Multimedia Resources in an Online Course: Access and Usage with Respect to Sensory Modality

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Abstract

In this paper we present research on students' perceptual modes and their learning activity with respect to use of multimedia learning resources in a virtual learning environment within an online course. The course content is offered in the form of lessons designed in the Moodle course management system. Lessons contain three different types of resources: textual, pictorial resources accompanied by text, and video resources. Considering the results of the VARK questionnaire, which labels the students' learning styles, i.e. perceptual modes, as visual, aural, read/write and kinesthetic, we investigate the relation between the students' perceptual modes and their learning activity regarding different types of resources. The results show that two out of three students are multimodal regarding their perceptual modality, and that students prefer pictorial resources accompanied by text. The research findings on learners' preferences lead to more effective instructional design in an online learning environment.

Key words: *multimedia learning; perceptual modality; VARK.*

Introduction

Virtual Learning Environment (VLE) is used to handle course-related materials and to conduct online learning activities. Student engagement in a VLE can be a source for a variety of statistical analyses (Castro et al., 2007), for example, simple measurements such as number of access times and time spent per page (Pahl & Donnellan, 2002). Also, reports on user activity can be obtained through time (Monk, 2005).

In a previous research, we examined the relationship between user activity based on log data and their background knowledge (Bago et al., 2011; Lauc et al., 2011). Statistical analysis can indicate access to course materials in order to show user trends, activities and outcomes concerning different knowledge background and formal

education. By analyzing the usage of different multimedia resources, we researched the preferences in using specific types of resources (Kišiček et al., 2013).

Learner preferences are individual responses to a learning environment, based on individual learning style. There are many interpretations and definitions of learning styles. Different perspectives and models have been taken on by researchers in an effort to identify, analyze and label a person's learning style. Instructional and environmental preference models classify learning style from a perspective that considers one's preferences in terms of sensory perception, for example visual, aural, read/write and kinesthetic (Fleming, 2006). Perceptual modalities define biologically based reactions to our physical environment and represent the way we most efficiently adopt data. In this paper, we investigate the relationship between students' perceptual mode, and engagement with different multimedia learning resources offered in a virtual learning environment. We used a sensory model VARK developed by Neil Fleming. It is an acronym for Visual (V), Aural (A), Read/Write (R), and Kinesthetic (K) referring to individual's sensory modality. Fleming (2011) defines a learning style as "an individual's characteristics and preferred ways of gathering, organizing, and thinking about information". The VARK questionnaire is a detection instrument developed within the VARK model and it provides metrics in each of the four perceptual modes, with individuals having preferences from one to all four modes. Fleming reports that about 39% of the population that have completed the online questionnaire have single style preferences, 15% have two preferences, 12 % have three, and 34% have a preference for all four styles (Fleming, n.d.).

Previous Research

Byrne (2002) investigated the relationship between individual learning styles and using effective online multimedia learning sources. The results of the experiment indicate association between learning style and multimedia preference for the kinesthetic learning preferences identified by the VARK.

Cockerline and Yearwood (2009) examined perceptual modality preferences determined by VARK inventory with regard to student use of online learning. They found a negative correlation between students' auditory preference scores and their use of WebCT, an online learning environment. There was a positive correlation between students' kinesthetic preference scores and their use of WebCT.

Bednarik & Fränti (2004) conducted research examining learning styles, also using VARK, in three different computer science courses. Using clustering they presented different perceptual modalities of how learners perceive information and state that a learner showing a priority in the visual modality prefers learning using charts, symbolic representations, or video materials.

Hassan et al. (2011) found that VARK preferences could not be reliably identified. A study on VARK reliability found preliminary support for the validity of the VARK model (Leite et al., 2010) and Leite asserts that evidence with respect to test-criterion

relationship could be obtained with contrasting learning style preferences measured by VARK with their task performance specifically developed for using a predominantly single learning style.

Multimedia Learning

Multimedia instruction refers to the presentation of both words (spoken or printed text) and pictures (illustration, photos, animation, video) that are intended to promote learning (Mayer, 2005). Since effective use of new instructional technology must be guided by a research-based theory of how students learn, the starting point is to understand how multimedia can be used to improve learning.

Cognitive load theory (Chandler & Sweller, 1991) is an instructional theory that starts from the idea that our working memory is limited with respect to the amount of information it can hold. Thereby, instructional designers need to find ways to help optimize the working memory. Sweller (2005) stresses the importance of using those multimedia principles in instructional design that include human cognitive ability.

In the field of instructional design, multimedia learning is the common name used to describe Mayer's cognitive theory of multimedia learning (Mayer, 2005a). According to this theory, the learner possesses a visual information processing system and a verbal information processing system. Furthermore, in multimedia learning the learner engages in three important cognitive processes. The first cognitive process is selecting. It is applied to incoming verbal information containing words and to incoming visual information containing pictures. The second cognitive process is organizing. It is applied to the words to create a verbally-based model of the presented material and to the pictures to create a visually-based model of given content. Finally, the third process is integrating both models so the learner builds connections between corresponding parts in the verbally-based model and the visually-based model.

Static text in the form of a textual resource is processed in the verbal system. Pictorial content accompanied by text is processed in both systems, visual and verbal. Animated content with narration in the form of a video resource also belongs to both systems, where speech is processed in the verbal system, and the animated picture is processed in the visual system.

