequence of activities during writing e-mails).

Table 4. Questions of the tests after one and three months and percentages of forgotten contents in traditional and interactive environments

Questions		Forgotten contents after 1 month		Forgotten contents after 3 months	
		Traditional environment	Interactive environment	Traditional environment	Interactive environment
The meanings of English words	1. create mail	14%	1%	17%	3%
	2. subject	4%	1%	4%	1%
	3. to	4%	0%	5%	1%
	4. send	12%	5%	16%	3%
	5. receive	0%	3%	6%	3%
	6. from	13%	1%	14%	3%
7. What is the Internet?		22%	3%	23%	7%
What is necessary for sending e-mail?	8. software	8%	1%	28%	3%
	9. computer	19%	4%	20%	8%
	10. Internet	9%	3%	6%	7%
11. What is a computer network?		15%	0%	26%	16%
For what purposes can the Internet be used?	12. for searching	22%	0%	20%	2%
	13. for communication	7%	3%	22%	19%
14. What is an e-mail?		1%	1%	11%	1%
15. What are the dangers of the Internet?		7%	1%	11%	8%
16. The sequence of activities during writing e-mails		45%	4%	51%	7%
Total (Average)		13%	2%	18%	6%

The significant differences between results of members in interactive and in traditional learning environment was verified using independent T-test. The T-test carried out 1 and 3 month after teaching.

Table 5. Results of frequencies and T-test in both groups, after 1 month of teaching

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Durability	1	16	12,63	10,996	2,749
	2	16	2,00	1,592	,398

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Durability	Equal variances assumed	11,020	,002	3,825	30	,001	10,625	2,778	4,952	16,298
	Equal variances not assumed			3,825	15,628	,002	10,625	2,778	4,725	16,525

Table 6. Results of frequencies and T-test in both groups, after 3 month of teaching

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Durability	1	16	17,50	11,747	2,937
	2	16	5,69	5,326	1,331

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Durability	Equal variances assumed	4,261	,048	3,663	30	,001	11,813	3,225	5,227	18,398
	Equal variances not assumed			3,663	20,916	,001	11,813	3,225	5,105	18,520

Consequently, it can be concluded that the durability of learnt contents is higher in an interactive learning environment, which confirms our hypothesis.

DISCUSSION AND CONCLUSIONS

The durability of learnt contents was analysed in details in a traditional and an interactive learning environment. Educational software was used in the interactive environment and its effects were measured, while in the traditional environment traditional teaching tools were used. One and three months after the final tests on obtained knowledge during the teaching, it was measured the durability of learnt contents in traditional and interactive environments. The durability of learnt contents in different educational environments was presented in percentages, and it was expressed using the percentage of forgotten contents, subtracting the results of the final and the repeated tests. This way we calculated the percentage of forgotten contents, which was inversely proportional to the learnt contents. After analysing and processing the results, it could be determined that pupils of an interactive learning environment forgot less than pupils of traditional environments.

Beside these statistical results, it could also be noticed that pupils in interactive environment did not forget the most important and complex parts of the previously learnt definitions.

The hypothesis of this research has been confirmed, which was formulated as follows:

- The implementation of educational software in primary schools has positive impact on increasing the durability of learnt contents.

REFERENCES

Armstrong, V., Barnes, S., Sutherland, R., Curran, S., Mills, S. & Thompson, I. (2005). Collaborative research methodology for investigating teaching and learning: the use of interactive whiteboard technology. *Educational Review*, 57 (4), 457-469.

Beauchamp, G. (2004). Teacher Use of the Interactive Whiteboard in Primary Schools: towards an effective transition framework Technology, *Pedagogy and Education*, 13 (3), 327-348.

Beetham, H. & Sharpe, R. (2013). *Rethinking pedagogy for a digital age: Designing for 21st century learning*, Routledge.

Digregorio, P. & Sobel-Lojeski, K. (2009). The effects of interactive whiteboards (IWBs) on student performance and learning: A literature review. *Journal of Educational Technology Systems*, 38 (3), 255-312.

Hall, I. & Higgins, S. (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning*, 21(2), 102-117.

Hennessy, S. (2011). The role of digital artefacts on the interactive whiteboard in supporting classroom dialogue. *Journal of Computer Assisted Learning*, 27(6), 463–489.

Higgins, S., Beauchamp, G. & Miller, D. (2007). Reviewing the literature on interactive whiteboards. Learning. *Media, & Technology*, 32 (3), 213-225.

Hodge, S. & Anderson, B. (2007). Teaching and learning with an interactive whiteboard: a teacher's journey, Learning. *Media and technology*, 32 (3), 271-282.

Glover, D., Miller, D., Averis, D. & Door, V. (2005a). Leadership implications of using interactive whiteboards. *Management in Education*, 18 (5), 27-30.

Glover, D., Miller, D., Averis, D. & Door, V. (2005b). The interactive whiteboard: A literature survey, Technology, *Pedagogy & Education*, 14 (2), 155-170.

Glover, D., Miller, D., Averis, D. & Door, V. (2007). The evolution of an effective pedagogy for teachers using the interactive whiteboard in mathematics and modern languages: An empirical analysis from the secondary sector. Learning. *Media, & Technology*, 32 (1), 5-20.

Glušac, D., Namestovski, Ž. & Pinter-Krekić, V. (2012). Impact of Implementing IT Tools in Elementary Schools on Pupils' Motivation Level. *Metalurgia International* 17 (11), 232-236.

