Researcher Daniel HOMOCIANU, PhD
E-mail: dan.homocianu@gmail.com
Researcher Sabina Cristiana NECULA, PhD
E-mail: sabina.mihalache@gmail.com
Professor Dinu AIRINEI, PhD
E-mail: adinu@uaic.ro
Researcher Laura-Diana RADU, PhD
E-mail: glaura@uaic.ro
Professor Mircea Radu GEORGESCU, PhD
E-mail: mirceag@uaic.ro
Associate Professor Livia Loredana BACIU, PhD
E-mail: baciu_livia@yahoo.com
Alina Cristina DAMIAN, Ph D student
"Alexandru Ioan Cuza" University of Iasi, FEAA
E-mail: alina.cristina.damian@gmail.com

MULTIMEDIA FOR LEARNING IN ECONOMY AND CYBERNETICS

Abstract. *The use of many multimedia channels in order to bring information to target groups is not something new. What is new is related to how these channels are exploited by mixing techniques and technologies. We realized an online questionnaire to identify the multimedia techniques/ tools that have impact on user's satisfaction. We used comparative statistical analyses (Levene's test) to observe if there are any significant differences between multimedia users and non-multimedia users. We identified that the preferred techniques are: the presence of a narrator, the existence of some suggestive images, slides and demos. These are only some factors that we identified. We studied also the influence of features as: access to, scenario type, interactivity, flexibility, additional options and effects and time dependency. We determined that the existence of useful links is an important factor for overall satisfaction of the user with multimedia materials.*

Keywords*: multimedia (MM), learning, video tutorial (VT), mixed methods, questionnaire.*

JEL classification: O33, D83, C19

1. Introduction

The scope of our paper is to find the MM techniques with impact on MM users from the educational point of view. Therefore we have reviewed the main MM techniques and studies accepted by the specialty literature. This study brings novelty by identifying the mix of MM tools that may enhance learner's experience.

Our experience with the target group was based on: VT playlists, VT with contextual/sequential hyper-linked annotations, extended desktop, mixed video conferences and dynamic hyper presentations. The main studies realized in this field of research do not observe the influence of these specific MM tools. Therefore the effort we spent in realizing, sharing, and testing different MM tools it is useful and of real benefit for others.

2. Literature review

The managers, educators, instructors as well as the academic and research people are in a continuous search for new and effective ways to attract and stimulate their target groups of employees, students or colleagues in order to increase the results of communication and learning process (Krippel *et al.* 2010). The use of many different types of communicating the information proved to be useful in the educational environment, because, according to the communication theory, it benefits from many channels and leads to strengthening the received information. This aspect improves the learning capacity (Krippel 2010; Timothy 2004; Bagui 1998; Daniels 1999; Severin 1967; Hartman 1961). In a more comprehensive approach, MM used in education helps in problem solving (learning by doing) and in understanding abstract concepts. It provides enhanced access for teachers and students in remote locations, facilitates individualized and cooperative learning, helps in management and administration of classroom activities and learning content, and simulates real life problem handling environments (Malik *et al.* 2012).

MM has an important role in education and it determines significant changes in the way that information is presented, and also in the auditor's perception. Low and Sweller (Low *et al.* 2005) found that "under certain, well-defined conditions, presenting some information in visual mode and other information in auditory mode can expand effective working memory capacity and so reduce the effects of excessive cognitive load". It is an instructional principle that can substantially increase learning (Mayer *et al.* 1994). The similarity to the real world is one of the essential characteristics of MM which was promoted as an efficient method of learning comparing to the traditional methods.

The training with MM tools has some characteristics identified by Mayer but studied and developed also by other authors:

- They assure a more efficient learning process when the person's attention that is trained is focused and not split (Kalyuga *et al.*1999);

- Learning is more efficient when it is interactive and supervised by a person who takes part to the learning process (Mayer 2003; Mayer 2005);
- Learning by making use of MM tools is more efficient when the control structures are activated before the presentation moment (Pollock *et al.* 2002);
- The learning process is more efficient when the trained persons can apply their acquired knowledge and receive feedback (Kalyuga 2005);
- Presenting simultaneously images and words enhance/increase learner's perception (Mayer *et al.* 1994);
- The use of dynamic effects in presentations can improve the learning process, especially when they are guided by trained persons (Mayer *et al.* 2001);
- The use of MM tools in education is more efficient if the trained persons are actively involved in presentations (Gilakjani *et al.* 2011).

The e-learning refers to a broad area of new techniques used for training all the people of an organization, often benefiting from the power of technology in order to overcome some limitations as time, distance and resources. A simple classification (e-learningconsulting.com) of the e-learning techniques separates them into: asynchronous, synchronous, and development and management techniques.

The PowerPoint presentations are considered a weak form of MM, and are well-known for its over-use in both the classroom and the boardroom. Craig & Amernic (Craig *et al.* 2006) observe that a majority of studies show that use of PowerPoint is not associated with a significant improvement in student grades and that there are studies that demonstrated a decrease in student performance when the instructor switched to PowerPoint (Bartlett *et al.* 2000). After a review of these studies, Craig & Amernic (Craig *et al.* 2006) conclude that PowerPoint's effectiveness is contingent upon the discipline, the learning objectives, and learner types.

The VTs are much appreciated in practice because they are frequently based on pragmatic scenarios suggesting: attitudes, behaviors, models or steps to get to a certain result (Airinei *et al.* 2010). Here we focus mostly on showing how to make them more accessible to the user. We consider important the access to individual pieces as well as getting to their atomic parts because of interactivity reasons.