Although there are general principles on how to use multimedia to help learners understand a specific content, there are differences in individual learning style concerning preferred multimedia learning material.

Principles of Multimedia Learning

The principles of multimedia learning relevant to our work are presented in this section. The first principle refers to multimedia learning effect explaining that it is better to present an explanation in words and pictures than solely in words. The multimedia effect is consistent with a cognitive theory of multimedia learning because learners who are given multimedia explanations are able to build two different mental representations, a verbal model and a visual model, and build connections between them (Mayer & Moreno, 1998).

The second principle is that students learn better when corresponding words and pictures are presented at the same time than when they are separated in time or in space. It emphasizes that corresponding words and pictures should be presented contiguously rather than separately (Mayer & Moreno, 1998).

The third principle is that words should be presented auditorily rather than visually (Debuse et al., 2009). When giving a multimedia explanation, words should be presented as auditory narration rather than as visual on-screen text, because on-screen text and animation can overload the visual information processing system. There is no overload when narration is processed in the verbal information processing system and animation is processed in the visual information processing system (Mayer & Moreno, 1998).

Considering a cognitive theory of multimedia learning, students with high visual ability are more able to create and hold the visual image in visual working memory. In this way they are more likely to benefit from contiguous presentation of words and pictures (Mayer & Sims, 1994).

In order to better understand multimedia learning it is important to differentiate between the impact of multimedia on learning and the instructional strategies which can be presented through multimedia. Furthermore, it is important to separate multimedia learning from the sensory modality (visual, aural, olfactory, tactile and taste information) chosen to represent instructional methods (Clark & Feldon, 2005).

There are learning strategies that are more appropriate for some media than others. The use of learning strategies aligned with media as well as with the user modality preferences is important to improve learning.

Research

The research was conducted within an online course during the winter term of the 2011/2012 academic year. The affected population comprised of graduate students attending an Information Science course at the Department of Information and Communication Sciences of the Faculty of Humanities and Social Sciences, University of Zagreb, Croatia. The course is elective for all students at the University on a graduate level and it is conducted as a fully online course via Moodle, the content management system. It covers advanced MS Office techniques for text and language processing. The content of the course is conveyed through eight multimedia lessons in the Moodle format, each including three different types of resources: textual resources, pictorial resources accompanied by text and video resources.

There are differences in learning approaches for the four VARK learning styles. For example, visual learners prefer maps and graphs, aural learners prefer attending lectures and discussion groups, read/write learners prefer printed handouts and readings while kinesthetic learners like doing things to understand them. Fleming (Fleming, n.d.) offers suggestions for classroom approaches for matching teaching styles and learning styles.

The main idea used to guide the research is that students prefer learning with some types of learning resources better than others regarding their individual perceptual mode and the preferences in usage of the resources. The aim is to determine the relationship between the students' perceptual mode and their online activity that is defined as access to different resources. Our hypothesis is that there is relationship between the sensory modality, i.e. perceptual mode, and the preferred multimedia resources that are offered in the online multimedia environment. Thereby, the research questions are the following:

- What are the students' perceptual modalities regarding the VARK sensory model?
- Do students prefer some types of resources more than other?
- Is there a relationship between a perceptual mode and a preferred multimedia learning resource?

Research Questions

In order to determine the relationship between sensory modality indicated through the VARK questionnaire and the value assigned for access to specific types of multimedia resources, the following questions were asked:

Visual sensory mode and access to multimedia resources

Q1: Is there a correlation between the value assigned for visual sensory mode and access to textual resources?

Q2: Is there a correlation between the value assigned for visual sensory mode and access to pictorial resources accompanied by text?

Q3: Is there a correlation between the value assigned for visual sensory mode and access to video resources?

Read/write sensory mode and access to multimedia resources

Q4: Is there a correlation between the value assigned for read/write sensory mode and access to textual resources?

Q5: Is there a correlation between the value assigned for read/write sensory mode and access to pictorial resources accompanied by text?

Q6: Is there a correlation between the value assigned for read/write sensory mode and access to video resources?

Kinesthetic sensory mode and access to multimedia resources

Q7: Is there a correlation between the value assigned for kinesthetic sensory mode and access to textual resources?

Q8: Is there a correlation between the value assigned for kinesthetic sensory mode and access to pictorial resources accompanied by text?

Q9: Is there a correlation between the value assigned for kinesthetic sensory mode and access to video resources?

At the end of all eight lessons, students were required to answer a feedback survey reporting on the types of resources they have been using as a preferable resource. The usage of specific types of resources is shown in Table 1.

Table 1.

Statistics for multimedia resources usage

	N	Median	Mode	Min	Max	Range
Textual	8	1	0	0	8	8
Pictorial	8	7	8	0	8	8
Video	8	1	0	0	7	7

The three questions about the relationship between the value assigned for using resources (obtained by the questionnaire) and access to related resources (obtained by the log analysis) are the following:

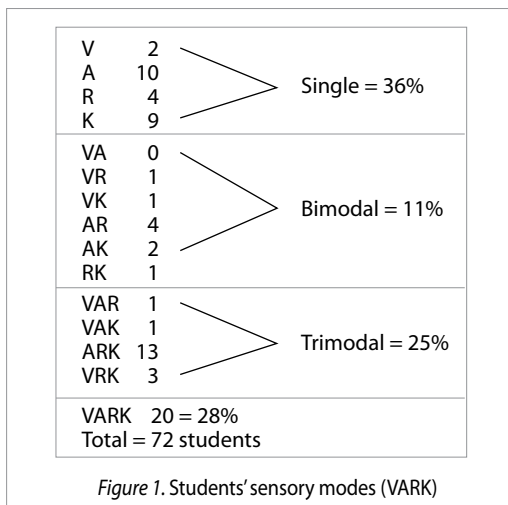*Value assigned for usage and access to related resources*

Q10: Is there a correlation between the value assigned for usage of textual resources and access to those resources?

