Critical Thinking as a Dimension of Constructivist Learning: Some of the Characteristics of Students of Lower Secondary Education in Croatia

Tomislav Topolovčan*[1] and Milan Matijević[2]

The aim of this study was to examine the characteristics of the frequency of constructivist learning and its dimensions, including critical thinking, the differences in them with regard to certain demographic characteristics, and correlations with the frequency of use of certain new media in teaching students in the final grade of lower secondary education in Croatia (N = 703). The results show that students assessed a significantly higher incidence of critical thinking in relation to the other four dimensions of constructivist learning. In respect of every latent dimension of constructivist learning, (all) students with higher grade point averages are inclined towards a higher assessment of the frequency of the personal relevance of learning, critical thinking, and collaborative learning. Girls are more likely to highlight the personal importance of studying, critical thinking, and student negotiation, while there is no difference in the assessments regarding gender in the control of studying and the uncertainty of learning with new media. Students, regardless of where they live, assess the incidence of general constructivist learning equally, also in regard to each dimension, i.e. the personal relevance of learning, the uncertainty of learning (with new media), critical thinking, shared control, and collaborative learning. The frequent use of new media is associated with the increased incidence of all the dimensions of constructivist learning. An interpretation of the results indicates that critical thinking is by far the most prominent dimension of constructivist learning, whereby the gender of students and their grade point average are, to some extent, key factors in the differences in critical thinking, but also in most other dimensions of constructivist learning. This paper explains in detail the didactic implications of its research results.

Keywords: new media, constructivist learning, critical thinking, secondary education, students

1 *Corresponding Author. University of Zagreb, Faculty of Teacher Education, Croatia; tomislav.topolovcan@ufzg.hr.

2 University of Zagreb, Faculty of Teacher Education, Croatia.

Kritično mišljenje kot dimenzija konstruktivističnega učenja: nekatere značilnosti učencev predmetne stopnje osnovne šole na Hrvaškem

Tomislav Topolovčan in Milan Matijević

Namen raziskave je bil preučiti značilnosti konstruktivističnega učenja in njegovih dimenzij, vključno s kritičnim mišljenjem, ugotoviti razlike med dimenzijami glede na določene demografske značilnosti in njihovo povezanost s pogostostjo uporabe določenih novih medijev pri poučevanju učencev v zadnjem razredu osnovne šole na Hrvaškem (N = 703). Rezultati kažejo, da so učenci kritično mišljenje ocenili statistično pomembno višje glede na preostale štiri dimenzije konstruktivističnega učenja. Glede na vsako latentno dimenzijo konstruktivističnega učenja se (vsi) učenci z višjimi povprečnimi ocenami nagibajo k višjemu ocenjevanju pogostosti osebne pomembnosti učenja ter kritičnega in sodelovalnega učenja. Dekleta pogosteje poudarjajo osebni pomen učenja, kritičnega mišljenja in lastnega soočanja z njim, medtem ko pri nadzorovanju učenja in negotovosti pri učenju z novimi mediji med spoloma ni statistično pomembnih razlik. Učenci – ne glede na to, kje živijo – enako ocenjujejo stopnjo splošnega konstruktivističnega učenja, tudi glede na vsako dimenzijo, tj. osebni pomen učenja, negotovost učenja (z novimi mediji), kritično mišljenje, deljeni nadzor in sodelovalno učenje. Pogostost uporabe novih medijev je povezana s povečano pogostostjo ocenjevanja vseh dimenzij konstruktivističnega učenja. Interpretacija rezultatov kaže, da je kritično mišljenje daleč najpomembnejša dimenzija konstruktivističnega učenja, pri čemer sta spol učencev in njihova povprečna ocena do določene mere ključna dejavnika pri razlikah v kritičnem mišljenju pa tudi pri večini preostalih dimenzij konstruktivističnega učenja. Prispevek natančno pojasnjuje didaktične posledice raziskovalnih rezultatov.

Ključne besede: novi mediji, konstruktivistično učenje, kritično mišljenje, predmetna stopnja, učenci

Introduction

The projects of many creative and innovative teachers at the beginning of the 20th century were in line with constructivist teaching. The misconception that those who know (teachers) can transfer knowledge to those who do not know (students) by lecturing and demonstration faced great competition in a new didactic scenario in which students became active subjects who research, discover, solve problems, collaborate, and think critically about everything they do and learn. Students ask questions and seek answers. They learn individually and in small groups. Instead of lecture rooms, schools had classrooms, laboratories, and workshops. This happened at the end of the 19th century and during the first decades of the 20th century. World War II halted all these revolutionary events in Europe, but in the USA the trend of change in class and schools continued (for more, see Skiera, 2010).