Persons that are undergoing to a learning process and have access to multiple forms of representation of information are growing their capacity to understand, learn, memorize, communicate and interfere (Scaife *et al.* 1996). Thus, in this paper we analyze the impact of mixing some MM materials and techniques using narrated presentations, video and interactive tutorials and portals on lifelong learning. In order to obtain a dimension of the impact we have addressed a questionnaire to a group of both current and potential users of MM. In this way we were also able to examine the effects MM materials have on common user's behavior and its attitude toward MM as an educational instrument. Some basic questions provoked us to begin, support and try to finish this study: (1) What is the

current experience of the common user with educational MM? (2) What is the influence on his behavior? (3) What is more important: to store more experience as MM or to make it accessible to the user in various ways? When trying to respond we also found an optimum MM solution actually based on a combination of many well-known techniques, technologies and tools. This mix itself also gives novelty.

3. Narrated & dynamic hyper presentations. Other interactive tools

When we started this study, we were aware of the PowerPoint (PPT) overuse problem and, specifically, of the low impact on the learning process.

Figure1. Last author in a narrated presentation example on www.uhu.es/unitv

We thought to improve this type of MM tool by introducing the narrator (Fig 1: video and presentation - different gestures on different slides). The emotional impact the narrator's presence (even virtual with gesture and mimic) has on the learning process plays a key role in this scenario.
Even this way the presentation will usually follow a given path. Therefore, a mind programming problem arises and this could be avoided by using a presentation without a predefined order of slides – DHP (Dynamic Hyper Presentation).

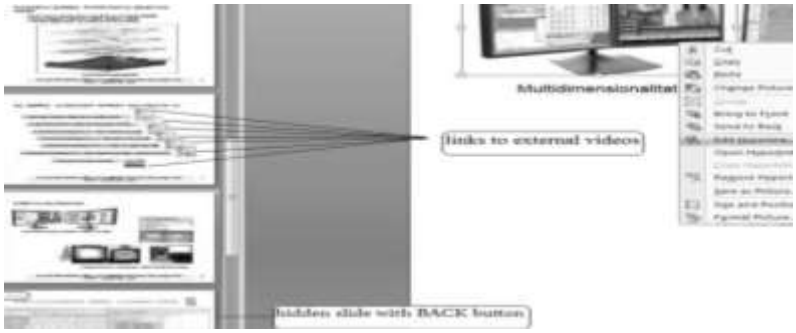

Figure2. DHP slides

Our experience is that the use of DHP which is a presentation with hyperlinks to external/internal resources (even hidden slides) creates the difference between conducted and interactive (Fig 2: anchors to video clips-center left, slide

no.7 and to hidden slides-right, current slide). A scenario with a huge presentation having many keywords and images linked to hidden sections containing additional explanations shows how everything depends on the behavior of the target group. A short and synthetic presentation (without hidden slides) will be made to those knowing the subject and not asking for additional explanations. A not foreseen course and time will take the presentation if the target public will start to ask questions during the roll of the main slides. This will determine the presenter to use the links he has smartly included behind some key words, images or other items that he predicted to be of interest or subject of questions. By clicking on such a link the presentation would dynamically bring a helpful hidden slide with a possible response. Thus the presentation becomes simple, short, logical and dynamically extensible at a certain point.

As well as DHP, the interactive media follows the constructionist learning theory and rules. We must include here a great variety of instruments from playlists and annotated videos to interactive tutorials, agents and wizards. The last ones (Fig 3) do not seem to increase learning in all cases and under certain circumstances may even diminish instructional effectiveness by producing cognitive overload (Krippel *et al.* 2010). This is not the case of content management technologies and tools (portals, playlists) that provide a contextual meaning of the media - first step to interactivity.

Figure 3. Microsoft Word interactive learning agents

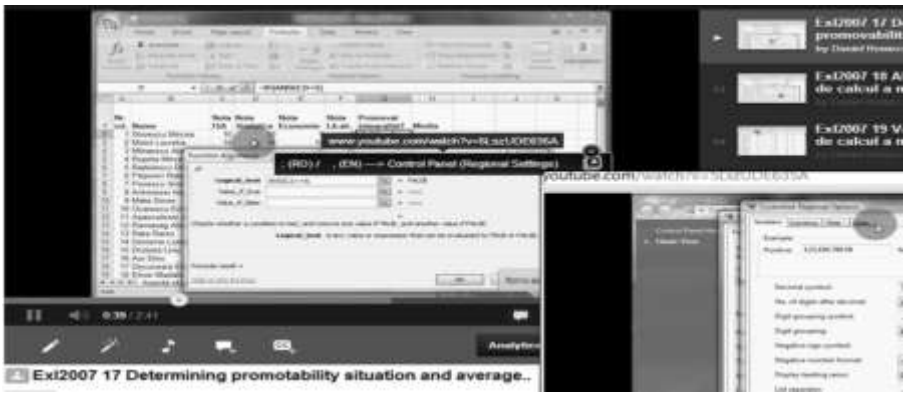

Figure 4. YouTube video portal - external links

A video-camera recording the activity of a computer monitor was always enough to create a VT. Thus we are tempted to conclude that its history is

associated to that of the movie industry which is absurd thinking of the poor processing power of the older computers and the incipient management of older data supports. VTs generally belong to asynchronous e-learning techniques and they consists in arrays of screenshot images called frames automatically presented one after another in a predetermined way with the possibility to turn back using the player navigation bar. When details are important what we need are more frames of recording, a higher resolution, zoom effects and annotations, even with the risk of losing the attention and the memory of the working context. In addition, the best compression possible and specialized capture and editing tools are required. A resolution common for most devices and a file format independent on codec/platform (we still use SVGA and .swf/.mp4) is recommended only when choosing a various target.