Q11: Is there a correlation between the value assigned for usage of pictorial resources accompanied by text and access to those resources?

Q12: Is there a correlation between the value assigned for usage of video resources and access to those resources?

Data Analysis and Results

An observational study was conducted on a sample of 72 students attending the course. Of the participants, 59 were women, and 13 men. The students' sensory modes were identified by the VARK questionnaire as shown in Figure 1. Among 72 students, 25 students (36%) have a single preference, resulting in one of the four main sensory modes: visual (V) – 2 students (3%), aural (A) – 10 students (14%), read/write (R/W) – 4 students (7%) and kinesthetic (K) – 9 students (12%). Forty-seven students (64%) have multimodal preferences, out of which 9 students (11%) bimodal (AK, AR, RK, VK, VR), and 18 students (25%) trimodal (VAK, VAR, VRK, ARK). Twenty students (28%) have all four preferences (VARK).

V	2	
A	10	Single = 36%
R	4	
K	9	

VA	0	
VR	1	
VK	1	Bimodal = 11%
AR	4	
AK	2	
RK	1	

VAR	1	
VAK	1	Trimodal = 25%
ARK	13	
VRK	3	

VARK   20 = 28%
Total = 72 students

Figure 1. Students' sensory modes (VARK)

Indicators for each participant considering the VARK questionnaire are values assigned for the following variables: visual, aural, textual and kinesthetic. The values refer to the number of points obtained by the VARK questionnaire. In 16 questions each of the possible answers referred to a sensory modality. Multiple answers were allowed. This way the students achieved a certain score in specific modality and that number represented the value assigned to a modality variable (visual, aural, textual and kinesthetic):

- Value assigned to visual variable
- Value assigned to aural variable
- Value assigned to read/write variable
- Value assigned to kinesthetic variable.

Values assigned to modality variables obtained by the VARK questionnaire are shown in Table 2.

Table 2.

Statistics for VARK sensory modes

	Median	Mode	Min	Max	Range
Visual	4	5	0	10	10
Aural	6	5	0	14	14
R/W	5	4	0	13	13
Kinesthetic	6	6	1	11	10

Students' access to different resources obtained by log file data analysis is shown in Table 3.

Table 3.

Statistics for multimedia resources access

	N	Median	Mode	Min	Max	Range
Textual	8	9.5	7	0	56	56
Pictorial	8	23	14	7	70	63
Video	8	6	4	0	41	41

Research Answers

Since the distribution of the compiled data is skewed, the analysis is based on nonparametric statistics. Therefore, Spearman's rank correlation coefficient is used to answer the abovementioned questions (as shown in Table 4). These correlations were tested to a significance level of 0.05.

Visual Sensory Mode and Access to Multimedia Resources

Research answer 1: Spearman's coefficient (ρ=-0.257) shows that the correlation between the value assigned for visual sensory mode and access to textual resources is negative and low.

Research answer 2: Spearman's coefficient (ρ=-0.285) shows that the correlation between the value assigned for visual sensory mode and access to pictorial resources accompanied by text is negative and low.

Research answer 3: Spearman's coefficient (ρ=-0.166) shows that the correlation between the value assigned for visual sensory mode and access to video resources is negative and low. However, the correlation is not significant.

Read/Write Sensory Mode and Access to Multimedia Resources

Research answer 4: Spearman's coefficient (ρ=-0.094) shows that there is no correlation between the value assigned for read/write sensory mode and access to textual resources. However, the correlation is not significant.

Research answer 5: Spearman's coefficient (ρ=-0.218) shows that the correlation between the value assigned for read/write sensory mode and access to pictorial resources accompanied by text is negative and low. However, the correlation is not significant.

Research answer 6: Spearman's coefficient (ρ=-0.257) shows that the correlation between the value assigned for read/write sensory mode and access to video resources is negative and low.

Kinesthetic Sensory Mode and Access to Multimedia Resources

Research answer 7: Spearman's coefficient (ρ=0.095) shows that the correlation between the value assigned for kinesthetic sensory mode and access to textual resources is low. However, the correlation is not significant.

Research answer 8: Spearman's coefficient (ρ=-0.153) shows that the correlation between the value assigned for kinesthetic sensory mode and access to pictorial resources accompanied by text is negative and low. However, the correlation is not significant.

Research answer 9: Spearman's coefficient (ρ=0.053) shows that the correlation between the value assigned for kinesthetic sensory mode and access to video resources is low. However, the correlation is not significant.

Value Assigned for Usage and Access to Related Resources

Research answer 10: Spearman's coefficient (ρ=0.723) shows that the correlation between the value assigned for usage of textual resources and access to those resources is high and positive.