In contrast to the intellectualist school of the 19th century, John Dewey (1859-1952) proposed a school in which children learn through independent work and research in immediate reality. School was seen as needing to satisfy children's natural interests for learning and becoming acquainted with the world that surrounds them. Learning was to be based on the student's opinion and other activities. Instead of lecture rooms, he insisted on learning in workshops, in the kitchen, laboratory, library, in the schoolyard, or in a school garden or an orchard. With such didactic scenarios, a student can compare, think, and conclude. It can be said that Dewey was among the first pedagogues to clearly point out and explain the importance of a student's opinion and learning by discovering and solving problems. In the USA, he was joined by Kilpatrick and Helen Parkhurst.

From the history of pedagogy and didactics, it is clear that critical thinking is an essential element of learning and teaching, especially in the movements of reform pedagogy (Oelkers, 2010; Skiera, 2010). Critical thinking was considered important as a process of learning, but the question was to what extent it was to be taught (Huber & Kuncel, 2015). Critical thinking is not easy to define (Huber & Kuncel, 2015; Lai, 2011), which is partly because it can be approached from various directions (Lai, 2011; Sternberg, 1986).

Critical thinking can be explained from three points of view: philosophical, psychological, and educational, or didactic (Lai, 2011; Lewis & Smith, 1993; Sternberg, 1986). From the philosophical point of view of critical thinking, Lai (2011) summarises the definitions of various authors. From the philosophical perspective, critical thinking can be defined as 'reflective and reasonable thinking that is focused on deciding what to believe or do' (Ennis, 1985, p. 45), "judging in a reflective way what to do or what to believe' (Facione, 2000, p.

61), 'the propensity and skill to engage in an activity with reflective skepticism' (McPeck, 1981, p. 8), and 'thinking aimed at forming a judgment' (Baillin et al., 1990; Ennis, 1985; Facione, 2000; McPeck, 1981, according to Lai, 2011). From the perspective of philosophy, critical thinking is seen as the ability to assess and take a stand or form a belief, while from the psychological standpoint, it is also something that an individual is capable of doing. In other words, it is the relationship between what individuals think and what they are ready to do (Sternberg, 1986).

In this respect, Lai (2011) points out that critical thinking, from a psychological point of view, can be defined as 'the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts' (Sternberg, 1986, p. 3), 'the use of those cognitive skills or strategies that increase the probability of a desirable outcome' (Halpern, 1998, p. 450) and 'seeing both sides of an issue, being open to new evidence that disconfirms your ideas, reasoning dispassionately, demanding that claims be backed by evidence, deducing and inferring conclusions from available facts, solving problems, and so forth' (Willingham, 2007, p. 8; Halpern, 1998; Sterneberg, 1986; Willingham, 2007, according to Lai, 2011). The third approach or tradition of critical thinking is educational, i.e. didactic. Although it is known that critical thinking has a long tradition in European didactics, in this respect, it is based on the known taxonomy of the cognitive goals of B.S. Bloom. Thus, according to Lai (2011) and Sternberg (1986), the final three levels of cognitive goals, i.e. to analyse, evaluate, and synthesise, are considered critical thinking. In addition to certain imperfections of critical thinking as conceived in this way, Sternberg (1986) emphasises that the advantage of the didactic approach is that it can be considered to be based on teaching and learning. Although philosophical, psychological, and didactic approaches offer different concepts of critical thinking, Lai (2011) summarised the main mutual elements, that is, some of the features of critical thinking. These features include analysing arguments, interventions based on inductive or deductive reasoning, assessing, evaluating and decision making, and problem solving (Case, 2005; Ennis, 1985; Facione, 1990; Halpern, 1998; Lipman, 1988, Paul, 1992; Tindal & Nolet, 1995; Willingham, 2007, according to Lai, 2011).

With various traditions and approaches to critical thinking, one of the main questions is defining the construct of critical thinking. The traditional approach to this construct defines it as a broad capacity to interpret information and finding the exact way to approach a problem, being applicable to a wide range of problems and situations. This approach is criticised due to the question of whether critical thinking manifests itself as an analysis of arguments,

and whether critical thinking is applicable in different areas. In other words, whether critical thinking is applicable in all areas of an individual's activity, or if it is only tied to certain specific activities, work, and domains (Kuncel, 2011). In this respect, a question is also raised about whether critical thinking is 'transferrable' from one area to another (Huber & Kuncel, 2015).

The two approaches to conceptualising critical thinking and putting it into operation are also tied to this. The first approach is one that defines critical thinking as a predisposition, while the second sees critical thinking as a skill (for more, see Huber & Kuncel, 2015). For these two concepts of critical thinking, special tests for its measurement have been formed. For critical thinking as a predisposition, the *California Critical Thinking Disposition Inventory* (CCTDI) is used, while for critical thinking as a skill, the *California Critical Thinking Skills Test* (*CCTST*) (Huber & Kuncel, 2015) is employed.

