Dr. Beatriz Tomšič Čerkez, Univerza v Ljubljani, Pedagoška fakulteta, beatriz.tomsic@pef.uni-lj.si

The development of spatial representation in the world of new media

Izvirni znanstveni članek

UDK 373.3.091.64:73

ABSTRACT

With the development of spatial perceptions being one of the most important goals of visual art education, we analysed the influence of different didactic tools – dynamic or static in the development of pupils' spatial perception. After an initial testing, we formed groups considering three different levels in their abilities to represent spatial organizations. In experimental groups pupils were introduced with the contents of the lesson using moving images while in control groups we used static images. Pupils had to make a drawing using the cues to represent space.

While pupils from the advanced level did not show differences, in the second group they showed more detailed drawings in the case of the use of dynamic didactic means. Among the less talented pupils, the results showed a difference: improvement in the case of static images while dynamic images produced a kind of insecurity that did not allow the free development of pupils' expression. We concluded that it is important to use the adequate didactic tools taking into account the goals we wish to achieve: dynamic images foster a unique experience of space but they can create insecurity and negative feelings in pupils that find it difficult to express themselves in terms of two dimensional representations of space.

Key words: new technologies, didactic tool, dynamic and static images, drawing

Razvoj prostorskih predstav v svetu novih medijev

POVZETEK

Ker je razvoj prostorskega dojemanja eden najpomembnejših ciljev likovne vzgoje, smo analizirali vpliv didaktičnih pripomočkov z uporabo dinamične ali statične slike na razvoj prostorskih predstav učencev. Po začetnem testiranju smo oblikovali skupine glede na tri različne ravni sposobnosti, ki predstavljajo prostorske organizacije na dvodimenzionalni površini. Učence eksperimentalne skupine smo seznanili z vsebino pouka z uporabo dinamičnih slik, medtem ko smo v kontrolni skupini uporabili statične slike. Učenci so morali narediti risbo z uporabo prostorskih ključev.

Medtem ko se med učenci napredne ravni niso pokazale razlike, so učenci v drugi skupini v primeru uporabe dinamičnih slik izdelali risbe z več podrobnostmi. Med manj nadarjenimi učenci so rezultati pokazali razliko: izboljšanje v primeru uporabe statične slike, medtem ko so dinamične podobe v njih sprožale negotovost, ki ni omogočala njihovega svobodnega izražanja. Potrdili smo, da je pomembno uporabiti ustrezne didaktične pripomočke, pri čemer moramo upoštevati cilje, ki jih želimo doseči: dinamične podobe spodbujajo edinstveno doživetje prostora, vendar pa lahko porajajo negativna čustva pri učencih, ki se težko izražajo z risbo.

Ključne besede: nove tehnologije, didaktični pripomočki, statične in dinamične slike, risba

Introduction

As the age of electronic images began, the proliferation of new technologies affected almost all aspects of our lives and resulted in a revolution in the world of visual media. Like its predecessor, the "linguistic turn," which prevailed during the 1970s, the "pictorial turn" is now in progress. The ways we deal with the heterogenic visual information the world of visual media offers today opens an inevitable number of very interesting and highly-significant questions applied to the field of education in general and of visual art education in particular, since it deals mostly with visual images of all kinds.

Especially worth note in today's school is the fact that the majority of the pupils is in daily contact with television or video with its colourful, fast-moving sequences of images, and of course, computers, which provide a wide range of possible uses and experiences. Scanning and combining images, experimenting with tools offered

by different programs, exploring the possibility of multiple printings, and the divergence between printed and screen images are only a few possible areas to consider. These experiences do not only imply increasing speed of changing images, mechanical simplicity, and wide possibilities in the resolution of different technical processes but perhaps most of all a specific experience of space perception and representation, which every pupil carries with him/herself to the classroom and is essential to education in general, and to art education in particular.

New spatial experiences are important not only in the case of Art Education but for other school subjects as far as most of them deal with visual representations of all kinds. This proposition is important when talking about the development of the capacity to imagine spatial relationships in the fields of geometry, geography, biology, physics or chemistry. On the other hand, "a developed visuality" and all the contents this concept involves and supposes are required in almost all activities and therefore, school must offer pupils proper operative experiences and develop specific competencies.