Even if the VTs are not basically interactive, they can become interactive by using ad-hoc annotations and links that can be easily added using on-line video tools and platforms as an additional layer over the one represented by the originally recorded material uploaded (Fig 4: playlists - upper-right, contextual externally hyper-linked annotations with comments - upper-left and sequential externally hyper-linked annotations for navigation - "forward"-middle). On the opposite side, screen-shot based tutorials (Fig 6: linked screen shots using highlighted areas) natively ensure the interactivity using links between screens and many other effects. As output they are not something new but the technology behind them has changed dramatically. In order to create an on-line application as support for their development and management in a friendly using manner we need a considerably programming effort, but the effect in terms of interactivity is tremendous.

The tests we have made with You Tube video portal show some advantages by using comments and ratings, playlists and annotations with links between video pieces giving a certain amount of interactivity.

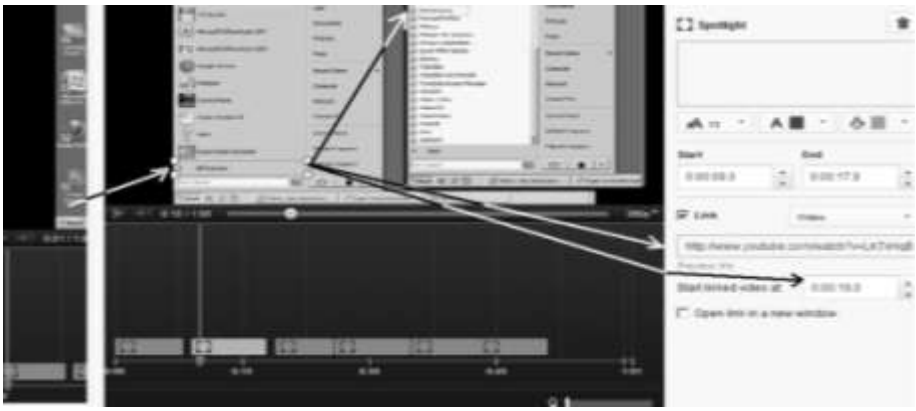

Figure 5. YouTube video portal - internal links

We have been disappointed by the loading gaps between even short linked parts published at different YouTube locations. This costs a lot in terms of user's attention and cause the loss of context. The solution is to use internal links to different moments of the same YouTube address - material (Fig 5: contextual internally hyper-linked annotations which speed-up the running of the tutorial making it also interactive). So we adapt to the user's profile either if he usually watch, does not interfere and to run the tests using the fully functional application at the end after seeing everything or if he is in a rush to understand the logic of the application without having it installed. Some other disappointing disadvantages of YouTube are related to the current lack of support for most mobile platforms when it comes to annotations with links and the limitation of links to YouTube addresses.

The tests made with www.appdemostore.com platform based on HTML5 show how the previous problems were solved changing the support technology and also some other advantages (Fig 6) related to interactivity (linked screen shots, transitions, clickable areas, autotyping, scrolls) and adaptability (device frames).
Managing VTs using the portal technology (e.g. Microsoft SharePoint) can bring tremendous advantages mostly because users can start a work session any time being coordinated or not and using also support files for video tutorials.

Figure 6. Www.appdemostore.com platform - interactive tutorial

The published video content as files with suggestive names containing key words can be organized in folder structures, exported as spreadsheet lists of links (Fig 7: using Microsoft SharePoint to generate a spreadsheet with links to portal resources/tutorials - portal.feaa.uaic.ro), browsed with a local disk manager application (Fig 8: using Microsoft SharePoint to browse a list of tutorials in Windows Explorer) or instantly lunched directly from the portal.

Figure 7. Exporting a list using FEAA faculty portal

More than links to resources stored in various on-line locations, a SharePoint based portal can manage an additional layer consisting in comments, feedback and observations of the user's community.

Figure 8. Browsing a list using FEAA faculty portal

Using VTs in combination with Google forms brings some other advantages as: (a1) the possibility to verify if the users have understood the scenario; (a2) the possibility to automatically quantify the correctness of the responses – Google forms uses Google spreadsheets in order to check out the user's responses to questionnaires or other tests. The main limitation of this video/screen-recording-based technique starts from the simple fact that recording, editing and watching videos takes time (González 2011). For example, Wink (Fig 9: tutorial development tool) allows a very time consuming frame-by-frame annotation.

Figure 9. Video tutorial annotation made in Wink

In addition, watching videos does not stimulate the user to actively participate even in a scenario with a presented software application running in the same time. And that is also caused by the time needed both for watching a tutorial sequence and then actively use the application in a similar way.

4. Extended desktops, mixed video conferences and presentations

Apparently nothing more than a well-known gadget, the second connector of most video adapters enables new horizons when exploiting the familiar "Windows, Icons Mouse and Pull-down menus/Pointing" graphical user interface (Fig 10). Among advantages: low costs/pixel, extended/multi visual perspective, high performance of text processing, high speed control of the application work space and simulative for multitasking.

