From 2D to augmented reality

Findings from a Delphi study on innovative media tool

Albertina da Conceição Dias
Universidad de Huelva, Facultad de
Ciencias Empresariales - GITICE
Plaza de La Merced,11.   21071
Huelva, España
albertina.dias@mibook.org

Mercedes García Ordaz
Universidad de Huelva, Facultad de
Ciencias Empresariales - GITICE
Plaza de La Merced,11.   21071
Huelva, España
ordaz@uhu.es

José Francisco Martínez López
Universidad de Huelva, Facultad de
Ciencias Empresariales - GITICE
Plaza de La Merced,11.   21071
Huelva, España
francis@uhu.es

Abstract—**the aim of this paper is to present the findings of a Delphi research on the challenges of bringing new possible business models, economically efficient and socially effective when exploring the new media tool for enhanced learning based on the technology of augmented reality, the multimedia interactive book.**

Keywords-augmented reality; Delphi research; enhanced learning; multimedia; business model, societal and economic development, efficiency, interactive book.

I.   FROM 2D TO AUGMENTED REALITY

The most gifted painters of the Renaissance period, and in particular Leonardo Da Vinci (1452-1519) had to resort to innovative concepts for their time, such as of projective geometry, to create their paintings with a three-dimensional aspect. This third dimension is conveyed by emulating in a drawing or a painting, the human visual system image creation process, which generates in the brain a perspective image of the world sensed by the human eyes. As already noticed by the Renaissance artists, the perceived dimensions of the objects in the image plane, show an inverse proportionality with the depth of the same objects, an important propriety that has been also understood and mapped by the computer graphics scientists in the 60s. Computer graphics have become much more sophisticated, generating photo-realistic images, in such applications as special effects for movies, real-time video-games, critical industries such as aerospace, automotive, or other sectors like, industrial product design, advertising and education. In Fig. 1, we depict an image with 2D graphics (left) and 3D graphics (right).
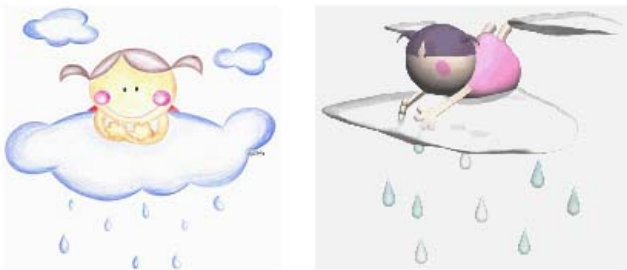

Figure 1.   Left: 2D image of real painting, copyright 2006 Mariana Dias; Right: 3D model, copyright 2006 SbH - Solutions by Heart, Ltd.

Only 3D allows for an enriched interaction and visualization of the scene, including a perception of depth, by means of virtual navigation and examination including the possibility to translate, rotate the virtual camera and the objects.

Augmented Reality (AR) is a multidisciplinary field of computer science, involving areas like 3D Computer Graphics, Computer Vision and Human-Computer Interaction, which deals with the combination of real-world and computer-generated virtual reality, where computer graphics objects are blended into real video footage in real time. The advances in the field of Augmented Reality (AR) technology offer a wide range of opportunities to the creation of new enhanced learning tools, providing more realistic context support incorporated with interactive scenarios, and bringing learners into contact with alternative interpretations and views.

This enhancement provided by AR derives from the computer-generated information which is usually registered in 3D space and related to objects and places in the real world. Considering AR as a visualization and interaction technique, the relationship of real and virtual objects maybe focused and contextualized in two different aspects: (1) To provide additional virtual context to an important object in the real world, or; (2) Enable the user to focus on a virtual object embedded in a real context. In both cases, AR generates the final image by overriding parts of the real-world imagery with synthetic images taken from 3D scenes [1].