Research answer 11: Spearman's coefficient (ρ=0.326) shows that the correlation between the value assigned for usage of pictorial resources accompanied by text and access to those resources is low and positive.

Research answer 12: Spearman's coefficient (ρ=0.795) shows that the correlation between the value assigned for usage of video resources and access to those resources used is high and positive.

Table 4.

Correlations between sensory modes, access to multimedia resources and their usage

Access to Resources	Sensory modes obtained by VARK			Preferences in usage of the resources		
	Visual	Read/Write	Kinesthetic	Textual	Pictorial	Video
Textual	-0.257* (.029)	-0.094 (.431)	0.095 (.429)	0.723** (.000)	-0.432** (.000)	0.357** (.002)
Pictorial	-0.285* (.015)	-0.218 (.066)	-0.153 (.200)	0.065 (.586)	0.326* (.005)	0.185 (.119)
Video	-0.166 (.163)	-0.257* (.029)	0.053 (.659)	0.249* (.035)	-0.335** (.004)	0.795** (.000)

Note: * = $p \leq .05$,   ** = $p \leq .01$

The significant correlations indicate the following:

Students with stressed visual modality access textual resources less. However, it is interesting to note that they access pictorial resources less, which indicates the need for future research. Moreover, students with stressed textual modality access video resources less.

Students who prefer the use of textual and video resources access related resources more. However, students who prefer pictorial resources access related resources less, which additionally indicates the need for future research.

Conclusion, Discussion and Further Research

Considering the VARK questionnaire results, two out of three students have multimodal sensory modes and prefer combining different types of multimedia resources. The most used type of resources is pictorial accompanied by text. Considering the data analysis, there is a low and negative correlation between textual modality and engagement with video resources, as well as between visual modality and engagement with textual resources.

Furthermore, the results show that the use of video resources is highly correlated with access to the same resources. Correspondingly, the use of textual resources is highly correlated with access to the same resources. However, there is a low correlation between the use of pictorial resources accompanied by text and access to those resources. A negative correlation exists between the use of pictorial resources and the access to textual resources.

Despite the fact that according to our survey, pictorial resources accompanied by text are the most used type of resources, the access to those resources is low correlated with their usage. Therefore, further study including time spent on each resource is needed to substantiate our research.

Considering the previous research (Byrne 2002; Cockerline & Yearwood 2009; Leite et al., 2010; Hassan et al., 2010) there are possibilities of obtaining relevant results, but there are also difficulties in research due to complexity of multimedia instructional design. In further research, the resources need to be redesigned in order to identify the relationship between sensory modality and learning preference.

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Multimedijski resursi e-kolegija: pristup i upotreba s obzirom na osjetilni modalitet

Sažetak

U radu je prikazano istraživanje odnosa osjetilnog modaliteta i aktivnosti studenata s obzirom na odabir multimedijskih resursa e-kolegija. Sadržaj kolegija prezentiran je upotrebom lekcija izrađenih u sustavu za upravljanje nastavnim sadržajima Moodle. Lekcije sadrže tri tipa resursa: tekstualni, slikovno-tekstualni i video resurs. Upotrebom upitnika VARK utvrđeni su načini učenja utemeljeni na senzornom modalitetu (vizualni, auralni, tekstualni i kinestetički), zatim istraženi odnosi modaliteta studenata i aktivnosti s obzirom na odabir različitih multimedijskih resursa. Rezultati pokazuju da su dva od tri studenta multimodalni i da su u učenju skloni odabiru slikovno-tekstualnog resursa.

Ključne riječi: *multimedijsko učenje; osjetilni modalitet; VARK.*

Uvod

Virtualno okruženje za učenje (engl. *Virtual Learning Environment*) omogućuje upravljanje nastavnim sadržajima i održavanje nastave *online*. Podaci o aktivnostima studenata u virtualnom okruženju podloga su za različite kvantitativne analize (Castro et al., 2007). Na primjer, mogu se provoditi jednostavna mjerenja broja posjeta i vrijeme provedeno po stranici (Pahl i Donnellan, 2002) te pratiti izvještaje o tjednim i mjesečnim korisničkim trendovima i aktivnostima (Monk, 2005).

U prethodnim istraživanjima, na temelju podataka o pristupu nastavnim sadržajima, istražili smo odnos između aktivnosti i predznanja s jedne i formalnog obrazovanja studenata s druge strane (Lauc et al., 2011; Bago et al., 2011). Nadalje, analizom upotrebe različitih tipova multimedijskih materijala istražili smo sklonosti u odabiru određenog tipa resursa (Kišiček et al., 2013).