Figure 10. Extended Desktop as multidimensionality and extension

What we call "a mixed video conferences technique" has the main advantage of a so-called "visual multitasking" difficult to get even with expensive desktop sharing facilities of videoconference software. It also brings additional live feed-back from distance by connecting two working places in a similar way to their natural physical extension (Fig 11).With the risk of distraction it can put together a lot of media inputs for learning. The scenario we have tested includes: the presenter using Skype (peer-to-peer) and MS Power Point, two projectors and two laptops in the front-right corner (the background larger image) and the audience in

the back-right corner of the room of the room (the smaller image - over the upper right side of the background image). The cost per spatial location is actually the price of one additional laptop and projection unit, the Skype video conference software being free in peer-to-peer versions. A great advantage is also the fact that a maximum effect in terms of perception and feed-back can be obtained with reasonable conditions: (1) use this infrastructure in both locations: A and B; (2) capture and transmit both the presentation and the image of the local presenter (A);

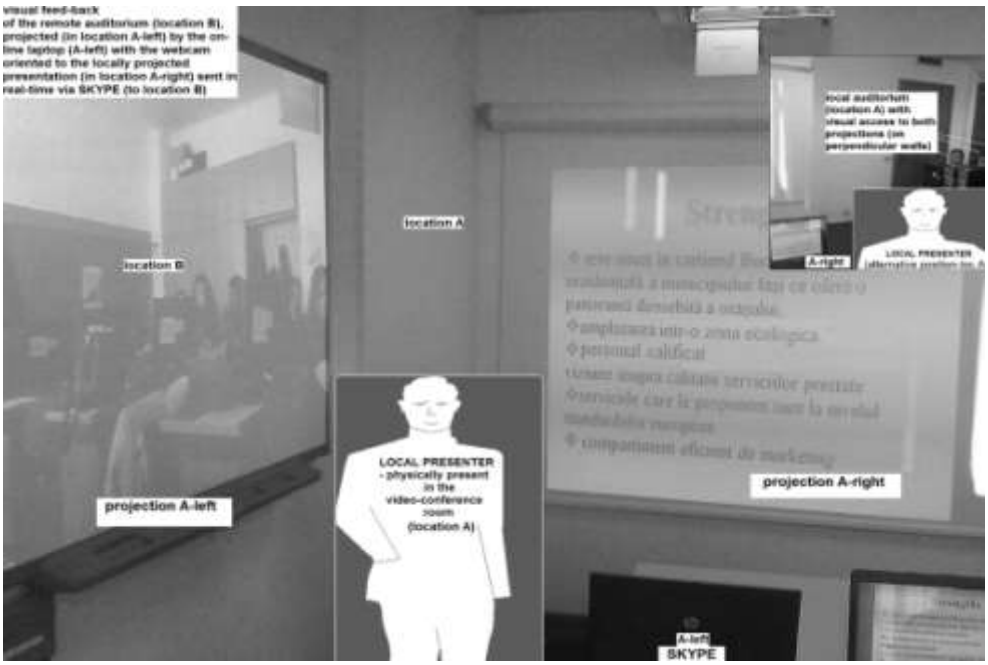

Figure 11. Mixed video conference and presentation room

(3) use a remote control for the local presentation laptop (Fig 11 – A-right laptop) which must have also SKYPE (another connection) and a web camera (external is better - because of flexibility in positioning reasons) oriented to the local auditorium in order to transmit its feed-back to the remote location; (4) receive (using both SKYPE connections) and project both images (see 2,3) at the remote location B; (5) simultaneously capture and send back to A from the remote location B at least the local feed-back and, if necessary another one (B moderator or coordinator, B projection - for transmitting technical details required when asking complex questions); (6) a high speed Internet connection in both places in order to simultaneously support two SKYPE - based video-communication lines.

For optimum performance in using this technique we need to carefully design the conference/presentation room: position of the projecting images (one to another and relative to the target group), distance between the enhanced/external

web camera of the capturing laptop and the first projection (Fig 11 - projection A-right), relative position of the narrator when presenting and narrating that projection. When capturing many external output areas as the projections above or a screen running a Power Point Presentation and simultaneously an application referred in it (Fig 12: video presentations, simple video tutorials and external recorded tutorials), we deal with a mixed video presentation which additionally offers more than a simple narration in terms of content explanation and visual suggestions.