This paper presents the Delphi research results of the exploitation of a product called multimedia interactive book (miBook) [2], which uses augmented reality interfaces, and proposes a novel tool that may impact learning efficiency. The miBook is the combination of a printed book (or its digital format) with the respective audiobook and its story-related 3D models (as well as 2D graphics), using technologies, like AR and other as multimedia as well, as frameworks to present and interact with audio-visual content. The miBook research project introduced a new methodological approach for learning based on the miBook prototype that was first utilized in 2006. Successfully tested in the real market, during the miBook's usage assessment studies [2] five consumers' experience revealed an enhanced learning experience in these ways: (1) adding visualization to a standard textbook enhanced its value as an educational material; (2) the visualized text is easier to understand and thus learning process is fostered (3) audio-visual content is more attractive than standard text books (4) adding visualization features to a standard text book creates a new media concept and possibilities, resulting in completely

new educational instrument and (5) miBook is a very intuitive and easy to use authoring tool that allows for greater creativity during the process of preparing educational material.

This paper is organized as follows. After the introduction (section I) concerning the related technological advances which allowed such innovative media, followed by a brief presentation of this enhanced learning tool and its previous research results focused on learning efficiency and envisaging exploring opportunities for the educational materials in the field of computer science envisaging to foster learning efficiency, section II focuses on a brief literature review on the Delphi technique and simultaneously describes (section III) the adherence and adequacy of the Delphi analysis for this research purpose regarding miBook's possible business models resulting from the first round questionnaire. Afterwards, in section IV, the final research results on the Delphi miBook studies are presented followed by the analytical summary which categorizes two possible business models for the miBook tool. Last section (section V) resumes some conclusions addressing related issues such as mobile learning or the web based innovation system and describes some future work.

II. LITERATURE REVIEW

The Delphi analysis is especially appropriate in new and constantly evolving scientific fields [3], being able to build more useful and effective prediction upon study objectives. Within the general methods of forecasting, as for instance the extrapolative method where historical available information is gathered looking into possible evolutionary trends or cycles or the correlation methods, in their attempt to see what factors are involved in development and how much influence they have in regard to determine the possible storyline that will continue all these factors, the Delphi methodology is based on consultation with people who are very knowledgeable about the environment in which the research carries out its work. These people write a report showing what are in their point of view, the possible alternatives within the future established by the research target. The Delphi technique, unlike other methods such as focus groups or nominal groups, provides information and reviews from experts physically far apart, and enables the generation of ideas with open questions, well structured with qualitative components added. It is also a consensus technique that avoids face to face confrontation of experts, allows the prioritization of the ideas raised by participants and encourages a thoughtful and confidential exchange of views among participants before a final solution. This method aims to extract and maximize the advantages offered by the methods based on expert groups and minimize its disadvantages. Taking advantage of the synergy of group discussion and removing undesirable social interactions that exist within any group, such as influences by hierarchies. This is expected to reach the most reliable panel consensus.

Summarizing, whenever the impacts of external factors have more influence on the evolution of the internal factors and the cultural, ethical or moral considerations dominate over economic and technological changes in an evolutionary process, the Delphi technique is able to obtain and refine group judgments. The consensus is obtained by a mathematical procedure of aggregating individual judgments.

Procedures of the Delphi method involve sending successive surveys to a group of experts previously chosen. With each new round, panelists receive feedback of the responses' concentration and dispersion in the previous phase, and they are asked to ratify or rectify. It should be stressed that although the method involves surveys, it is not sampling, nor is it to get the parameters of a distribution.

The Delphi technique differs from current surveys in some aspects which can be summarized as follows [4].