Način učenja predstavlja odgovor pojedinca na okruženje za učenje, a temelji se na individualnom stilu učenja. Stil učenja definira se iz različitih perspektiva. Polazeći od osjetilnog modaliteta u definiranju načina na koji pojedinac prima i obrađuje informaciju, učenike je moguće klasificirati na tekstualni, auralni, vizualni i kinestetički tip i njihove kombinacije (Fleming, 2006). Osjetilni modalitet definira naše biološki utemeljene reakcije na fizičko okruženje i predstavlja način na koji

najučinkovitije usvajamo informacije. U ovom radu istražujemo odnos osjetilnog modaliteta i interakcije studenata s različitim tipovima multimedijskih resursa ponuđenih u virtualnom okruženju za učenje. Koristili smo se senzornim modelom VARK koji je razvio Fleming. VARK je akronim za: *Visual* (vizualni), *Aural* (auralni), *Read/Write* (tekstualni) i *Kinesthetic* (kinestetički) i odnosi se na osjetilni modalitet pojedinca. Fleming (2011) definira stil učenja kao „karakteristike pojedinca i preferirani način skupljanja, organiziranja i razmišljanja o informacijama" određujući ga putem osjetilnog modaliteta. Upitnik VARK je instrument za utvrđivanje modaliteta razvijen u okviru senzornog modela VARK. Mjeri zastupljenost svakog od četiri osjetilna modaliteta, od kojih pojedinci mogu posjedovati jedan, dva, tri ili sva četiri modaliteta. Prema Flemingu, 39% ljudi ima izražen jedan modalitet, 15% dva, 12% tri, a 34% ima izražena sva četiri modaliteta (Fleming, n. d.).

Pregled dosadašnjih istraživanja

Byrne (2002) je istraživao odnos između individualnog stila učenja i upotrebe različitih multimedijskih resursa. Rezultati eksperimenta ukazuju na povezanost između stila učenja i sklonosti u odabiru resursa za kinestetički modalitet utvrđen VARK-om.

Cockerline i Yearwood (2009) ispitivali su odnos između osjetilnog modaliteta utvrđenog upitnikom VARK i učenja studenata u virtualnom elektroničkom okruženju. Korelacija između slušnog modaliteta studenata i upotrebe WebCT-ja, elektroničkog okruženja za učenje, pokazala se negativnom, a korelacija između kinestetičkog modaliteta studenata i upotrebe WebCT-ja pokazala se pozitivnom.

Bednarik i Fränti (2004) proveli su istraživanje o stilovima učenja upotrebom upitnika VARK za tri različita kolegija iz područja računalne znanosti. Klasteriranjem podataka dobivenih iz log datoteka prikazali su različite osjetilne modalitete putem kojih studenti percipiraju informacije i ukazali su na to da studenti s istaknutim vizualnim modalitetom preferiraju učenje putem grafova, simboličnih prezentacija i video materijala.

Hassan et al. (2011) ukazuju na to da modalitet utvrđen upitnikom VARK nije moguće pouzdano identificirati. Međutim, studija o pouzdanosti instrumenta VARK dala je pozitivne preliminarne rezultate (Leite et al., 2010) pa Leite tvrdi da bi dobivene rezultate trebalo dodatno potkrijepiti tako da se modalitet pojedinca uspoređuje s uspjehom na testu koji je dizajniran prema individualnim sklonostima.

Učenje putem multimedija

Multimedijsko učenje uključuje prikaz sadržaja učenja putem riječi (govorenih ili pisanih) i slika (ilustracija, fotografija, animacija, videa) s ciljem poboljšanja usvajanja znanja (Mayer, 2005). Učinkovita upotreba informacijske tehnologije u obrazovanju treba se temeljiti na rezultatima znanstvenih istraživanja o tome koliko uspješno učenici usvajaju prezentirana znanja. Polazna je točka multimedijskog učenja razumjeti način na koji upotreba multimedija može unaprijediti učenje.

Teorija kognitivnog opterećenja (Chandler i Sweller, 1991) objašnjava da je naša radna memorija ograničena u odnosu na količinu informacija koju može primiti. Instrukcijski dizajneri stoga trebaju pronaći način kako optimalizirati iskoristivost radne memorije. Sweller (2005) naglašava važnost primjene onih principa multimedijskog instrukcijskog dizajna prema kojima se uvažavaju kognitivne sposobnosti čovjeka.

U području instrukcijskog dizajna multimedijsko učenje temelji se na spoznajnoj teoriji učenja putem multimedija (Mayer, 2005a). Prema toj teoriji, učenik ima sustav za procesiranje vizualnih informacija i sustav za procesiranje verbalnih informacija. Kod učenja putem multimedija učenik prolazi tri važna kognitivna procesa. Prvi je odabir dolazećih verbalnih informacija koje sadrže riječi i dolazećih vizualnih informacija koje sadrže slike. Drugi kognitivni proces je organizacija riječi, kako bi se kreirao verbalni model prezentiranog materijala, i slika, kako bi se kreirao vizualni model danog sadržaja. Treći je proces integracija oba modela u kojem učenik gradi veze između odgovarajućih dijelova verbalnog i vizualnog modela.

Statičan tekst u obliku tekstualnog resursa procesiran je u verbalnom sustavu. Slikovni sadržaj popraćen tekstom u obliku slikovno-tekstualnog resursa pripada i verbalnom i vizualnom sustavu. Animirani sadržaj s naracijom u obliku video resursa pripada također u oba sustava, pri čemu se govor obrađuje u verbalnom sustavu, a animirani slikovni prikaz u vizualnom sustavu.

Unatoč općim principima o tome kako koristiti multimedij s ciljem poboljšanog razumijevanja sadržaja učenja, neizostavno je uzeti u obzir razlike u stilu učenja pojedinca i njegova senzornog modaliteta, kao i njegovu sklonost odabiru određenog tipa obrazovnog resursa.