Computers are making new and unique aesthetic experiences possible and also changing the way in which art is conceived, created, and perceived. Numerous images are produced with widely available, highly interactive, and user-friendly software. A new world has opened for artists as well as for educators and their pupils. Technological development requires the teaching profession to make changes at an unprecedented rate and opens a wide number of questions (Beckman 1998). Those connected with the impact of "multimedia" technologies on pupils are relevant to teaching as well as to artistic practice.

Many researches have been held about the use of new multimedia technologies and their increasing role in education. The term "multimedia" refers to the combination of multiple technical resources for the purpose of presenting information represented in multiple formats via multiple sensory modalities. Accordingly, multimedia resources can be considered in three different levels: the technical level (the technical devices such as computers, networks, displays, etc., that are the carriers of signs); the semiotic level (the representational format such as texts, pictures, and sounds of those signs); the sensory level (the sensory modality of sign reception such as visual or auditory modality). Many researches indicate that multiple external representations and multiple modalities are not always beneficial for learning (Schnotz, Lowe, 2003). Mayer's theory states that students learn more deeply from words and pictures than from words alone, that they learn more deeply when extraneous material is excluded rather than included, and that they learn more deeply when printed words are placed near rather than far from corresponding pictures (2003). Schnotz and Bannert state that adding pictures to a text may not always be beneficial for learning, but may have negative effects if poorly matched to the learning task (2003).

In the field of visual art education we deal with the possibility to generate and use didactic means that are based on animations with dynamic (moving) images. The reception of dynamic images requires a special predisposition as far as they function as a kind of reduction of authentic spatial experience. "The authentic observer is truly an artist: he divines what is significant and is good at sniffing out and retaining what matters in the fleeting and peculiar mix of phenomena," wrote the German poet Novalis (citiran v: Virilio 2000, 47). "You'd be hard pressed to find a better description of the energy of observation – image energy or, more precisely, information energy. Indeed, if speed is not strictly speaking a phenomenon but the relationship between phenomena (relativity itself), and if speed allows us to see and to conceive and not just to get around more easily, Novalis has described absolutely accurately the kinematic optics of the gaze that strives to retain the essential in the ephemeral movement of phenomena. Incidentally, this is what computer scientists today call image capacity", says P. Virilio (2000, 48).

Dynamic images suppose the immersion in a virtual reality. In virtual reality, a panoramic view is joined by sensor-motor exploration of an image space that gives the impression of a "living environment". Interactive media have changed our idea of the image into one of multi-sensory interactive space of experience with a time frame, notes O. Grau (2004). "The majority of virtual realities that are experienced almost wholly visually seal off the observer hermetically from external visual impressions, appeal to him or her with plastic objects, expand perspective of real space into illusion space, observe scale and colour correspondence, and use direct light effects to make the image appear as the source of the real. The expression "virtual reality" is a paradox, a contradiction in terms, and it describes a space of possibility or impossibility formed by illusionary addresses to the senses. Virtual reality is in essence immersive" (Grau, 2004, 15). If we follow these ideas, we must agree that dynamic images within didactic tools foster different reactions and responses than static images.

In spite of the fact that moving images suppose »realistic« elements connected with the perception of space, many authors (Mayer, 2003, Schnotz and Bannert, 2003, Lewalter, 2003) think that in many cases they do not foster improvement in learning because they cannot replace the value of other spatial-visual representations like schemas in the case of learning contents about the nature of features that show systemic organizations.

In fact, it is possible to ground the inquiries on the ways learning will presumably change within investigations such as those recently held by D. Lewalter, who questions the assumption that animations result in better learning than static pictures and examines whether the two kinds of visual displays lead to different cognitive processing. She argues that the difference between their respective cognitive processing demands is twofold. On the one hand, directly supporting the construction

of a dynamic mental model through an animation may reduce the load of cognitive processing. On the other hand, the transitory nature of dynamic visuals may cause higher cognitive load because learners have less control of their speed of processing (2003).