Anonymity: no expert knows the identity of others that make up the panel discussion. Responses are anonymous, which prevents most prestigious participants greatly influence the opinions of others. This anonymity is understood in the sense that each expert does not know how the others have answered, except in the aggregate form. Each expert of the panel is considered equally and does not represent the institution to which they are linked. This also facilitates greater openness of views as well as greater level of flexibility because each participant can learn in between rounds and change his initial opinions without being influenced by the opinions of experts with more prestige and without loss of image credibility. The only possible influence is the consistency of the arguments;

Iteration and controlled feedback: the iteration is achieved by repeatedly presenting questionnaires on the analyzed problem and each round can be influenced by the outcome of the previous round. These successive iterations of the questionnaire provide feedback information on the opinion of the panel and in each subsequent submissions, the expert has to confirm or rectify his opinion;

Statistical form: the information presented to the experts is not only in terms of the majority, but all views are presented indicating the degree of agreement that has been obtained. There is a process of anonymous interaction trend towards convergence in the resulting opinion of the group.

Therefore, the essential elements of the Delphi method are (a) the panel of experts: these are the people chosen to formulate his opinion about the problem questions. The choice should fall on those most competent in the field and, if possible, who may have different perspectives, thereby tending to the selection of some interdisciplinary groups; (b) the questionnaire which is typically more open in the first round, i.e. non-structured, with a first set of open questions, though more difficult to analyze, allowing some degree for creativity and freedom of the participant and enriching the scope of analysis, and (c) the number of rounds needed to obtain convergence among experts' opinion.

III. THE DELPHI MIBOOK RESEARCH

A. Adherence of the Delphi method in miBook research

The miBook research illustrates the need for the creation of innovative business models along with the need for the validation of the identified benefits from the first usage evaluation process in the real market. On one hand, the adherence of this Delphi methodological approach for miBook

research appeared to be reasonable considering already known results in driving this method in the fields of Information Systems (IS) and Information Technology (IT). On the other hand, alternative scientific methodologies like the "discussion groups" or Focus Groups could create problems of biased responses due to the predominance of opinion leaders [5]. Furthermore, during Exploration phase of miBook research, aiming to obtain hypothetical new technological enhanced learning scenarios, and in particular identify the possible miBook's benefits and major developers of new business models, the Delphi survey was chosen due its historical known appropriateness concerning forward planning to establish hypotheses about the development of scenarios and on their socio-economic implications. Fundamentally, the method serves to clarify aspects of the evolution of a situation, to identify priorities or to display different future scenarios. For example, it has been widely used to generate forecasts in the areas of technology, education, among others [3].

The Delphi miBook research gathered twenty-eight experts from inter-disciplinary fields of expertise with the following percentage weights of participation resumed below on Table I.

TABLE I.   CHARACTERIZATION OF THE PANEL OF EXPERTS

Teaching activities	Fields of Expertise	Country	Academic Background
Teaching (67,9%)	Education and training (35,7%)	Spain (25,0%)	PhD[b] (75,0%)
	Information and Communication Technologies (28,6%)	Portugal (57,1%)	Sc. Master[c] 14,3%
Other activities (32,1%)	Economics, Business and Social Research (17,9%)	Other EU[a] (17,9%)	
	Policy and Decision-makers (17,9%)		Sc. Degree[d] (10,7%)

a. Other European countries. b. Philosophy Doctor. c. Scientific Master. d. Scientific Degree

The qualifications and set of skills of the experts were ranked according to exposure and experience with teaching activities and enhanced learning initiatives. Furthermore the identification of experts for miBook Delphi panel was based on a multiple-step approach [6], which required the preparation of a list of contacts with knowledge resources in the selected fields of expertise previously mentioned above. After the first initial contacts with selected experts in each of the fields of expertise and it was used the 'snowball' sampling method [7], that is to say, the first selected experts were asked to provide recommendations for other possible valuable participation in the survey. In order to minimize possible non-response from invited experts, one of these initial contacts introduced both the researcher, the study theme and presented a demonstration of the miBook prototype (in presence or virtually) to a larger group of potential respondents to the miBook survey [8].

As recommended, once the experts agreed to participate, the first round questionnaire was sent by e-mail [6]. The survey used both unstructured questions, as a method to extract how each individual responds to the questions and avoids limiting the range of answers, and also used structured questions in order to compare/contrast experts' responses to a research answer and increase the reliability and credibility of research data [9].