Irrespective of whether critical thinking is a predisposition or a skill, whether it focuses on a wide range of areas or on a specific one, in the educational, i.e. didactic context, one of the important questions is whether it can be taught, that is, whether one can be taught to think critically (Huber & Kuncel, 2015). With this in mind, Hattie (1982, according to Huber & Kuncel, 2015) claims that learning is not a predictor of critical thinking. In contrast, Huber and Kuncel (2015) indicate that it is possible to teach and learn critical thinking. Several more questions arise in relation to the claim that critical thinking can be taught and learned. These questions relate to whether critical thinking is developed by formal education or informal learning, whether there are changes in the extent of learning during education and whether changing the educational content in the curriculum can be considered a meaningful factor in developing critical thinking (according to Huber & Kuncel, 2015).

Regardless of these dilemmas, and taking into consideration some of the mutual features of critical thinking (Lai, 2011; Sternberg, 1986), both as a predisposition and a skill, it is justified from the didactic point of view to claim that, for the development of students or for eventual teaching and learning, it is necessary to have a student-centred approach. This confirms what reform pedagogues have claimed: it is the students' activity that is important. In other words, the constructivist class represents a significant contribution to teaching and developing critical thinking. Accordingly, Taylor, Fraser and Fisher and their associates (Kim, Fisher & Fraser, 2006; Taylor, Fraser, & White, 1994; Taylor, Fraser, & Fischer, 1997) conceived and defined the concept of constructivist learning in this way, in which one of its dimensions is critical thinking. Constructivism cannot be defined and explained from just one scientific standpoint (Philips, 1995). Different approaches, for example, the sciences of sociology,

biology, philosophy, neuroscience, cognitive psychology, and systems theory, implement it in their starting framework and interpret it accordingly (Philips, 1995; Terhart, 2003). Constructivism can be explained as a philosophical (ontologically and epistemologically), psychological and didactic approach or theory (Kanselaar, de Jong, Andriessen, & Goodyear, 2002).

From the didactic point of view, constructivist learning can be defined as a self-regulated, non-linear, and interpretive process of building knowledge, supported by interaction with one's surroundings (Fosnot & Perry, 2005, pp. 34). In other words, it is not possible to transfer or teach knowledge to someone, but it is the individual who constructs their own knowledge based on their foreknowledge, emotional state, and own (critical) thinking, in interaction and communication with other people or in using objects. Therefore, as features of constructivist learning, the following can be noted (Boethel & Dimock, 2000, according to Yilmaz, 2008, pp. 167–168):

1. learning is an active process;
2. learning is an adaptive activity;
3. learning is situated in the context in which it occurs;
4. knowledge is not innate, passively absorbed, or invented but constructed by the learner;
5. all knowledge is personal and idiosyncratic;
6. all knowledge is socially constructed;
7. learning is essentially a process of making sense of the world;
8. experience and prior understanding play a role in learning;
9. social interaction plays a role in learning; and
10. effective learning requires meaningful, open-ended, challenging problems for the learner to solve.

With such defined and characterised constructivist learning, the teacher has a different role from that in a teacher-centred classroom. The teacher is no longer a person who possesses knowledge and then transfers it to students (since the starting point consists of different ontological and epistemological assumptions), but is a co-constructor of the students' knowledge. From this point of view, the concepts of learning and teaching are separated, since it is possible to learn without teaching, to learn while being taught (in class), to teach without triggering the process of learning, and to learn what is not explicitly taught (hidden curriculum). Concentrating solely on the terms of the learning environment, and starting from it as the focus of the mutual activity of students and the teacher (Bognar & Matijević, 2005), teaching means organising the activities of learning through which students will, by performing

activities connected with a certain content, individually or cooperatively, form their own knowledge. With this in mind, the features of constructivist learning are those that provide (Herrington, Oliver, & Herrington, 2007):

1. authentic contexts that reflect the way knowledge will be used in real life;
2. authentic activities;
3. access to expert performances and the modelling of processes;
4. multiple roles and perspectives;
5. the collaborative construction of knowledge;
6. opportunities for reflection;
7. opportunities for articulation;
8. coaching and scaffolding; and
9. authentic assessment.

With such defined features of constructivist learning, some features of encouraging critical thinking can be recognised. These derive mostly from the standpoint of the multiple roles and perspectives of certain learning content and activities and reflection that encourage the forming of abstract terms. Such defined features of constructivist learning are to a certain extent analytically set. From the didactic point of view, synthesising all the mentioned features allows us to point to certain learning strategies which unite all constructivist features. We can thus consider (Topolovčan & Matijević, 2016; Topolovčan, Rajić, & Matijević, 2017):

1. inquiry-based learning;
2. problem-based learning;
3. project-based learning;
4. cooperative learning;
5. play-based learning; and
6. learning-by-doing.