With our research, we wished to understand the impact different kinds of images – dynamic and static images - produce on pupils' motivation and their acquisition of knowledge about visual art concepts from this perspective. We tried to understand what are the basic structure procedures that should be taken into account when implementing such didactic means in the process of teaching and learning within visual art education and which are the keys for their application in creative visual art expression. We departed from the idea that pupils' activities should be guided to acquiring knowledge about visual art concepts, as cognition is the condition for the rearrangement of "the visually perceived world" to meaningful visual signs. This should lead pupils to new discoveries, depiction of their own feelings and wishes, and spontaneous upgrade of their experience.

About the research

Being the development of spatial perception and of the ability of its representation one of the most important goals of visual art education, we tried to analyse the influence of different kinds of images – dynamic (images in movement with relatively high speed) or static when used as didactic tools in the development of pupils' spatial perception and its expression through their art works.

Methods

The research was planned for the specific field of drawing within visual art education. It included 143 randomly chosen 12-year old pupils (7th grade elementary school). The experimental research was designed as an experiment with departments for comparison: an experimental group, in which pupils were introduced with the contents of the lesson using moving images, and a control group, where we used static images (Sagadin 2003).

Two types of data were collected: an initial testing, where we tried to establish the characteristics of each pupil concerning spatial perception and the development of the ability of space representation, and the elaboration of a practical art work from drawing.

The initial testing consisted of the realization of a drawing by observation with the motif of an open space and the title "Looking through the window". The evaluation schema included a scale of three grades - very successful, successful and less successful regarding the characteristics of every drawing. It focused on five to-

pics, cues to define the characteristics of every drawing concerning spatial representation (the ability to represent spatial depth): reduction of sizes of represented elements in the direction of spatial depth, reduction of details in the represented elements, reduction of contrasts in the represented elements, cover of the elements that are located in distant plans of the image by the elements in first plan, representation (or not) of the ground line, properly drawn perspective. For every topic the higher mark was 5 points which means that the highest possible mark that a pupil could get was 25 points considering the whole test. Pupils that got from 25 to 19 points were classified as "very successful", the ones that got from 10 to 18 points were classified as "successful" and the last group, with marks that ranged between 1 and 9 points was regarded as "less successful". For the purpose of documentation of evaluation, special formularies were prepared with the explanation of the three elaborated categories to classify the works. The art works were examined using the same schema and according to precise instructions by three independent evaluators to guarantee high objectivity in the evaluation.

The average results of the initial testing were as follows: 20% of the tested pupils were recognized as very successful, 64% as successful and 16% as less successful. On the basis of the initial testing, we formed groups considering three different levels in their abilities to represent spatial organizations through two dimensional art works. The initial testing also allowed us to verify that the populations from the experimental and control groups shared the same general characteristics, so that it would be possible to detect differences when applying the experimental conditions.

In general, it was possible to note that the pupils regarded as "very successful" fulfilled the five conditions but there was a clear difference if we compare their works with the rest. Properly drawn perspectives and reductions of contrasts in the represented elements in the direction of spatial depth were especially stressed in their works. As Lowenfeld and Brittain state that at this age, there is a tendency to define a representation that is every day more related to nature (1966).

In spite of the fact that they were regarded as "less successful", the works of these pupils showed that at their age, there is a general developmental tendency to abandon the representation of the ground line and to represent the elements in first plan "covering" the elements that are located in distant plans of the image. The "successful" pupils added to these characteristics their preoccupation for the reduction of sizes and details of represented elements in the direction of spatial depth.

In the second phase, and with a difference in time of two weeks, we asked pupils to make a drawing according to the same given task as in the first case: drawing the same view with the motif of an open space and the title "Looking through the window". This time, pupils in control groups were shown a static series of images of an open space; in experimental groups pupils were shown a video with the same images linked in a dynamic (moving) sequence and with sounds. In both departments

we used these images to introduce pupils into the cues to represent spatial depth in a drawing. In this case pupils could draw the chosen motif either from memory or by observation.

Every drawing from each of the three groups was again evaluated by three independent evaluators according to the same instructions used in the initial testing. The results of the evaluation were compared conducting an analysis of variance which allowed us to confirm the differences in the results of comparison in the experimental and control groups.