The miBook survey has obtained reasonable convergence and divergence among experts' opinion on the second round thus achieving the previous targeted exploratory scenarios.

B. Results on the first round questionnaire

The aim of this first round was to determine the level of consensus on the ranking of the relevant factors. For each item and question the following analysis was performed.

The panel of experts was given a list of five questions (both structured and unstructured as already mentioned above) for initial ratification and discussion, following recommended approach, i.e. questions were identified from previous research results compared with the literature review in the relevant scientific fields related, in order to avoid having unreasonable brainstorming [10].

The selected questions presented to the panel of experts were the following: (1.1) In order to create an economy that will prosper, what are the capabilities listed that are most important at present and which of them must be the most important in the near future, especially considering the economies of Portugal and Spain?; (1.2) Identify and briefly describe the factors which, in your opinion, are the most important to the success of the learning process; (1.3) Do you consider that the inclusion of new learning tools in schools, universities or enterprises would be a relevant factor for the economies of the Iberian Peninsula?; (1.4) As a teacher or as a learner, what is the importance and percentage of use of the following educational materials (Table III) for increased efficiency in learning?; and (1.5) Considering that the average cost of a miBook is ten Euros (including book, audiobook summary or abridged audiobook, augmented book, so to say the AR license for accessing and interacting with 3D contents), which business scenario seems to be more likely in the next 5 years?

At first glance, from the initial descriptive statistical analysis, apparently, there is a growing importance of all the listed Economic and Social capabilities (Table II) in the near future (2014), since the mean valorization is higher within a period of five years. However, there isn´t sufficient statistical evidence for this conclusion and these mean values maybe simply due to the randomness of the data. The Intellectual factors such as Knowledge and Learning (K&L) capabilities provide easier acquisition, processing and use of information resources, which it turns out to be much more effective in creating economic value and enhancing the Innovation and Entrepreneurship (INN) capacity of people and organizations. Coherence in Policies' Management and execution (MGT) have been critical for innovation national systems, as well as sharing the knowledge about common problems in different countries and planning for establishing mutual advantages relationships. Digital and Internet Access (DIA) is then an essential opportunity for any community by allowing benefits of the new technologies and decreasing economic and knowledge barriers among countries. Communication and

Future Vision (CFV) seem to be another important capability in terms of co-operation and collaboration among the most innovative countries.

To obtain a response on differences in a paired-means (2009 versus 2014), with a 95% level of confidence, it was performed a nonparametric statistical test[1] known as Method of Wilcoxon [11] which results indicate statistical evidence that all economic and social variables analyzed are considered to be much more important in 2014. The adoption of nonparametric tests is due to the lack of normality in the variables, typical of a small sample size. These tests, like the Wilcoxon one, can be even more powerful than the parametric ones [12]. Given the fact of dealing with related samples tests, Wilcoxon test is a reliable nonparametric alternative to the t test [13]. This test allows for the analyses of the differences between two conditions (like pre and post test) in the same groups of individuals. This test was applied to variables K&L, INN, MGT, DIA, CFV and the results highlight a growing importance of the selected variables in the next five years.

TABLE II.   ECONOMIC AND SOCIAL CAPABILITIES

Abbreviation	Economic and Social capabilities	Mean		Z / Asymptotic Significance (Bilateral)
		2009	2014	
K&L	Intellectual[a]	6,32	8,21	-3,587**/0,000
INN	Innovation & Entrepreneurship	6,39	8,07	-3,860**/0,000
MGT	Management[b]	5,43	7,25	-2,835**/0,005
DIA	Digital & Internet Access	5,96	7,96	-3,508**/0,000
CFV	Communication & Future Vision	5,64	7,36	-3,008**/0,003

a. Knowledge and Learning. b. Coherence in policies execution. ** Sig. < 0,01

The second question followed unstructured method aiming to identify the main factors which, in the opinion of the panel, are more important to the success of the learning process as well as the weight of each of them for each expert when considering in his own self opinion. A Pareto analysis was performed in order to catch information not only about the most frequent causes that may impact learning efficiency but also to evaluate the magnitude of these factors. A preliminary qualitative analysis regarding the brief description of these factors obtained from the experts' answers suggested, at least ten different types of such factors (Social, Economic, Political, Education, Learning, Pedagogy, Cultural, Networks, Technology and Future Work Perspective). After the Pareto analysis, results demonstrate that the first five factors, Social, Economic, Political, Education and Learning cover 83% of the impact on learning efficiency.