These learning strategies are not new. Didactic and pedagogical history tells us that they were formed over a hundred years ago in the directions and movements of reform pedagogy. It is important to emphasise that neuroscientific research confirms the features of constructivist learning (e.g. Hermmann, 2009; Sprenger, 1999) and, therefore, also confirms the didactic value of the directions and movements of reform pedagogy (e.g. Skiera, 2010). By analysing and summarising all the mentioned features of constructivist learning in more detail, it can be emphasised that constructivist learning, i.e. constructivist didactics, is essentially a didactic of lifelong learning.

In terms of the development and role of computer technologies in education, it is justified to say that this research area in education has been one of the most dynamic in the last four decades (Tamim et al., 2011). According to Tamim et al. (2011), many primary empirical studies on the role of digital media in education have been carried out in the last forty years; based on them, in the last 30 years or so, more than sixty meta-analyses have been conducted. This number of meta-analyses has led to second order analyses based on them, which constitute a meta-analysis of meta-analysis (Tamim et al., 2011).

These meta-analyses have shown that in the 1970s and 1980s there was a euphoric view of the role of new media in education (Tamim et al., 2011). That is, computer (new) media were considered the single factor that greatly increased the quality of teaching and the level of achieving the desired outcomes. It could also be claimed that learning and teaching with digital media are equally or even more effective than without it (Schmidt et al., 2009; Torgerson & Elbourne, 2002). From as early as the 1990s, the effect of media decreased significantly, while in the 2000s contrasting results, interpretations, and conclusions arose (Rosen & Salomon, 2007; Tamim et al., 2011). In other words, it was shown that learning with digital media does not have to be more effective than learning without them. Specifically, it was found that new media are not the single factor that increases the quality of learning and raises the extent of achieving the desired outcomes. It was confirmed that learning is a multivariate phenomenon and process in which interrelated factors have important roles, as have digital media. Accordingly, it was shown that the important things for the quality of learning and achieving the desired outcomes are the type of learning outcomes, class content, the individual characteristics of students and teachers (the extent and type of foreknowledge, motivation, mental condition, capacity for using digital media), types of evaluation, and the didactic organisation of learning based on constructivist learning (c.f. Dillon & Gabbard, 1998; Rosen & Salamon, 2007; Tamim et al., 2011; Topolovčan & Matijević, 2016; Topolovčan, Matijević, & Dumančić, 2016).

The value of new media in classrooms is perceived if the new things they offer are analysed more closely. When all the functional novelties are abstracted, what is truly different about what digital media offers in class is digital, simultaneous, and multi-modal transfer, storing and presenting content, executing tasks with the help of digital technology that were (until recently) done manually, and digitally forwarded communication (adapted from: Kanselaar et al., 2002). Thus, it can be claimed that using digital media requires activities that involve the students in cooperation, research, play, etc., and not presentation by the teacher from the front of the classroom. Therefore, the didactic value

of using digital media is the fact that they enable inquiry-based and problem-based learning, individualisation of work, situational (contextual) learning, cooperative learning and creative learning, that is, learning-by-doing (Kanselaar, de Jong, Andriessen, & Goodyear, 2002; Schulz-Zander & Tulodziecki, 2011).

The characteristics of all these activities for living and learning in a digital environment are also immanent features of constructivist strategies of learning, such as learning by researching, learning by problem solving, cooperative learning, learning by playing, project learning, and action learning (Topolovčan & Matijević, 2016; Topolovčan, Matijević, & Dumančić, 2016). However, they are also manifest forms of critical thinking. In this regard, critical thinking can be viewed as an integral conceptual and practical element of constructivist learning (Taylor, Fraser, & Fischer, 1997), which can also be stimulated using digital media (Topolovčan & Matijević, 2016; Topolovčan, Matijević, & Dumančić, 2016).

Methodology

Aims

The aim of this research was to examine the features of critical thinking as an integral element of constructivist learning. In this sense, the position of the dimension of critical thinking in relation to other dimensions of constructivist learning as conceived by Taylor, Fraser, and Fisher (1997) was also the subject of examination. Another aim of the research was to find out whether there are differences in the dimensions of constructivist learning, and of critical thinking, given the gender and place of residence of the students, and the correlation with the final grade average of the previous year and the frequency of using certain new media in class.

Sample

The convenience sample comprised students of the eighth grade (N = 703). The sample covered fourteen schools in eight counties of Croatia (Varaždin County, Međimurje County, Koprivnica-Križevci County, Brod-Posavina County, Osijek-Baranja County, Primorje-Gorska Kotar County, Split-Dalmatia County, and the City of Zagreb). In the subsample of students based on gender, there were 334 (47.5%) boys and 369 (52.5%) girls. Considering their residence, 601 (85.5%) students live in a town/city, and 102 (14.5%) in a village. Along with data on gender and residence, one of the attributes of the respondents was the frequency of using new media in class. New media include computers, the internet, mobile phones, multimedia software, smart phones,