It is important to stress the fact that our intention was not to make a comparison between pupils' works but to establish the differences in the work of each pupil regarding the influence of the didactic tool used for the introduction of the class.

Results and discussion

In the experimental groups the results of the second evaluation were as follows: in the group of the pupils regarded as very successful, 60% got higher marks than in the initial testing and 40% got the practically the same marks as in the first testing; in the group of the pupils that were regarded as successful, 78% got higher marks, 12% got the same and 10% got lower marks than in the initial testing; in the group regarded as less successful, only 10% got the same marks as in the initial test, 15% got higher marks while 76% got lower marks than in the initial test (Figure 1).

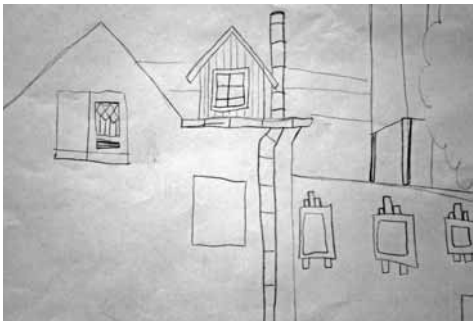
In the control groups the results were as follows: in the group of the pupils regarded as very successful, 65% got higher marks than in the initial testing and 35% got the same; in the group of the pupils that were regarded as successful, 70% got higher marks, 30% got the same marks as in the initial testing; in the group regarded as less successful, 42% got the same marks as in the initial test while 58% got higher marks than in the initial test (Figure 2).

First drawing
Dynamic images, very successful

Second drawing

First drawing
Dynamic images,
very successful

Second drawing



First drawing
Dynamic images, less successful

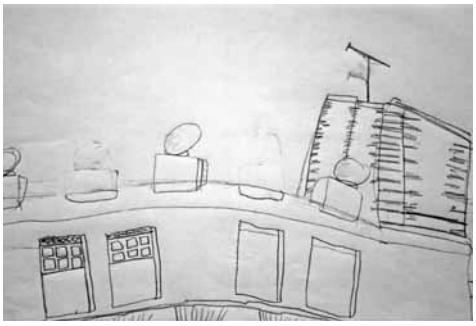
Second drawing

Figure 1: Examples of pupils' works in the experimental group: the first drawing is presented on the left side, the second drawing produced by the same pupil after the use of dynamic didactic means is presented on the right side.

First drawing
Static images,
very successful

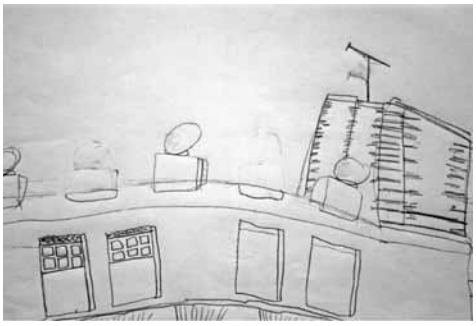
Second drawing

Figure 2: Examples of pupils' works from the control group: the first drawing is presented on the left side, the second drawing produced by the same pupil after the use of static didactic means is presented on the right side.



First drawing
Static images, successful

Second drawing



First drawing
Static images, less successful

Second drawing

As a result we confirmed that pupils in the experimental group were in general more motivated for the resolution of the practical work than their peers in control groups. While pupils from the advanced level ("very successful in spatial representation") did not show important differences if we compare the results from experimental and control groups, the works from pupils belonging to the second group ("successful in spatial representation") showed more detailed drawings in the case of the use of dynamic didactic means (Figure 1). It is interesting to note, that while there were no regressions in the marks of the pupils in control group, there was a difference of 8% on the side of higher marks got by pupils in experimental groups but at the same time, also 10% got lower marks than in the initial testing. In spite of the fact that these figures do not represent an important improvement we could at least conclude that the influence of high speed dynamic images is not unidirectional but depends on many factors probably linked to specific and individual elements regarding the personality of each pupil. This includes issues of cultural tradition, familiarity with dynamic representations of space and such dynamic "environments" etc.