Principi učenja putem multimedija

U ovom poglavlju navedeni su principi multimedijskog učenja relevantni za naše istraživanje. Prvi princip odnosi se na efekt učenja putem multimedija i govori da je bolje prikazati sadržaj učenja riječima i slikama, nego samo riječima. Efekt multimedija konzistentan je sa spoznajnom teorijom multimedijskog učenja. Učenici kojima su pojašnjenja dana putem slikovnog i tekstualnog prikaza, mogu izgraditi dva različita mentalna prikaza, verbalni i vizualni, a zatim djelotvorno graditi veze među njima, što utječe na učinkovitost učenja (R. E. Mayer i Moreno, 1998).

Drugi princip nalaže da je učenje učinkovitije kad su riječi i slike prikazane istodobno, nego kad su razdvojene u vremenu i prostoru. Dakle, odgovarajuće riječi i slike trebaju biti prostorno i vremenski povezane (R. E. Mayer i Moreno, 1998).

Treći princip govori da je bolje da riječi budu govorene nego pisane. Prilikom objašnjenja danih putem multimedija riječi trebaju biti prikazane kao naracija, a ne putem prikaza teksta na ekranu, jer tekst na ekranu i animacija mogu preopteretiti sustav za obradu vizualnih informacija. To se ne događa kad je govorena informacija

primljena putem slušnog kanala i obrađena u sustavu za verbalno procesiranje informacija, a animacijom prikazana informacija primljena putem vidnog kanala i procesirana u sustavu za vizualno procesiranje informacija (Mayer i Moreno, 1998).

Prema spoznajnoj teoriji multimedijskog učenja, vizualni tip učenika sklon je kreiranju i zadržavanju vizualnog prikaza u vizualnoj radnoj memoriji. Prema tome, takvom tipu učenika više će odgovarati slikovno obogaćen sadržaj (R. Mayer E. i Sims, 1994), premda je uvijek neophodno uzeti u obzir individualne razlike u učenju.

Da bismo bolje razumjeli multimedijsko učenje, važno je razdvojiti utjecaj multimedija na učenje od strategija poučavanja za koje se multimedij koristi. Nadalje, važno je razlikovati učenje putem multimedija od osjetilnog modaliteta za primanje informacija (Clark i Feldon, 2005).

Određene strategije učenja prikladne su za određeni medij. Za unapređenje procesa učenja važan je odabir prikladnog medija u odnosu na strategiju učenja, kao i podudarnost s individualnim načinom učenja pojedinca.

Istraživanje

Istraživanje je provedeno u okviru izbornog elektroničkog kolegija „Društveno-humanistička informatika" ponuđenog svim studentima diplomskih studija Filozofskog fakulteta u zimskom semestru akademske godine 2011./2012. Kolegij uključuje napredne tehnike upotrebe MS Office alata za obradu teksta i jezika. Sadržaj kolegija prikazan je u obliku osam lekcija danih u Moodle formatu. Dio sadržaja koji obuhvaća odabrana znanja i vještine iz računalnog opismenjavanja, u svakoj od lekcija, prezentiran je tekstualnim resursom, slikovno-tekstualnim resursom i video resursom.

S obzirom na četiri osjetilna modaliteta modela VARK, mogući su različiti načini učenja. Na primjer, vizualni tipovi učenika preferiraju grafički prikaz, auralni tipovi preferiraju pohađanje predavanja i sudjelovanje u raspravama, tekstualni tipovi preferiraju uručke i materijale za čitanje. Kinestetički tipovi učenika preferiraju praktičan rad i simulacije. Fleming (Fleming, n. d.) daje sugestije za različite pristupe nastavi s ciljem što boljeg podudaranja stila poučavanja i učenja.

Glavna odrednica ovog istraživanja jest postojanje sklonosti korisnika za određeni tip multimedijskog resursa za učenje. Cilj je utvrditi odnos između osjetilnog modaliteta studenata i aktivnosti na kolegiju koja je definirana kao pristup resursu. Polazišna hipoteza je povezanost osjetilnog modaliteta i pristupa multimedijskim resursima u virtualnom okruženju s pretpostavkom da postoji sklonost odabiru određenog tipa resursa u odnosu na osjetilni modalitet pojedinca. Prema tome, očekuje se da će studenti određenog osjetilnog modaliteta više, odnosno manje pristupati određenom tipu multimedijskih resursa. Pitanja postavljena u istraživanju su sljedeća:

- Koji su osjetilni modaliteti studenata prema modelu VARK?
- Postoji li sklonost studenata odabiru određenog multimedijskog resursa?
- Kakav je odnos između osjetilnog modaliteta studenata i sklonosti u odabiru multimedijskih resursa?

Istraživačka pitanja

Istražili smo odnos između senzornog modaliteta utvrđenog upitnikom VARK i pristupa određenom tipu multimedijskih resursa.

Vizualni modalitet i pristup multimedijskim resursima

• Q1: Postoji li korelacija između vrijednosti pridruženih vizualnom modalitetu i čestotnosti pristupa tekstualnim resursima?

• Q2: Postoji li korelacija između vrijednosti pridruženih vizualnom modalitetu i čestotnosti pristupa slikovnim resursima popraćenih tekstom?

• Q3: Postoji li korelacija između vrijednosti pridruženih vizualnom modalitetu i čestotnosti pristupa video resursima?