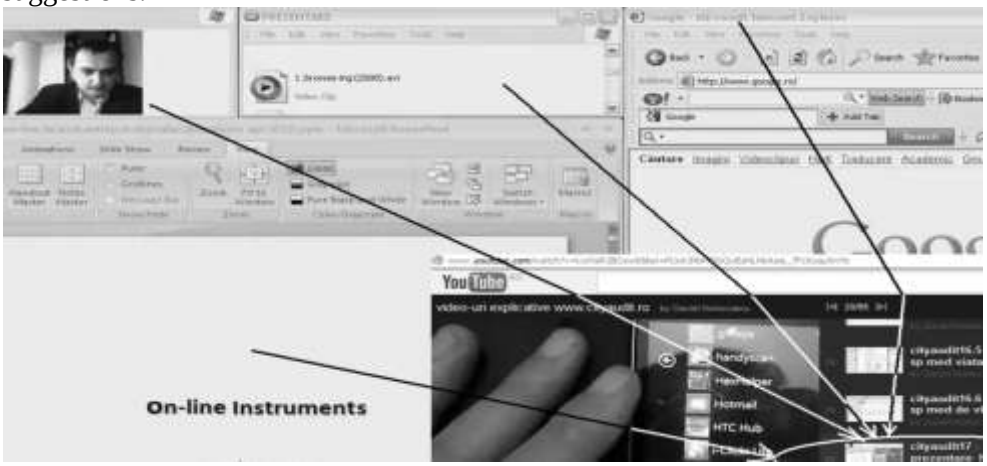

Figure 12. Collection of mixed videos

The example above also shows a mixed video presentation using both audio and video and four output areas captured and included in a 1440x900 high definition video material. These four areas refer to: (I) web camera area/window, (II) disk management application area for files associated to the presentation - Windows Explorer, (III) presentation area - Microsoft Power Point and (IV) browser/on-line application area. All four areas were captured using CAMTASIA Studio application by recording the entire screen. When published on a video portal and integrated within a playlist this mixed presentation will become a component that can be resumed to and acts as a so familiar Power Point presentation slide as well as the rest of the components. The figure 12 actually illustrates a collection of: (a) mixed video presentations recorded with CAMTASIA - background image meaning screen activity stored as a video clip uploaded as a piece of an YouTube playlist; (b) simple VTs recorded with Super Screen Recorder and cut in Virtual Dub – the 16.5&16.6 pieces/first 2 above the selected one; (c) externally (camera) recorded VTs (here a mobile device), all uploaded, annotated and integrated in a 95 pieces playlist - over 6 hours of MM materials in a sequential watch.

Using the extended desktop technique - at least the second monitor / projector, the result will be more suggestive and complex in terms of captured

areas. It will surely over demand the public attention although the well-known saying "A picture paints a thousand words!" still applies.

5. The case study on using MM tools: methodology and findings

The study is based on the analyze of the results obtained from an online questionnaire addressed to the students which follow university studies of one of the major business faculty from Romania, in 2012-2013 university year. The sample was estimated to be representative for the entire population. It results a minimum of 367 respondents for a confidence level of 95%, according to the formula (1), (Plesea *et al.* 2011).

$$n = \frac{N * Z^2 * p(1-p)}{[d^2 * (N-1)] + (Z^2 * 0.25)} \quad (1)$$

Where n=the size of the sample; N = the total population (in our case, the number of the students is N = 8122 students); d=error margin (5%); Z (1.96) =coefficient for the chosen confidence interval of 95%; p= standard deviation (0.5).

As we made this study during one university year, but having a consistent experience in teaching students with MM materials of more than 4 years, we have selected students, graduates, university professors and obtained a target group of 650 possible respondents. We have got 573 valid responses that we analyzed concluding on the impact of many types of MM materials on the learning process.

The main principles and features on which we have constructed our hypotheses could be synthesized in the 4IQ acronym meaning in nine words: Freedom, Organization, Utility, Rating, Intuition, Integration, Interactivity and Inner Quality.

The result of this study are also meant to explain why we have chosen to combine many of the MM types and techniques described before, being also a confirmation of our previous tests and implementations done by taking into consideration the future stage in education where "face-to-face" teaching is only a minor part (Cox 2012) of the e-learning-based system and not vice versa as in the present stage.

The framework of this research consists in four major constructs ((MM's utility, the free and organized access to MM, the interactivity and flexibility of the MM and MM's time duration) and claims four sets of relationships (hypotheses H1, H2, H3, and H4) among these constructs. Each set of hypotheses refers to a significant difference among the respondents surveyed:

Hypothesis 1: Among the respondents surveyed, there is a significant difference in the average score of MM's utility between users which have used MM and users which have not. We have considered four measures: free and organized access to MM provided by a friendly interface (portal, web site), interactivity and flexibility of the MM in terms of navigation, MM's quality and MM's time duration.

Hypothesis 2: There is a significant difference in the average score of MM's free access between users which have used MM and users which have not. Te following three corresponding measures were considered: suggestive given file names, intuitive access to MM files and possibility to save MM files or e-mail them.
Hypothesis 3: There is a significant difference in the average score of MM's interactivity and flexibility as navigation between users which have used MM and users which have not. Two measures were considered: possibility to access another MM basing on useful links and existence of forward and backward options.
Hypothesis 4: There is a significant difference in the average score of MM's quality between users which have used MM and users which have not. Five measures were considered: video quality, cursor's capture, existence of text annotations, of zoom effects, and of supplementary audio explanations.

We distributed our questionnaire to the target group mentioned above. We have started from the premise that all these users which have access and use the Internet are also capable to answer our questions being in the position of the one who needs and uses MM. After several e-mail reminders and cross-posting in social media, a total of 573 usable responses were received. As shown in Table 1 and 2, 5.57% of respondents have not yet used MM, while 94.41% have used MM, 41.88% of total respondents have used MM by their owns, when they wanted to understand concepts, problems or problem-solving methods, 22.68% of total respondents have used MM guided by a professor during a lesson or a video-conference, and 26.52% have used MM either guided by a professor or by their owns.

Table 1: Target group data

		Age				Gender		MM' use		
	Frequency	18-25	26-30	31-40	over 40	M	F	Alone	Guided	Alone and Guided
MM	541	328	62	78	73	181	360	240	130	152
	94.41%	60.63%	11.46%	14.42%	13.49%	33.46%	66.54%	41.88%	22.68%	26.52%
non-MM	32	10	2	6	14	12	20	-	-	-
	5.59%	31.25%	6.25%	18.75%	43.75%	37.50%	62.50%	-	-	-

MM's utility was composed of four measurements. Respondents were asked to evaluate their current satisfaction with MM based on a five-point Likert scale (Likert *et al.* 1932). For the second section of survey regarding MM success factors, a thorough survey of literature was conducted to ensure content validity. We derived 11 important dimensions for this construct, in which all items were scored on a five-point Likert scale ranging from "one = very unimportant" to "five

= very important". If the respondents have previously used MM, respondents were asked to rate the degree of importance for each factor based on their experience. The same questions were also asked to the respondents which have not used MM, with the only difference that we asked the respondents to rate these factors based on their perceptions or related experience.