tablets, and social networks. The respondents assessed the frequency of using new media: 16.8% of students never use a computer in class, 10.4% use it once a month, 14.9% 2-3 times a month, 15.1% once a week, 18.2% several times a week, and 24.6% of students daily. A total of 11.8% never use the internet in class, 8.7% once a month, 16.4% 2 to 3 times per month, 13.8% once a week, 16.6 % several times per week and 32.7% use it daily. Mobile phones are never used in class by 25.7%, once a month by 9.1%, 2 to 3 times per month by 14.9%, once a week by 8%, several times per week by 10.8% and daily by 31.4% of students. 37% of students never use multimedia software in class, 17.2% use it once a month, 16.6% 2 to 3 times per month, 10.1% once a week, 8% several times per week, and 11.1% use it daily. 57% of students never use tablets in class, 7.8% use them once a month, 10.8% 2 to 3 times per month, 3.3% once a week, 9.1% several times per week and 11.9 % use them daily. 36% of students never use smart phones in class, 7.8% use them once a month, 12.5% 2 to 3 times per month, 8% once a week, 9.8% several times per week and 25.9 % use them daily. Social networks are never used in class by 24.9% of students, once a month by 9.5%, 2-3 times per month by 13.8%, once a week by 9.2%, several times per week by 12.2%, and daily by 30.3% of students. The data were collected in 2014.

Instruments

Data were collected using the pen-and-paper method, in the form of a questionnaire. The first part of the questionnaire comprised demographic data: gender (male/female), residence (city/village), final grade average in the previous year, and the frequency of using a computer, the internet, mobile phone, multimedia software, tablet, smart phone and social networks, measured with a six-point scale (1 = *never*, 2 = *once a month*, 3 = *two to three times per month*, 4 = *once a week*, 5 = *several times per week*, 6 = *daily*). The data on the characteristics of constructivist learning, and with that critical thinking, were collected using the Constructivist Learning Environment Scale (*CLES*) (Taylor, Fraser, & White, 1994; Taylor, Fraser, & Fisher, 1997. This instrument comprises five factors and thirty-five Likert type five-point items (1 = *never*, 2 = *rarely*, 3 = *occasionally*, 4 = *often*, 5 = *almost always*) and every mentioned factor comprises seven manifest statements. The *Personal Relevance* factor refers to the importance of learning as perceived by respondents. The *New Media Uncertainty* factor originally referred to uncertainty in mathematics, but since this factor may relate to any teaching area (mathematics, science, etc.), it can be modified into uncertainty of learning using new media. The *Critical Voice* factor focuses on critical thinking, the multiplicity of perspectives, reflection and selection skills. The *Shared Control* factor refers to the ability to plan learning, participation

in planning educational activities and self-regulated learning. *Student Negotiation* focuses on collaborative learning, understanding, and negotiation about learning activities. With an exploratory factor analysis (PCA, Varimax rotation) (KMO = .917; Bartlett's test of sphericity c^2 = 3207.31; p = .00) and an eigenvalue greater than 1, eight factors that explain 55.98% of the total variance were obtained. The threshold for factor loadings was .40. This kind of structure does not sufficiently replicate the original factor structure of the instrument, so a quasi-confirmatory FA with five factors was carried out.

Table 1
Factor structure of the Constructivist Learning Environment Scale

	Statements	1	2	3	4	5
32.	It's OK to speak up for your rights (CV)	.67				
27.	I'm free to express my opinion (CV)	.66				
21.	It's OK to complain about anything that stops me from learning (CV)	.66				
15.	It's OK to complain about activities that are confusing (CV)	.55				
26.	By using *new media*, I can learn a lot about the world around me (UNM)	.52				
17.	I try to make sense of other students' ideas (SN)	.48				
19.	I get a better understanding of the world outside of school (PR)	.48				
16.	I have a say in deciding the rules for classroom discussion (SC)	.47				
31.	I learn that today's new media is different from the media of long ago (UNM)	.40				
5.	I get the chance to talk to other students (SN)					
22.	I have a say in deciding how much time I spend on an activity					
40.	I have a say in deciding how my learning is assessed (SC)		.68			
34.	Other students explain their ideas to me (SN)		.66			
33.	I have a say in deciding what will be in the test (SC)		.63			
23.	I ask other students to explain their ideas (SN)		.58			
41.	Other students pay attention to my ideas (SN)		.57			
10.	I help the teacher decide how well my learning is going SC)		.57			
4.	I help the teacher to plan what I'm going to learn (SC)		.57			
28.	Other students ask me to explain my ideas (SN)		.52			
39.	I feel unable to complain about anything (CV)		.45			
11.	I talk with other students about how to solve problems (SN)					
37.	What I learn has nothing to do with the world outside of school (PR)			.66		
29.	I feel confused (SN)			.63		
30.	What I learn has nothing to do with my out-of-school life (PR)			.60		
3.	It's OK to ask the teacher 'Why do we have to learn this?' (CV)			.53		
14.	I learn how the *new media* are constructed. (UNM)				-.75	
20.	I learn about various kinds of *new media* used by people in other cultures (UNM)				-.70	
13.	I learn how I can use *new media* outside the classroom (school). (UNM)				-.64	
8.	I learn how the *new media* have changed over time. (UNM)				-.63	
38.	I learn how the *new media* can help me discover many rules in nature. (UNM)				-.42	
25.	I learn about interesting things in the world outside the classroom (school) (PR)					
1.	I learn about the world outside the school (PR)					.73