A high level of consensus was achieved on question (1.3) with converging opinion among the panel. The great majority (around 96%) of the inquired sample agrees that the inclusion of new learning tools in schools, universities or enterprises would be a relevant factor for the economies of the Iberian Peninsula.

---

[1] PASW18 (formerly SPSS Statistics) was the software used to perform the statistical tests. © 2010 SPSS Inc., an IBM Company. All rights reserved.

On the fourth question the panel of experts was asked about the current and future (again within five years) importance and percentage of use of five different types of educational materials: book, e-book, audiobook, video and miBook.

Descriptive statistical analysis enlightened an average decrease in the level of appreciation and percentage of use of printed books; an increasing importance and usage of e-books and audiobooks; video seems to be equally important within the next five years but the percentage of use is expected to grow on average (3%); and finally, miBook is expected to increase the level of importance as well as in percentage of use, pretty much along the results of the audiobook analysis (Table III).

Once again, it was adopted the already mentioned nonparametric test of Wilcoxon due to the lack of normality in the variables, typical of a small sample size [11, 12 and 13]. The results highlight that the importance and percentage of use of video will not be significantly different in 2014; furthermore, the results also indicate that the e-book, the audiobook and the miBook will probably assume greater importance as well as percentage of use, as educational materials, within the near future (2014) and, the traditional book will lose importance.

TABLE III.   EDUCATIONAL MATERIALS IMPORTANCE

Educational materials	Analytical perspective	Mean		Z / Asymptotic Significance (Bilateral)
		2009	2014	
Book	Importance	7,81	6,74	-3,225**/0,001
e-book		5,00	6,89	-3,617**/0,000
Audiobook		3,15	4,78	-3,595**/0,000
Video		5,54	6,31	-2,362*/0,018
miBook[a]		3,30	6,40	-3,742**/0,000
Book	Percentage of Use	57%	35%	-4,208**/0,000
e-book		17%	22%	-2,570*/0,010
Audiobook		6%	9%	-2,389*/0,017
Video		15%	18%	-1,756 NS/0,079
miBook[a]		6%	16%	-3,520**/0,000

a. or other new media similar tool based on AR. ** Sig. < 0,01. * Sig. <0,05. NS - Not significant.

When considering the scenario that the average cost of a miBook is ten Euros the results suggest that all types of business models might have a positive impact, although some experts pointed out few reasonable justifications to consider the four types of identified institutions (Universities, Government, Private companies, or partnership between some or all of them) as negative for establishing the new business models for the miBook tool. However, the analysis to be acceptable it would need further information and therefore this question was reformulated in the second round of the Delphi survey.

IV.   RESULTS OF THE DELPHI MIBOOK RESEARCH

The results from the first round conducted to the decision of removing the questions three and four from the original

questionnaire; since there was evidence of converging opinions in what it concerns the need of new enhanced learning tools and also, considering the achieved reasonable consensus that, in the near future the importance and percentage of use of the e-book, the audiobook and the miBook will probably assume greater importance and percentage of use within the near future.

Each expert, informed of the results of the first round, was asked to send new answers in a second round and, to justify them if they differ from the overall. In this second round, the comparison of the experts' views had a moderating influence which came facilitating the existence of convergence among initial different opinion. It is important to mention that the analysis of the Delphi data and the summary of the proceedings should be undertaken on the basis of statistical analysis (for example, cluster analysis or factor analysis) to identify convergences and divergences in the answers [14]. On the second round questionnaire the group of questions (1.1), (1.2) and (1.5) were reformulated in order to obtain further and accurate results.