Table 2: Target group description

	MM		Non-MM			MM		Non-MM	
Administration	7	1.29%	-	-	IT/Other	5	0.92%	-	-
Other	29	5.36%	6	18.75%	IT/hardware	2	0.37%	-	-
Arts/Media	4	0.74%			IT/Software	24	4.44%	2	6.25%
Accounting	17	3.14%	2	6.25%	Marketing/Public Relations	10	1.85%	2	6.25%
Economy	28	5.18%	2	6.25%	Human Resources	2	0.37%	-	-
Education/ Research	68	12.57%	3	9.38%	Health	21	3.88%	1	3.13%
Finances	1	0.18%	-	-	Consultancy	15	2.77%	2	6.25%
Engineering	21	3.88%	4	12.50%	Student	262	48.43%	7	21.88%
Management	22	4.07%	1	3.13%	Turism	3	0.55%	-	-

We presented in Table 3 the average values which we derived in order to analyze the distribution. These characteristics which formed the Part 1 of the survey intended to describe the respondents' profile. For every proposed characteristic, the group of MM's users had greater average values than the group of non-MM's users. We choose to characterize respondents basing on their assessment on: using proper devices and platforms for MM, the importance that professor has in guiding MM's use, the basic use of MM, and the functionalities that respondents like to have in using a platform which offers MM.

Table 3: Mean values of the descriptive characteristics for both groups

	MM	non-MM		MM	non-MM
	541	32		541	32
Multimedia video making tools	2.83	1.84	Problem solving	4.05	3.72
Social Network	4.01	3.22	Sound, picture	3.84	3.50
Mobile devices	3.63	3.06	Naration	3.13	3.13
Proffesor importancy	3.78	3.53	Feedback, evaluation platform	3.72	3.69
Information credibility	3.57	3.13	Comments and ratings	3.66	3.38
Own	2.62	2.41	Video+Audio	4.04	3.75
Books	4.08	3.91	Video+Audio+text annotations	4.11	3.72
Audio	3.20	3.09	PowerPoint	3.81	3.47
Video	3.83	3.41			

We asked the respondents to evaluate the optimal MM's duration time. It seems that the optimal duration time for a MM is one belonging to the 6-10 minutes interval of time (17.1% of total respondents), followed by the interval 3-5 minutes (16.57%). The lowest duration time seems to be one in the 1-2 minutes interval (2.09% of total respondents).

To analyze the hypotheses, we used Levene's tests (Morton *et al.* 1974) to observe if there were any significant differences between the two groups.

We separate the discussion of analysis results into four subsections from the point of view of hypothesis testing. First of all, hypothesis H1 was examined to

determine whether or not the average score of respective utility indicators are equal between the two groups. In the next section, we not only check the overall perception regarding the importance of MM materials success factors, but also investigate the differences in perception between the two groups regarding the free and organized access to MM. Finally in the testing of H3 and H4, we would like to understand whether or not the average scores of MM's interactivity and flexibility indicators and of the MM's quality are equal between the two groups.

As the relation between MM's uses and MM's utility is concerned, Table 4 summarizes the results of utility comparison between the two groups showing that on average MM's users are much more satisfied than users which have not used MM for all utility indicators. Overall, MM's users seems to be more satisfied with their MM's interactivity and flexibility in terms of navigation, while MM's time duration have the lowest average score for both groups. To further evaluate whether the performance differences are significant, the Levene's tests were used (Table 4) to test the null hypothesis $\mu_{i,MM} = \mu_{i,non\text{-}MM}$, where $\mu_{i,MM}$ and $\mu_{i,non\text{-}MM}$ denote the average scores of utility indicator i for MM and non-MM users, respectively. We also applied Levene's test (Morton *et al.* 1974) for equality of variances to determine whether equal variances should be assumed for this hypothesis testing. As Levene's test for MM's interactivity and flexibility in terms of navigation is the only assessment in which the null hypothesis could be accepted, we can infer that the two groups are identical in terms of our assessments. Notably, the findings for MM's interactivity and flexibility in terms of navigation suggest that this factor has positive effects on the users' overall satisfaction. The result may motivate to consider navigation as an input for the process of training using MM materials.

Table 4: Users' satisfaction comparison between MM's users and MM's non-users

MM's utility indicator	Average score		Levene's test	*p*-value (significance level)
	MM	Non-MM		
The given free access, online, well organized and available through a friendly interface	4.16	3.81	0.33	0.561
MM's interactivity and flexibility in terms of navigation	3.94	3.59	3.009	0.083*
MM's video quality	4.07	3.84	0.073	0.785
MM's time duration	3.62	3.44	0.964	0.326

*Significant at p<0.1

As the relation between MM's utility and the free given access is subject of questions, Table 5 summarizes the results of free access means comparison between the two groups. It indicates that on average MM's users are much more satisfied than users which have not used MM in terms of having online, free access, organized and offered through a friendly interface such as portal or web site. Overall, MM users seems to be more satisfied with their possibility to save the video file or to send it via e-mail, while the intuitive access to video materials have the lowest average score for both groups. To further evaluate whether the free access differences are significant, the Levene's tests were used (Table 5) to test the

null hypothesis $\mu_{i,MM} = \mu_{i,non\text{-}MM}$, where $\mu_{i,MM}$ and $\mu_{i,non\text{-}MM}$ denote the average scores of free access indicator i for MM and non-MM users, respectively. We also applied Levene's test for equality of variances to determine whether equal variances should be assumed for this hypothesis testing. As all of the p-values are greater than a minimum confidence level of 0.05, we can infer that there is no difference between the two groups in terms of their preferences concerning the free access at MM materials. However, the resulted p-value of 0.115 for the possibility to save the video file or to send it via e-mail confirmed the fact that MM's users are more prone to save the necessary files than non-users are.