	Statements	1	2	3	4	5
2.	I learn that the *new media* can give perfect answers. (PR)					.52
9.	I feel free to question the way I'm being taught (CV)					.41
7.	New learning starts with problems about the world outside the school (PR)					
	Eigenvalue	9.12	2.60	1.77	1.56	1.26
	% of explained variance	12.8	9.3	8.72	5.78	5.32

Note. CV = Critical Voice; SC = Shared Control; PR = Personal Relevance; UNM = Uncertainty about New Media; SN = Student Negotiation (the abbreviations for the factors are from the original factor structure).

A quasi-confirmatory five-factor FA explains 46.63% of the total variance (Table 1). The first factor consists of nine items, out of which four are from the *Critical Voice* factor, which is why this is considered the *Critical Voice* factor, although it also contains two items of the *Uncertainty of New Media* factor, and one from the *Personal Relevance* of learning, *Shared Control* and *Student Negotiation* factor. The second factor comprises nine items, of which four are from the *Shared Control* factor; it also consists of four particles from *Student Negotiation* and one from the *Critical Voice* factor, so it is unclear as to what factor can be considered. The third factor consists of four items, of which two are from the *Personal Relevance of Learning* factor, one from the *Critical Voice* and one from the *Student Negotiation* factor. Since two items are from *Personal Relevance*, it can be considered that this structure gravitates towards that factor. The fourth factor is represented by five items from *Uncertainty of New Media*, so this structure gravitates towards the *Uncertainty of New Media* factor. The fifth factor comprises three items, two of which are from *Personal Relevance*, and one is from *Uncertainty of New Media*, so it is unclear which factor can be considered.

Table 2
Descriptive features of the Constructivist Learning Environment Scale

	Subscale	UNM	CV	SC	SN	*N* of statements	*M*	*SD*	*Min*	*Max*	α
1.	Personal relevance	.61**	.48**	.35**	.50**	7	3.24	0.69	1	5	.63
2.	New media uncertainty		.52**	.39**	.50**	7	3.28	0.81	1	5	.78
3.	Critical voice			.47**	.52**	7	3.35	0.77	1	5	.71
4.	Shared control				.62**	7	2.63	0.75	1	5	.72
5.	Student negotiation				1.0	7	3.07	0.74	1	5	.72

Note. CV = Critical Voice; SC = Shared Control; PR = Personal Relevance; UNM = Uncertainty about New Media; SN = Student Negotiation.
*p< .05. **p< .01.

The structure obtained using quasi-confirmatory FA shows that this kind of structure is not sufficient to replicate the original factor structure of the

instrument; therefore, five composite dimensions were constructed with the original number of manifest items of the *Constructivist Learning Environment* scale. The cross correlations of factors are satisfactory (Table 2). Given this, an original factor structure of instruments was implemented.

Statistical data were processed and analysed by means of the SPSS 20.0 software package. Non-parametric tests were used because the data did not meet the criteria for parametric tests, since the data had been collected through a Likert scale (ordinal scale). A Friedman test was used to examine the difference between the dimensions of constructivist learning, a Mann-Whitney U test was used to determine the differences between the dimensions of constructivist learning with regard to gender and place of residence, and a Spearman correlation test was used to examine the correlations.

Results and Discussion

In terms of the research question, if there is a difference in assessing the dimensions of constructivist learning, i.e. if the dimension of critical learning is different than other dimensions, the Friedman test results indicate that there is a statistically significant difference among the dimensions of constructivist learning $\chi 2$ (4, n = 703) = 610,426; $p < .001$ (average values and standard deviations are shown in Table 1). In other words, it was seen that students assess *Critical Voice (Thinking)* (*Mdn* = 3.42) as most the frequent, and after that *New Media Uncertainty* (*Mdn* = 3.28), *Personal Relevance* (*Mdn* = 3.27), *Student Negotiation* (*Mdn* = 3.14) and *Shared Control* (*Mdn* = 2.57). These results are in contrast to some of the previous ones (Taylor, Fraser, & White, 1994; Nix, Fraser, & Ledbetter, 2003), since they indicate that the dimension of *Critical Thinking* is not the most frequent one. Differences among the results could be explained by cultural differences between samples and different teaching practices. They can also be explained by the foreknowledge and experience of the students (which are subject to different teaching practices), because it has been shown that richer learning experience can be important for a higher level of critical thinking. This is also confirmed by the connection between critical thinking and constructivist learning; it has been shown that students with less experience in solving different tasks profit more by learning from direct teaching, as opposed to constructivist learning (Kalyuga, Chandler, & Sweller, 2001). In other words, students with more foreknowledge can learn better in the constructivist way. A similar finding is also claimed by Reid, Zhang, and Chen (2003) and Lee and Chen (2009) who, based on their research, show that more successful students better organise the conditions for constructivist learning.