This time, Factor analysis was the statistical method[2] used for this analysis due to the possibility this technique offers in gaining information on the interdependencies between observed variables that may be used later to reduce the set of variables without decreasing information quality [15]. Another main application of factor analytic technique consists in detecting the structure in the relationships between variables or to classify the variables. The adequacy degree of adjusting the sample data to a factor analysis is usually measured with Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests. This multivariate statistical method can be successfully employed once the KMO test is greater than "0,5" which indicates that the observed variables have correlation between themselves and, therefore suggesting that factor analysis will be a useful technique [16]. For determining the number of factors to retain, the Kaiser rule (probably the most widely used) established that, only factors with Eigenvalue[3] greater than one should be retained [17]. The same is to say that unless a factor (or a principal component) should extract at least as much as the equivalent of one original variable, otherwise it should be dropped. The Bartlett test of sphericity indicates that the correlation matrix is not an identity matrix, as postulated by the null hypothesis and, that the determinant of the correlation matrix is significantly different from the identity matrix. In this case the null hypothesis is rejected[4] and it does make sense to perform a factor analysis, as this suggests that there is great redundant information and therefore, the number of factors needed to explain a high percentage of information decrease comparing the original variables.

The first question of this second round (2.1) is a new one and it was strategically asked after obtaining the results on the third and fourth question of round one. The panel is confronted with the following hypothetical statement: miBook is a conceptual model capable to develop an innovative enhanced learning model based on cultural heritage (blended text, audio, image, video and various unstructured contents). The identified miBooks' main benefits in the learning process (resulting from the pilot test on miBook's usage evaluation [2] and listed above in section I) were then sent to the experts to evaluate them (Table IV). Factor analysis was performed for the study and interpretation of the correlations found among the group of benefits of using miBook in the learning process (observed variables) in order to identify possible factors common to all of them trying the possibility to obtain a lower number of unobserved variables (factors[5]).

The KMO test is greater than "0,7" (Table IV) which indicates high correlation between the variables and therefore factor analysis is pretty much adequate. Given the result of Bartlett test of sphericity, it is possible to reject the null hypothesis, also confirming the adequacy of performing factor analysis.

TABLE IV.   PRINCIPAL FACTORS EXPLAINING MIBOOKS' BENEFITS

miBooks' Benefits	Factor
Dynamic audiovisual contents are easier to understand since we are able to value reason and calculate (contents' mental construction) in a more complete scenario than just reading and listening. Self management over contents (self control on visualization of relationships among different concepts) motivates learners' interest.[a]	CREATIVITY
Augmented Reality (AR) feature provides an enhancement to the user's cognitive perception of the real world and situational awareness, in indoor and outdoor environments.[b]	REALISM
Adding visualization to text book enhances our ability to understand contents. Easy to use authoring tool (possible to create/select self learning contents) that can be used in fixed workplaces and, that can be accessed from everywhere through internet or using mobile handheld devices with camera.[c]	ACCESSIBILITY
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,726
Bartlet's test of Sphericity / Approx. Chi-Square	190,557
Degrees of freedom	45
Sig.	0,000

a. Summarizing three of the identified benefits. b. *Idem*. c. Summarizing four of the identified benefits.

The original variables of the sample may then be explained in three different factors: Creativity (almost 33% of variance), Realism (25% of variance) and Accessibility (22% of variance) which together may explain 81% of total variance) and the following table shows which of them belongs to each of the variables.

The second question of the second round (2.2) consisted on the resubmission of the question (1.1) from the first round, only this time once the analysis of the first round enlightened the

---

[2] PASW18 (formerly SPSS Statistics) was the software used to perform the statistical tests. © 2010 SPSS Inc., an IBM Company. All rights reserved.
[3] Eigenvalue is the variance explained by each factor.
[4] The significance level (Sig.) must be <0.05 (the more is close to zero the better.)