Table 5: Comparison of MM's free access indicators between MM's users and non-users

MM's free access indicator	Average score		Levene's test	*p*-value (significance level)
	MM	Non-MM		
Suggestive given names for video files	3.89	3.41	1.875	0.171
The intuitive access to video materials	3.65	3.28	0.659	0.417
The possibility to save the video file or to send it via e-mail	4.09	3.72	2.487	0.115

As the relation between MM's utility and the interactivity and flexibility offered is concerned, Table 6 summarizes the results of interactivity and flexibility comparison between the two groups. It indicates that on average MM's users are much more satisfied than users which have not used MM in terms of the interactivity and flexibility offered. Overall, MM's users seems to be more satisfied with their possibility to have available the options of forward and backward, while the existence of useful links is very important for MM's users and the most important for our test. To further evaluate whether the interactivity and flexibility differences are significant, the Levene's tests were used (Table 6) to test the null hypothesis $\mu_{i,MM} = \mu_{i,non\text{-}MM}$, where $\mu_{i,MM}$ and $\mu_{i,non\text{-}MM}$ denote the average scores of interactivity and flexibility indicator i for MM and non-MM users, respectively. We also applied Levene's test for equality of variances to determine whether equal variances should be assumed for this hypothesis testing. As all of the Levene's tests are positive and significant, we can infer that the two groups differ in terms of their assessments of our indicators. It seems that the existence of useful links between different MM materials has a great importance among MM surveyed users. Therefore, we reject the null hypothesis and consider that MM's utility depends very often on the interactivity and flexibility offered.

Table 6: Comparison of MM' interactivity & flexibility indicators between MM's users and non-users

MM's interactivity and flexibility indicator	Average score		Levene's test	*p*-value (significance level)
	MM	Non-MM		
The existence of useful links	3.92	3.41	4.38	0.036
Forward/ Backward options	4.22	3.88	1.579	0.209

*Significant at p<0.05

As the relation between MM's utility and the quality of the MM materials is subject of questions, Table 7 summarizes the results of video materials' quality comparison between the two groups. It indicates that on average MM's users are much more satisfied than users which have not used MM materials in terms of quality offered. Overall, MM's users seems to be more satisfied with their possibility to have supplementary audio explanations and video quality, while the existence of cursor's capture is of lower importance. To further evaluate whether the quality differences are significant, the Levene's tests were used (Table 7) to test the null hypothesis $\mu_{i,MM} = \mu_{i,non\text{-}MM}$, where $\mu_{i,MM}$ and $\mu_{i,non\text{-}MM}$ denote the average scores of MM's quality indicator i for MM and non-MM users, respectively. We also applied Levene's test for equality of variances to determine whether equal variances should be assumed for this hypothesis testing. Our results showed that none of the Levene's tests is significant. However, the values of the tests are positive which means that MM users gave a greater importance to our indicators than non-MM users.

Table 7: Comparison of MM's video quality indicators between MM's users and non-users

MM quality indicator	Average score		Levene's test	*p*-value (significance level)
	MM	Non-MM		
Video quality (working performance and resolution)	4.11	3.78	1.508	0.219
Cursor's capture	3.52	3.25	0.229	0.631
Text annotation	3.68	3.22	1.020	0.312
Zoom effects	3.78	3.41	0.465	0.495
Supplementary audio explanations	3.9	3.69	0.093	0.759

We asked users to evaluate four components which we considered to be important for the structure of a MM: the presence of a narrator, having some suggestive images, the presence of slides, and the existence of a demo into a MM.

Table 8: Comparison of MM's structure indicators (4 components) between MM's users and non-users

	narator		suggestive images		slides		demo	
	MM	non-MM	MM	non-MM	MM	non-MM	MM	non-MM
10%	**27.36%**	1.26%	9.12%	0.63%	**50.31%**	3.14%	**27.36%**	1.26%
20%	**24.53%**	1.26%	24.21%	3.14%	**34.91%**	1.57%	**23.90%**	1.26%
30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
40%	17.30%	0.94%	**30.19%**	0.94%	11.32%	0.63%	19.18%	0.94%
60%	11.95%	0.31%	9.43%	0.31%	0.63%	0.00%	6.60%	0.31%
70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8 presents our main findings. It seems that the ideal composition of a MM would have to be: around 30% from MM's time duration the presence of a narrator, around 30% from MM's time duration the presence of some suggestive images, around 20% from MM's time duration the presence of slides, and around 20% from MM's time duration the run of a demo. In proposing this composition we simply did an approximation of the average of the biggest and nearest values.

6. Conclusions

The use of MM opens the gate to both efficient and effective ways to teach pragmatic skills and not only. All categories of users which we have questioned have chose features that determined us to conclude about a certain combination of components and techniques to use in our future developments and researches. Most responses emphasized intuition and suggestion based components as preferred. Those related to the presence of the trainer gestures are included in this preference. The need for organizing such materials as slides and videos comes secondly. Such components also gave us an idea of priority of MM development tools to use: video conference applications and recordings, narration tools, development platforms of interactive lessons, trainings and tests, portal and presentation applications and VT development tools.