In the case of the less talented pupils, the results showed an important difference: the works showed an improvement in the case of the groups that worked with static images while dynamic images evidently produced a kind of insecurity that did not allow the free development of pupils' expression. The evaluators decided that there was quite an important improvement as far as pupils that used static images (control groups) showed more accuracy in using spatial cues and their drawings had more properly drawn details than in the case of the initial testing (Figure 2).

The use of new technologies influences the acquisition of knowledge about visual art concepts and their application in visual art expression regarding the cognitive functioning – knowledge of visual art concepts, understanding art concepts in the frame of visual art education tasks and their use in visual art expression, analysis and synthesis of visual art concepts and critical evaluation of the results. The cognitive development of pupils also influences successful emotional, social and aesthetic development as well as the psychomotor development of manual skills. That is why a combination with traditional work (in our case, drawing with traditional materials) was necessary in order to make the translation from the virtual to the actual world. The abundance of "virtual-visual information" must not prevent pupils from rich experiences with the other senses, especially when connected with artistic facts.

The use of the dynamic images is a motivating element within the framework of traditional school because it is interesting and surprising. It also fosters the critical evaluation of the information. We should not forget that new technologies also allow going back and reviewing the material as frequently as needed, promote comparisons and evaluation and produces a high degree of independence, originality and

individual compromise, since every individual must find him/herself involved in practical search to get information.

Conclusion

The drawings from the experimental and control groups differed in their treatment of three-dimensional representation. We could conclude that it is extremely important to plan with adequate didactic tools, taking into account the aims we wish to achieve from visual art education lessons: dynamic images foster a unique lived experience of space but they can also create oppression, insecurity and negative feelings, especially in pupils that find it difficult to express themselves in terms of two dimensional representations of space.

The traditional dimensions of learning are still present in our practices, but at the same time we investigated alternative concepts. Old paradigms based on technical skills, encyclopaedic knowledge, and mere self-expression does not respond to the demands of society now. New technologies bring an entirely new range of experiences and possibilities. These transformations affect the way we approach and learn about visual arts. It is important to approach art education from critical perspectives regarding the complexity of the "visuality" deeply integrated in current, everyday life. Not only are we all bombarded with visual images, but we must respond to them at every step, making decisions that involve creativity, originality, spatial visualization, motivation, and imagination. The abundance of "visuality" must not prevent us from rich experiences with the other senses, especially when connected with visual facts. This becomes even more important if we consider the individuality of each pupil, his/her necessities, affinities, cultural background, gender etc.

The sensorial experiences of sight, hearing, touch and their combinations are limited in cyberspace (Musil, 2001). In fact, the evolution of media technology tends to present things as realistic as possible; however, physical interaction is not possible, as well as the inclusion of non-verbal signs like body language or the "real" context of the sensorial experience (Crary 2001). That is why the multi-sensory orientation of material culture studies instead of visual culture is congruent with contemporary trends in arts and culture and will permit art educators to facilitate the aesthetic imagination necessary to engage and to participate in contemporary arts and cultural experiences, using hybrid methods and environments when teaching and learning in a specifically holistic way (Blandy and Bolin, 2003).

This is evidently a time of intensive development of new paths in art education, as shown by the fact that many authors promote the expanding field of material culture studies as a viable theoretical foundation and practical direction for art educa-

tion. Challenging the current shifting stance of art education toward accepting a position of visual culture, these authors argue that rather than adopt a visual culture perspective, art education would be more readily served by embracing far-reaching holistic forms and practices that can be critically examined through the interdisciplinary, multidisciplinary, and trans-disciplinary methods associated with material culture studies. Evidence suggests that orientations to educating people about the arts and culture that are vision centred or focus only on traditional arts disciplines will fail pupils by preparing them in a much too myopic manner (Crow 2006). The multi-sensory orientation of material culture studies is congruent with contemporary trends in arts and culture and will permit art educators to facilitate the aesthetic imagination necessary to engage and to participate with contemporary arts and cultural experiences, as well as appreciating and understanding the history of arts and culture in a much more holistic way (Blandy and Bolin 2003). In our research we supported these ideas as far as we could in trying to demonstrate the relativity of the importance of "vision" if it is taken as the only element that can foster improvements in the development of space representation and putting aside a holistic conception of perception.