[5] Factors or principal components are based on linear combinations of the observed variables plus "error" terms.

growing importance of the evaluated variables in the near future, the panel was simply asked to re-evaluate the same variables in terms of importance for societal and economic development. Factor anlysis' results in the extraction of two principal components: "Intercommunication" and "Wisdom" (Table V). To reiterate, the KMO test is greater than "0,6" and, near reaching "0,7" and, once again the Bartlett test of sphericity allows for the rejection of the null hypothesis, suggesting that the factor analysis is meaningful.

TABLE V. PRINCIPAL FACTORS INFLUENCING SOCIO-ECONOMIC DEVELOPMENT ALONG WITH THE POSSIBILITY OF ACCESSING MIBOOK'S TOOL

Societal and Economic factors	Factor
Digital and Internet Access Communication and Future Vision	INTER COMMUNI CATION
Management Innovation and Entrepreneurship Intellectual Knowledge and Learning	WISDOM
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,635
Bartlet's test of Sphericity / Approx. Chi-Square	43,135
Degrees of freedom	10
Sig.	0,000

Retaining only two factors (principal components) with Eigenvalues greater than one, it is possible to identify a first factor as "Intercommunication" and a second one as "Wisdom".

In the first round (question 1.2), from the ten efficiency learning factors that were suggested from the panel five of them covered 83% of the impact on learning efficiency. On this round, this was again submitted to panel ratification as the third question (2.3), only this time, principal component analysis was performed in order to identify which ones are to assume greater importance in near future. Although the KMO test is not reaching "0,5", given the result of Bartlett test of sphericity, it is possible to reject the null hypothesis, thus confirming the adequacy of performing factor analysis. Furthermore, the first two factors with Eigenvalues greater than one explain almost 67% of total variance. Hence, retaining only the first two principal components with Eigenvalues greater than one suggests a first factor named as "Structural capital" and second one named as "Human capital", respectively (Table VI).

TABLE VI. PRINCIPAL FACTORS INFLUENCING LEARNING EFFICIENCY

Factors influencing learning efficiency	Factor
Economic, Learning, Future work perspective and Education.	STRUCTURAL Capital
Politics, Pedagogy, Cultural, Networks, Technology and Social	HUMAN Capital
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,381
Bartlet's test of Sphericity / Approx. Chi-Square	149,281
Degrees of freedom	45
Sig.	0,000

Fith and last question (2.5) of the second round, was reformulated considering the following scenario. Admitting the hipothesis that the miBook's demand is simplified in three different categories: academic learning, professional learning and entertainment (Table VII), then possible business models should count with the appropriate content providers for this hypothetical market segments, along with their direct participation in the construction of other contents derived from the original ones (which usually are printed books).

TABLE VII. MAJOR DEVELOPERS OF BUSINESS MODELS FOR NEW MEDIA

Market segments	Factor
Academic learning: school are major miBooks' contents producers and also responsible for placement in the market. **Professional learning**: private and public sectors are miBook's content producers and responsible for placement in their own internal markets.	PROFESSI ONAL Model
Entertainment Learning -Edutainment: miBook is basically produced by private sector but occasionally establishes partnerships with other public, private and/or academic contents' owner. -Business/Academic: school and public sector are major miBooks' content producers but the private sector is the unique responsible for placement in global market. -Mixed: miBook is exclusively produced by content's owner or under its supervision, no matter who is going to be responsible by its placement in market.	BUSINESS Model
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,623
Bartlet's test of Sphericity / Approx. Chi-Square	47,362
Degrees of freedom	10
Sig.	0,000

Once again, factor analysis was performed for the study and interpretation of the correlations found among the miBook's possible market segments in order to identify possible factors common to all of them trying the possibility to obtain a lower number of unobserved variables. The KMO test is greater than "0,6" which indicates high correlation between the variables and, therefore factor analysis is pretty much adequate. Given the result of Bartlett test of sphericity, it is also possible to reject the null hypothesis, again confirming the adequacy of performing factor analysis. From the initial observed variables it is feasible the identification of two principal components summarizing two major developers of business models named as Professional model and Business model.