Although, in contrast, when separately comparing critical thinking and constructivist learning, those two concepts are connected (Bošnjak, 2009).

Table 3
Differences in constructivist learning regarding gender

	Personal Relevance			New Media Uncertainty			Critical Voice			Shared Control			Student Negotiation		
	M	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*
Boys	3.18	.85	3.21	3.29	.85	3.29	3.45	.88	3.42	2.67	.77	2.71	3.07	.88	3.07
Girls	3.29	.68	3.28	3.27	.77	3.28	3.79	.74	3.79	2.59	.72	2.57	3.13	.72	3.14
U	55626.5*			60411.0			52418.0**			58259			55337*		
z	-2.236			-0.452			-3.430			-1.251			-2.342		

Note. *p< .05. **p< .01.

Considering the research question about whether there are differences in the dimensions of constructivist learning regarding gender, the Mann-Whitney U test showed that, in respect of any latent dimension of constructivist learning (Table 3), girls assess that they often pay attention to the personal importance of learning and *critical voice*, while the boys do so occasionally. These results can be interpreted in such a way that, possibly, the girls have higher intrinsic motivation for learning, which then also implies critical thinking. It is also reasonable to explain these results with certain individual cognitive gender characteristics obtained in some studies, interpreted by Zarevski, Matešić, and Matešić (2010). It is also possible that girls have a more pronounced critical voice because they have more prominent verbal, social and communication skills (elements of social constructivism) which may be important for the formation of critical thinking. Indeed, the importance of communication, verbal and social skills confirms the result that girls have more pronounced student negotiation than boys. It can therefore justifiably be recommended that boys be encouraged through student-centred didactic arrangements to develop communication skills and critical thinking that would eventually increase the intrinsic (personal) relevance of learning. In contrast, girls and boys occasionally perceive the uncertainty of new media, control (of learning) and student negotiation in the context of constructivist learning. These (descriptive) results show that constructivist learning and teaching still do not dominate in Croatian schools. The results that there are no gender differences in individual dimensions are in line with the results of Hermans et al. (2008) who claim that there are no differences in constructivist learning. The fact that there are no gender differences is also in line with the results

of neutralising cognitive gender differences (mostly in intelligence), as shown by Zarevski, Matešić and Matešić (2010). This result can also be interpreted by modern cultural-social changes in the perceptions of gender roles and prejudice.

Table 4
Differences in constructivist learning considering residence

	Personal Relevance			New Media Uncertainty			Critical Voice			Shared Control			Student Negotiation		
	M	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*
City	3.24	.71	3.28	3.27	.83	3.28	3,35	.78	3.42	2,63	.76	2.57	3,08	.74	3.14
Village	3.2	.55	3.21	3.33	.65	3.42	3,39	.69	3.42	2,58	.65	2.57	3,05	.69	3.14
U	28745.0			29593.0			30239.0			29483.5			29761.5		
z	-1.008			-0.218			-1.646			-0.617			-0.470		

Note. *$p < .05$. **$p < .01$.

Regarding the research question about whether there are differences in the dimensions of constructivist learning regarding residence (Table 4), the Mann-Whitney U test shows that there are no differences in any dimension. In other words, students who both live in the city and in the village assess the frequency of all dimensions of constructivist learning equally; that is, *personal Relevance, New Media Uncertainty, Critical Voice (Thinking), Shared Control and Student Negotiation,* along with the fact that the *Shared Control* dimension has the lowest assessment. These results imply that there are fewer differences among students from rural and urban areas, which can also be interpreted with the role of informal learning and using new media (Toplak, Topolovčan, & Matijević, 2013), primarily the internet and social networks. These results are encouraging because they indicate that neither the location of the school nor the residence of the students is crucial to the quality of teaching and learning, which to some extent indicates a reduction in geographical differences that has also been identified in some education systems, for example, Finland (Sahlberg, 2012).