The results of this research support the assumption that important information for developing new learning environments in the context of a rapidly changing world is obtained if we focus our research expectations not only on the numeric survey results but also on the qualitative data to examine how pupils react in certain learning contexts.

Art education might be a way to promote learning experiences, develop understanding and create holistic representations of the world, as well as creative and critical thinking through aesthetic dimensions. The aesthetic dimension is a unique process of cognition that can be developed by art education and exploited by other fields in the school context (Swift and Steers 1999). In effect, a global understanding of our past as well as our contemporary world demands this set of complex elements and rich "connecting experiences," which should be one of the principal objectives of education at all levels.

DALJŠI POVZETEK

Svet vizualnih medijev in informacij danes neizogibno odpira nekaj zanimivih in pomembnih vprašanj na področju vzgoje in izobraževanja, posebno pa pri likovni vzgoji.

Večina učencev je v dnevnem stiku z računalniki, ki ponujajo veliko možnosti uporabe in porajajo različne izkušnje, ki so posebno doživetje ob zaznavi prostora. Izkušnja uporabe multimedijskih sredstev, ki jo vsak učenec »prinese s seboj« v šolo, je izredno pomembna. Pri likovni vzgoji imamo večkrat opravka z možnostjo ustvarjanja in uporabe didaktičnih sredstev z animacijami oz. dinamičnimi (gibljivimi) slikami, ki v navidezni resničnosti dajejo vtis »živega okolja«. Izraz multimedia se nanaša na kombinacijo več tehničnih sredstev z namenom predstavitve informacij različnih oblik preko različnih čutnih načinov. Kljub domnevi, da dinamične slike predstavljajo percepcijo prostora, ki je »realistična« in blizu dejanski izkušnji treh dimenzij, mnogi avtorji (Mayer, 2003; Schnotz in Bannert, 2003; Lewalter, 2003) menijo, da v mnogih primerih ne spodbujajo izboljšanja učenja, saj ne morejo nadomestiti vrednosti drugih prostorsko-vizualnih predstavitev, kot so sheme v primeru učnih vsebin o zadevah, ki so sistemsko organizirane.

Ker je razvoj prostorskega dojemanja eden najpomembnejših ciljev likovne vzgoje, smo analizirali vpliv didaktičnih pripomočkov z uporabo dinamične in statične slike na razvoj prostorskih predstav in razumevanja likovnih pojmov pri učencih. Raziskava je bila načrtovana na področju risanja. Vključevala je 143 naključno izbranih 12-letnih učencev (7. razred osnovne šole). Zasnovana je bila kot eksperiment s primerjalnima skupinama: eksperimentalno skupino, v kateri so bili učenci seznanjeni z vsebino pouka z uporabo dinamične slike, in kontrolno skupino, kjer smo uporabili statične slike.

Po začetnem testiranju smo oblikovali skupine glede na tri različne ravni sposobnosti: zelo uspešno, uspešno in manj uspešno – glede na značilnosti organizacije predstavitve prostora na dvodimenzionalni površini pri vsaki risbi. Učence eksperimentalne skupine smo seznanili z vsebino pouka z uporabo dinamičnih slik, medtem ko smo v kontrolni skupini uporabili statične slike. Učenci so morali narediti risbo z uporabo prostorskih ključev.

Likovna dela smo vrednotili z uporabo iste sheme in v skladu z natančnimi navodili. Sodelovala je skupina treh neodvisnih ocenjevalcev, da smo zagotovili visoko objektivnost pri vrednotenju.