The impact on the common user of MM materials was concluded to be significant. But this was not the case of MM development tools mainly because they are less known and used. So the current experience of the common user with educational MM could be described as average.

Another conclusion is that MM materials have an overall positive influence on common users' behavior. The main reasons are: they help better understanding through the use of many input channels and they create motivation for action and decision with great impact on lifelong learning.

Our general conclusion concerns the importance of how we have to deal with MM. In other words, it is crucial not just to store the MM, but to find the appropriate combination and the right tools to make it accessible to various types of users, skills, preferences, purposes and tasks.

REFERENCES

[1] **Airinei D., Homocianu D. (2010),** ***The Importance of Video Tutorials for Higher Education - The Example of Business Information Systems***; *Proceedings of the 6th International Seminar on the Quality Management in Higher Education*;
[2] **Bagui S. (1998),** ***Reasons for Increased Learning Using Multimedia****; Journal of Educational Multimedia and Hypermedia* 7, 3-18;
[3] **Bartlett R. M., Cheng S., Strough J. (2003),** ***Multimedia versus Traditional Course Instruction in Undergraduate Introductory Psychology***; *Teaching of Psychology* 30, 335-338;
[4] **Cox M. J. (2012),** ***Formal to Informal Learning with IT: Research Challenges and Issues for e-learning***; Journal of Computer Assisted Learning 29, 99-100;
[5] **Craig, R. J., Amernic J. H. (2006),** ***PowerPoint Presentation Technology and the Dynamics of Teaching***; *Innovation in Higher Education* 31, 147-160;
[6] **Daniels L. (1999),** ***Introducing Technology I the Classroom; PowerPoint as a First Step***; *Journal of Computing in Higher Education* 10, 42-56;
[7] http://www.e-learningconsulting.com/consulting/what/e-learning.html
[8] **Fernández González M. J. (2011),** ***Advantages and Limits of Video-Recording as a Tool for Students, Teachers and Researchers in Music Conservatoires***; *Proceedings of the International Conference the Future of Education*;
[9] **Gilakjani A. P., Ismail H. N., Ahmadi S. M. (2011),** ***The Effect of Multimodal Learning Models on Language Teaching and Learning***; *Theory and Practice in Language Studies* 1, 1321-1327;
[10] **Hartman F. R. (1961),** ***Single and Multi-channel Communication: A review of research and a proposed model***; *AV Communication Review* 9, 235–262;
[11] **Kalyuga S. (2005),** ***Prior Knowledge Principle in Multimedia Learning;*** *The Cambridge Handbook of Multimedia Learning*;
[12] **Kalyuga S., Chandler P., Sweller J. (1999),** ***Managing Split Attention and Redundancy in Multimedia Instruction***; *Applied Cognitive Psychology* 13, 351-371;
[13] **Krippel, G., McKee A. J., Moody J. (2010),** ***Multimedia Use in Higher Education Promises and Pitfalls***; *Journal of Instructional Pedagogies*, 1-8;
[14] **Likert, R. A. (1932),** ***Technique for the Measurement of Attitudes***; *Archives of Psychology* 140, 1055;
[15] **Low, B. R., Sweller J. (2005),** ***The Modality Principle in Multimedia Learning***; Cambridge University Press;
[16] **Malik S., Agarwal A. (2012),** ***Use of Multimedia as a New Educational Technology Tool – A Study***; *International Journal of Information and Education Technology* 2, 468-471;

[17] **Mayer R. E., Chandler P. (2001),** ***When Learning is just a Click away: Does simple interaction foster deeper understanding of multimedia messages?*** ; *Journal of Educational Psychology* 93, 390-397;
[18] **Mayer R. E., Sims V.K. (1994),** ***For whom is a Picture Worth a Thousand Words? Extensions of a dual-coding theory of multimedia learning***; *Journal of Educational Psychology* 86, 389-401;
[19] **Mayer R. E. (2003),** ***Learning and Instruction***; Prentice Hall;
[20] **Mayer R. E. (2005),** ***Principles of Multimedia Learning Based on Social Cues: Personalization, Voice and Image Principles****; The Cambridge Handbook of Multimedia Learning*, Cambridge University Press;
[21] **Morton B. B., Alan B. F. (1974),** ***Robust Tests for the Equality of Variances***; *Journal of the American Statistical Association* 69, 364-367;
[22] **Plesea D., Pamfilie R., Maiorescu I. (2011),** ***Relatia dintre structura comunicării si evitarea incertitudinii reflectată în designul site-urilor web românesti***; *Amfiteatru Economic Review* 13 (5), 631;
[23] **Pollock E., Chandler P., Sweller J. (2002),** ***Assimilating Complex Information***; *Learning and Instruction* 12, 61-86;
[24] **Scaife M., Rogers Y. (1996),** ***External Cognition: How Do Graphical Representations Work?*** *International Journal of Human-Computer Studies* 45, 185-213;
[25] **Severin W. J. (1967),** ***The Effectiveness of Relevant Pictures in Multiple Channel Communication***; *AV Communication Review* 15, 386– 401;
[26] **Timothy E. (2004),** ***Animating to Build Higher Cognitive Understanding: A Model for Studying Multimedia Effectiveness in Education***; *Journal of Engineering Education* 93, 59–64.