Furthermore, regarding the research question about whether there is a connection between the assessment of the dimensions of constructivist learning and the final grade average and the frequency of using computers, the internet, mobile phones, multimedia software, tablets, smart phones, and social networks in the classroom, the Spearman correlation test was used (Table 5). The test shows that students with a higher final grade average are more inclined towards *Personal Relevance, New Media Uncertainty, Critical Voice* and *Student Negotiation* than students with a lower final grade average are. However, there is no correlation

between the final grade average and *Control of Learning.* The fact that students with a higher final grade average are more inclined towards more frequent constructivist learning (and in four dimensions) could be explained and justified if we assume that they have better foreknowledge, but this has no firm theoretical or practical basis from the didactic point of view. However, this result is in line with the statements of Kalyuga, Chandler and Sweller (2001), Hermans et al. (2008), Lee and Chen (2009), and Reid, Zhang, and Chen (2003) who point out that students with better foreknowledge show better constructivist learning. Nevertheless, one should be cautious with such an interpretation, especially because there is no connection between success in school and the *Shared Control* dimension, which can be an indicator of learn-how-to-learn competence. It should also be pointed out that the outcomes of learning should not be measured with conventional instruments for teacher-centred classes (Rosen & Salomon, 2007). Another significant reason for cautious interpretation is that the control of learning is an inner condition of learning while grades are an external motivator and an outer condition of learning (Cindrić, Miljković, & Strugar, 2010), which puts it within the teacher's competence, not the student's.

Table 5
The correlation of frequency of constructivist learning with the frequency of using new media and final grade average

Factors	Grade	Computer	Internet	Mobile phone	Multimedia software	Tablet	Smart phone	Social networks
Personal Relevance	.11**	.11**	.14**	.07	.05	-.02	.09*	.12**
New Media Uncertainty	.08*	.11**	.13**	.07	.15**	.03	.15**	.12**
Critical Voice	.13**	.09*	.11**	.07	.11**	.06	.05	.08*
Shared Control	.04	.12**	.12**	.08*	.15**	.12**	.08*	.11**
Student Negotiation	.14**	.11**	.13**	.07*	.08*	.03	.10**	.11**

Note. *$p < .05$. **$p < .01$.

Spearman's correlation test (Table 5) shows that students with a higher final grade average in school more often assess the personal importance of learning, they doubt certain aspects of the role of new media, they have a critical voice (opinion) and negotiate more often. Furthermore, it shows that the more frequent importance of learning is connected to the more frequent use of computers, the internet, smart phones, and social networks in class. More frequent uncertainty about new media is connected to the more frequent use of computers, the internet, multimedia software, smart phones and social media in class. Critical voice,

that is, more frequent critical thinking, is connected to the more frequent use of computers, the internet, multimedia software and social networks. A more frequent sense of control over the individual's own process of learning is connected to the more frequent use of computers, the internet, mobile phones, multimedia software, tablet computers, smart phones and social networks. More frequent student negotiation is connected to the more frequent use of computers, the internet, mobile phones, multimedia software, smart phones and social networks. These results can be interpreted by the fact that today's students are members of the net generation which means that new media are their everyday tools. Consequently, the results partly confirm the results of other studies (Topolovčan & Matijević, 2016; Topolovčan, Matijević, & Dumančić, 2016).

Conclusion

The results of this research support the following conclusions. Critical thinking, apart from being an integral element of constructivist thinking, is also its most dominant dimension. This implies that it is possible to develop critical thinking with constructivist teaching and learning. Furthermore, it is evident that the place of residence of students (the location of the school) is not an important factor, neither in critical thinking nor in other dimensions of constructivist learning. On the other hand, the gender of students is important: female students are more inclined towards critical thinking, attributing importance to learning and cooperative learning. Although students with a higher final grade average are more inclined to critical thinking and to all the other dimensions of constructivist thinking (except control of learning), it is not possible to claim with certainty that the final grade average itself is significant for such a connection. This is especially so because of the worrying shortcomings of numerical grading. The more frequent use of new media in class, mostly computers, the internet, multimedia software, smart phones, and social networks, is connected to the more frequent constructivist thinking, but also to critical thinking: it is possible to interpret the use of new media as important for constructivist learning, but also for critical thinking, because new media are an integral element of the environment of learning of the net generation. From a theoretical and comparative analysis, a review of recent results of empirical studies, and based on the results of this empirical study, it is evident that critical thinking is an essential element of education. However, it is also indicated that critical thinking cannot be developed through a teacher-centred approach, but rather by means of student-centred classes: constructivist learning, in other words. In this respect, and to obtain more complete results, it would also be desirable to explore critical thinking by comparing primary and secondary education, and then to compare the

students' and teachers' assessments and a range of other factors such as learning styles, desired orientations of learning, computer self-efficacy, etc. Of course, these are the limitations of the current study, but at the same time a recommendation for future research. Based on these results, it is recommended in practice to organise constructivist learning, but also with new media, because in such a way it would be possible, to a certain extent, to develop critical thinking.

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Biographical note

Tomislav Topolovčan, PhD (Educational Science – Didactics), graduate primary education teacher with an additional qualification in Art. Assistant Professor at the Faculty of Teacher Education in Zagreb, where he lectures in Didactics, Media Pedagogy, and Qualitative and Quantitative methods.

Milan Matijević, PhD (Pedagogy), graduate teacher of Pedagogy and Sociology. Professor at the Faculty of Teacher Education in Zagreb, where he lectures in Didactics, Alternative Schools, Methodology of Teaching the Social Sciences, and Methodology of Research in the Social Sciences.