Rezultati začetnega testiranja so bili naslednji: 20 % testiranih učencev je bilo zelo uspešnih, 64 % uspešnih in 16 % manj uspešnih. Na podlagi začetnega testiranja smo oblikovali skupine glede na tri različne ravni njihove sposobnosti pred-

stavljanja vidnega prostora v risbi. V drugi fazi, ki je potekala dva tedna kasneje, smo učence prosili, da izdelajo novo risbo z enako nalogo kot v prvem primeru: risanje pogled z motivom odprtega prostora po opazovanju. Rezultati druge naloge so bili naslednji: 60 % učencev, ki so bili prvič zelo uspešni, je dobilo višje ocene kot v začetnem testiranju. Med uspešnimi učenci jih je 78 % dobilo višje ocene kot na začetku. V skupini manj uspešnih je 10 % učencev dobilo isto oceno kot pri prvem preizkusu, 15 % jih je dobilo višje ocene, 76 % učencev pa je dobilo nižje ocene kot pri prvem preizkusu. V kontrolni skupini so bili rezultati naslednji: v skupini učencev, ki so bili manj uspešni, jih je 42 % dobilo enako oceno kot pri prvem preizkusu, medtem ko jih je 58 % dobilo višje ocene kot pri prvem preizkusu.

Po zaključku raziskave smo lahko sklepali, da vpliv hitrosti oz. dinamične podobe ni enosmeren, ampak je odvisen od mnogih dejavnikov, povezanih s posebnostjo osebnosti vsakega učenca. Medtem ko se med učenci napredne ravni niso pokazale razlike, so v drugi skupini v primeru uporabe dinamičnih slik učenci izdelali risbe z več podrobnostmi. Med manj nadarjenimi učenci so rezultati pokazali razliko: izboljšanje v primeru uporabe statične slike, medtem ko so dinamične podobe sprožale negotovost, ki ni omogočala svobodnega izražanja učencev. Potrdili smo, da je pomembno uporabiti ustrezne didaktične pripomočke, pri čemer moramo upoštevati cilje, ki jih želimo doseči: dinamične podobe spodbujajo edinstveno doživetje prostora, vendar pa lahko porajajo negotovost in negativna čustva pri učencih, ki se težko izražajo z risbo.

Ključne besede: nove tehnologije, novi mediji, didaktični pripomočki, statične in dinamične slike, risba

BIBLIOGRAPHY

Beckman, J. (1998). *The Virtual Dimension*. New York: Princeton Architectural Press.

Blandy, D., Bolin, P. E. (2003). Beyond Visual Culture: Seven Statements of Support for Material Culture Studies in Art Education. *Studies in Art Education*, Vol. 44, Number 3, Spring 2003. Reston: National Art Education Asociation, 246-263.

Crary, J. (2001). *Suspensions of Perception - Attention, Spectacle, and Modern Culture*. Cambridge, Massachusetts: MIT Press.

Crow, D. (2006). *The Cultural Shift from Words to Pictures*. Worthing/West Sussex: AVA Publishing SA.

Grau, O. (2004). *Virtual Art. From Illusion to Immersion*. Cambridge - Massachusetts, London: The MIT Press.

Lewalter, D. (2003). Cognitive Strategies for Learning from Static and Dynamic Visuals. *Learning and Instruction*, Vol. 13, Number 2, April 2003. Amsterdam: Elsevier Science Ltd., 177-190.

Lowenfeld, V., L. Brittain, W. (1966). *Creative and mental growth*. London: Collier-Macmillan Limited.

Mayer, R. E. (2003). The Promise of Multimedia Learning: Using the Same Instructional Design Methods across Different Media. *Learning and Instruction*, Vol. 13, Number 2, April 2003. Amsterdam, Elsevier Science Ltd., 125-140.

Musil, B. (2001). Kiberpsihologija – Psihologija Kiberprostora: Intrapersonalni in Interpersonalni Pojavi. *Anthropos*, 33, 4-6 (2001), 353-370.

Sagadin, J. (2003). *Statistične metode za pedagoge.* Maribor: Obzorja.

Schnotz, W., Lowe, R. (2003). External and Internal Representations in Multimedia Learning. *Learning and Instruction,* Vol. 13, Number 2, April 2003. Amsterdam: Elsevier Science Ltd., 117-124.

Schnotz, W., Bannert, M. (2003). Construction and Interference in Learning from Multiple Representations. *Learning and Instruction*, Vol. 13, Number 2, April 2003. Amsterdam: Elsevier Science Ltd., 141-156.

Swift, J., Steers, J. (1999). A Manifesto for Art in Schools. *Journal of Art and Design Education,* 18 (1), 7-13.

Virilio, P. (2000). *A Landscape of Events.* Cambridge: The MIT Press.