Johnson, M. (2011). Review of "Educational dialogues" – by Karen Littleton & Christine Howe, British *Journal of Educational Technology*, 42-46.

Kolb, D. A. & Kolb, A. Y. (2005). T*he Kolb Learning Style Inventory – Version 3.1. 2005 Technical Specifications*, HayGroup, Boston, 2005, 72.

Namestovski, Ž. (2013). Analysis of the Effects of Applying Educational Software Tools on Pupils' and Teachers' Motivation Level in Primary Schools (doctoral thesis), University of Novi Sad Technical faculty "Mihajlo Pupin", Zrenjanin.

Northcote, M., Mildenhall, P., Marshall, L. & Swan, P. (2010). Interactive whiteboards: Interactive or just whiteboards. *Australasian Journal of Educational Technology*, 26(4), 494-510.

Ősz, R. (2013). *New Technologies Mean New Methods of Learning*. Iwate: WSEAS Press, 59-64.

Schuck, S. & Kearney, M. (2007). *Exploring pedagogy with interactive whiteboards: A case study of six schools* (Sydney, University of Technology Sydney). Available online at: http://www.ed-dev.uts.edu.au/teachered/research/iwbproject/pdfs/iwbreportweb.pdf (accessed February 12, 2009).

Slay, H., Siebörger, I. & Hodgkinson-Williams, C. (2008). Interactive whiteboards: real beauty or just "lipstick"? *Computers & Education*, 51, 1321–1341.

Thompson, J. & Flecknoe, M. (2003). Raising attainment with an interactive whiteboard in Key Stage 2. *Management in Education*, 17(3), 29-33.

Tóth, P. (2014). The Role of Individual Differences in Learning. *Acta Polytechnica Hungarica*, 11 (4), 183-197.

Smith, H. J., Higgins, S., Wall, K. & Miller, J. (2005). Interactive whiteboards: boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, 21(2), 91-101.

Swan, K., Schenker, J. & Kratcoski, A. (2008). *The effects of the use of interactive whiteboards on student achievement*. Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications.

Zevenbergen, R. & Lerman, S. (2008). Learning environments using interactive whiteboards: New learning spaces or reproduction of old technologies? *Mathematics Education Research Journal, 20* (1), 108-126.

Wall, K., Higgins, S. & Smith, H. (2005). "The visual helps me understand the complicated things": Pupil views of teaching and learning with interactive whiteboards. *British Journal of Educational Technology, 36* (5), 851-867.

Weimer, M. J. (2001). *The influence of technology such as SMART board interactive whiteboard on student motivation in the classroom*. Available online at: http://smarterkids.org/research/paper7.asp (accessed February 12, 2009).

Istraživanje o trajnosti naučenih sadržaja u tradicionalnim te interaktivnim nastavnim okruženjima

Sažetak: Cilj je istraživanja u ovom radu bio ispitati postoji li razlika između tradicionalnih i interaktivnih okruženja učenja u odnosu na trajnost naučenog sadržaja. Istraživanje je provedeno u Vojvodini, sjevernoj pokrajini Republike Srbije, tijekom školske godine 2013. Upitnikom je obuhvaćeno 186 učenika koji su učili u tradicionalnim nastavnim okruženjima (uglavnom su upotrebljavani tiskani nastavni materijali) i 193 učenika koji su učili u interaktivnim nastavnim okruženjima (uz upotrebu interaktivne ploče). Upitnik je proveden u dva nastavna okruženja u okviru nastavnog predmeta *Od igre do računala* (izborni predmet) u 3. razredu osnovne škole, nakon jednog mjeseca i nakon tri mjeseca. Nakon analize i obrade podataka utvrđeno je da učenici u interaktivnim nastavnim okruženjima zaboravljaju znatno manje nastavnih sadržaja nego učenici u tradicionalnim nastavnim okruženjima.

Ključne riječi: trajnost, interaktivno okruženje, sadržaji naučeni pomoću interaktivne ploče, tradicionalno okruženje

Umfrage über die Haltbarkeit des Lerninhalts in traditionellen und in interaktiven Lernumgebungen

Zusammenfassung: Das Ziel der veröffentlichten Forschung war die Untersuchung der Dauerhaftigkeit vom erworbenen Wissen in den traditionellen und in den interaktiven Lernumgebungen. Die Forschung wurde in der Wojwodina, nördlicher Provinz von Republik Serbien, im Schuljahr 2013 durchgeführt. 186 Schüler nahmen an der Forschung teil, die in der traditionellen Lernumgebung unterrichtet wurden (meistens lernten sie aus gedruckten Lernmaterialien) und 193 Schüler, die in der interaktiven Lernumgebung unterrichtet wurden (sie lernten mit Hilfe der interaktiven Tafel). Die Forschung wurde in der Lernumgebung des Schulfaches Vom Spielzeug bis zum Computern (fakultatives Fach) in der dritten Klasse der Grundschule durchgeführt. Die Studie analysierte die vergessenen Inhalte in beiden Umgebungen nach einem Monat und nach drei Monaten. Nach der Analyse und Verarbeitung der Ergebnisse konnte festgestellt werden, dass die Schüler in der interaktiven Lernumgebung deutlich weniger Lehrmaterialien vergessen haben als die Schüler in der traditionellen Umgebungen.

Schlüsselbegriffe: Haltbarkeit; interaktive Umgebung; interaktive Tafel, Lerninhalte; traditionelle Umgebung.