Tekstualni modalitet i pristup multimedijskim resursima

• Q4: Postoji li korelacija između vrijednosti pridruženih tekstualnom modalitetu i čestotnosti pristupa tekstualnim resursima?

• Q5: Postoji li korelacija između vrijednosti pridruženih tekstualnom modalitetu i čestotnosti pristupa slikovnim resursima popraćenih tekstom?

• Q6: Postoji li korelacija između vrijednosti pridruženih tekstualnom modalitetu i čestotnosti pristupa video resursima?

Kinestetički modalitet i pristup multimedijskim resursima

• Q7: Postoji li korelacija između vrijednosti pridruženih kinestetičkom modalitetu i čestotnosti pristupa tekstualnim resursima?

• Q8: Postoji li korelacija između vrijednosti pridruženih kinestetičkom modalitetu i čestotnosti pristupa slikovnim resursima popraćenih tekstom?

• Q9: Postoji li korelacija između vrijednosti pridruženih kinestetičkom modalitetu i čestotnosti pristupa video resursima?

Povratna informacija studenata dobivena je putem upitnika o upotrebi resursa na kraju svake od 8 lekcija. Deskriptivna statistika zastupljenosti pojedinog resursa prikazana je u Tablici 1.

Tablica 1.

Pitanja o odnosu između vrijednosti pridruženih upotrebi resursa (dobivenih upitnikom) i čestotnosti pristupa resursima (dobivenih log analizom) su sljedeća:

Upotreba resursa i pristupa resursima:

• Q10: Postoji li korelacija između vrijednosti pridruženih korištenju tekstualnih resursa i čestotnosti pristupa tekstualnim resursima?

• Q11: Postoji li korelacija između vrijednosti pridruženih korištenju slikovno-tekstualnih resursa i čestotnosti pristupa slikovno-tekstualnim resursima?

• Q12: Postoji li korelacija između vrijednosti pridruženih korištenju video resursa i čestotnosti pristupa video resursima?

Analiza podataka i rezultati

Opservacijska studija provedena je na uzorku od 72 ispitanika čiji je osjetilni modalitet utvrđen upitnikom VARK (prikazano na Slici 1.) razvijenim unutar modela VARK. Od sveukupno 72 studenta koji su pohađali kolegij, 59 su žene, a 13 muškarci. Studenti su pristupili hrvatskoj inačici upitnika putem sustava za upravljanje nastavnim sadržajima Moodle. 25 studenata (36%) ima samo jedan izraženi modalitet: vizualni (V, engl. Visual) – 2 studenta (3%), auralni (A, engl. Aural) – 10 studenata (14%), tekstualni (R/W, engl. Read/Write) – 4 studenta i kinestetički (K, engl. Kinesthetic) – 9 studenata (12%). 47 studenata (64%) ima multimodalne sklonosti, od kojih je 9 studenata (11%) bimodalno (AK, AR, RK, VK, VR), a 18 studenata (25%) trimodalno (VAK, VAR, VRK, ARK). 20 studenata (28%) ima sva četiri izražena modaliteta (VARK).

Slika 1.

Indikatori dobiveni upitnikom VARK su vrijednosti pridružene sljedećim varijablama: vizualni, auralni, tekstualni i kinestetički. Vrijednosti se odnose na broj bodova dobivenih upitnikom VARK. U ukupno 16 pitanja svaki od ponuđenih odgovora odnosio se na jedan modalitet. Bilo je moguće odabrati više odgovora unutar jednog pitanja. Tako su studenti skupili određeni broj bodova iz nekog modaliteta koji predstavlja vrijednost pridruženu varijabli modaliteta (vizualni, auralni, tekstualni i kinestetički).

- Vrijednost dodijeljena varijabli za vizualni tip (*visual*)
- Vrijednost dodijeljena varijabli za auralni tip (*aural*)
- Vrijednost dodijeljena varijabli za tekstualni tip (*read/write*)
- Vrijednost dodijeljena varijabli za kinestetički tip (*kinesthetic*)

Deskriptivna statistika vrijednosti pridruženih varijablama modaliteta prikazana je u Tablici 2.

Tablica 2.

Deskriptivna statistika čestotnosti pristupa tekstualnom (*textual*), slikovno-tekstualnom (*pictorial*) i video (*video*) resursu dobivena je iz log datoteka, što je prikazano u Tablici 3.

Tablica 3.

Odgovori na istraživačka pitanja

Budući da je distribucija skupljenih podataka asimetrična, analiza je utemeljena na neparametrijskoj statistici. Spearmanov koeficijent korelacije ranka upotrijebljen je za dobivanje odgovora na postavljena pitanja (kao što je prikazano u Tablici 4.). Korelacije su testirane sa stupnjem pouzdanosti od 95% (p=0,05).

Vizualni modalitet i pristup multimedijskim resursima

Odgovor 1: Spearmanov koeficijent (ρ=-0,257) pokazuje da je korelacija između vrijednosti pridruženih vizualnom modalitetu i čestotnosti pristupa tekstualnim resursima negativna i niska.

Odgovor 2: Spearmanov koeficijent (ρ=-0,285) pokazuje da je korelacija između vrijednosti pridruženih vizualnom modalitetu i čestotnosti pristupa slikovno-tekstualnim resursima negativna i niska.

Odgovor 3: Spearmanov koeficijent (ρ=-0,166) pokazuje da je korelacija između vrijednosti pridruženih vizualnom modalitetu i čestotnosti pristupa video resursima negativna i niska. Međutim, korelacija nije značajna.

Tekstualni modalitet i pristup multimedijskim resursima

Odgovor 4: Spearmanov koeficijent (ρ=-0,094) pokazuje da nema korelacije između vrijednosti pridruženih tekstualnom modalitetu i čestotnosti pristupa tekstualnim resursima. Međutim, korelacija nije značajna.

Odgovor 5: Spearmanov koeficijent (ρ=-0,218) pokazuje da je korelacija između vrijednosti pridruženih tekstualnom modalitetu i čestotnosti pristupa slikovno-tekstualnim resursima negativna i niska. Međutim, korelacija nije značajna.

Odgovor 6: Spearmanov koeficijent (ρ=-0,257) pokazuje da je korelacija između vrijednosti pridruženih tekstualnom modalitetu i čestotnosti pristupa video resursima negativna i niska.

Kinestetički modalitet i pristup multimedijskim resursima

Odgovor 7: Spearmanov koeficijent (ρ=0,095) pokazuje da je korelacija između vrijednosti pridruženih kinestetičkom modalitetu i čestotnosti pristupa tekstualnim resursima niska. Međutim, korelacija nije značajna.

Odgovor 8: Spearmanov koeficijent (ρ=-0,153) pokazuje da je korelacija između vrijednosti pridruženih kinestetičkom modalitetu i čestotnosti pristupa slikovno-tekstualnim resursima negativna i niska. Međutim, korelacija nije značajna.

Odgovor 9: Spearmanov koeficijent (ρ=0,053) pokazuje da je korelacija između vrijednosti pridruženih kinestetičkom modalitetu i čestotnosti pristupa video resursima niska. Međutim, korelacija nije značajna.

Vrijednosti pridružene upotrebe resursa i pristupu resursima:

Odgovor 10: Spearmanov koeficijent (ρ=0,723) pokazuje da je korelacija između vrijednosti pridruženih upotrebi tekstualnih resursa i čestotnosti pristupa tekstualnim resursima visoka i pozitivna.

Odgovor 11: Spearmanov koeficijent (ρ=0,326) pokazuje da je korelacija između vrijednosti pridruženih upotrebi slikovno-tekstualnih resursa i čestotnosti pristupa slikovno-tekstualnim resursima niska i pozitivna.

Odgovor 12: Spearmanov koeficijent (ρ=0,795) pokazuje da je korelacija između vrijednosti pridruženih upotrebi video resursa i čestotnosti pristupa video resursima visoka i pozitivna.

Tablica 4.

Statistički značajne korelacije upućuju na sljedeće:

Studenti s izraženim vizualnim modalitetom manje pristupaju tekstualnim resursima. Međutim, zanimljivo je da također manje pristupaju slikovno-tekstualnim resursima, što upućuje na potrebu za daljnjim istraživanjima. Nadalje, studenti s izraženim tekstualnim modalitetom manje pristupaju video resursima.

Kod studenata koji su skloni upotrebi tekstualnih i video resursa, izražena je podudarnost u pristupu odgovarajućim resursima. Međutim, kod studenata koji su skloni upotrebi slikovno-tekstualnih resursa, neznatno je izražena podudarnost s njihovim pristupom odgovarajućim resursima, što također upućuje na potrebu za daljnjim istraživanjima.

Zaključak, rasprava i buduća istraživanja

Prema rezultatima upitnika VARK, dva od tri studenta imaju multimodalne osjetilne sklonosti i preferiraju kombiniranje različitih vrsta multimedijskih resursa. Najzastupljenija je upotreba slikovno-tekstualnog resursa. Analiza podataka ukazala je na postojanje niske i negativne korelacije između tekstualnog modaliteta i interakcije s video resursima, kao i između vizualnog modaliteta i interakcije s tekstualnim resursima.

Nadalje, rezultati su pokazali da je upotreba video resursa visoko korelirana s čestotnošću pristupa video resursima. Također, upotreba tekstualnih resursa visoko je korelirana s čestotnošću pristupa tekstualnim resursima. Međutim, upotreba slikovno-tekstualnih resursa nisko je korelirana s pristupom slikovno-tekstualnim resursima. Također, postoji i niska negativna korelacija između upotrebe slikovno-tekstualnih resursa i čestotnosti pristupa tekstualnim resursima.

Unatoč činjenici da su slikovno-tekstualni resursi najviše upotrebljavani, njihova upotreba nisko je korelirana s pristupom tim resursima, što ukazuje na potrebu uključivanja dodatnih varijabli, poput vremena zadržavanja na pojedinom resursu.

S obzirom na dosadašnja spomenuta istraživanja (Byrne, 2002; Cockerline i Yearwood, 2009; Leite et al., 2010; Hassan et al., 2010) koja ukazuju na mogućnost dobivanja relevantnih rezultata, ali i poteškoće u istraživanju zbog raznolikih čimbenika u području multimedija i instrukcijskog dizajna, daljnja istraživanja trebalo bi usmjeriti na redizajniranje resursa u nastojanju da se potvrdi povezanost osjetilnog modaliteta i sklonosti u upotrebi pojedinog resursa.