The answers to this second round indicate that the majority of experts did not wish to change their opinion in what it concerns to questions reformulated from the first round. At this stage it was decided that further ranking rounds would not be required due to the level of consensus and / or dissensus achieved. The panel clearly identified a number of viewpoints on the factors considered most important. The responses in both rounds to the miBook Delphi survey were analyzed to determine the general trend and the most extreme responses.

V. CONCLUSIONS AND FUTURE WORK

The consultation process has produced at least, the following five major findings, (1) New enhanced learning tools are actually needed and, a set of strategies and recommendations are listed for the development of miBook's tool, being the most relevant concerning Structural and Human Capital; (2) the e-book, the audiobook and the miBook tend to

be more important and growing in terms of number of users in the near future; (3) Creativity, Realism and Accessibility are the most important benefits for miBook's users during the learning process; (4) Intercommunication and Wisdom are to be of growing importance in near future; and last (5) recommended business strategy for miBook is possibly sustainable when supply is focused on different marketplaces, corresponding to different users' needs: Professional and Business, which are potentially the ideal major developers of the business models for the new media tools.

The way firms and other non private organizations combine this available resources and technology to deliver value by providing more benefits in relation to costs, as perceived by clients and partners will determine the marketplace for each product and service proposition. But, when it concerns to launch innovations in the market the successful formation of a marketplace, where supply meets demand, shall have a certain dependency on the specific systemic conditions and characteristics of each geographical region no matter how intensive is the popular phenomena of 'globalization'.

There are many problems, suggestions and contributions arising from this miBook hypothetical scenario that have been pointed out along this work. Because of the various themes arising from technology and learning issues' debate, perhaps is too ambitious to draw upon the results of this research concrete new business models. Anyhow, the digital imaging accelerated expansion in the various contexts of graphic and audiovisual creation has led to many major changes, and has promoted the development of a growing digital culture, pushing the boundaries of human value and enabling them to perform increasingly complex tasks. If the eighties can be considered as the decade of the introduction and expansion of computer technology, the nineties constitute the early visual experimentation and finding new 'languages' for inter-communication. Thus, future work can at least envision the major developers for the miBook tool which can trigger an intense interesting debate about its effects on a variety of contexts, from teaching and learning issues to intellectual property rights and governance. These emerging issues, although extremely important, were generally treated in this research and limited to the strict contextualization and suitability for a global approach to the miBook tool.

[1] Kalkofen, Denis; Mendez, Erick (Student Members IEEE) and Schmalstieg, Dieter. (Member IEEE). Comprehensible Visualization for Augmented Reality. IEEE Transactions on Visualization and Computer Graphics, Vol. 15, No. 2, 2009

[2] Dias, Albertina. Technology enhanced learning and augmented reality: An application on mulltimedia interactive books, International Business & Economics Review, vol 1(1), pp. 72-77, 2009.

[3] Luna Huertas, Paula; Martínez López, Francisco José; Infante Moro Alfonso; Luna Huertas, Carlos (Eds.), Investigación Delphi sobre la currícula universitaria en sistemas de información/tecnologías de la información: hacia el paradigma latino. Universidad de Sevilla. Serie: Ciencias Económicas y Empresariales. Núm. 67, Sevilla, 2006.

[4] Taylor, Raymond E. and Meinhardt, David J. Defining computer information needs for small business: A delphi method. Journal of Small Business Management. Nº 23, pp. 3-9, April, 1985.

[5] Wissema, Hans J.G. Trends in technology forecasting. R&D Management, 12(1), pp. 27-36, 1982.

[6] Okoli, Chitu and Pawlowski, Susanne. The Delphi method as a research tool: an example, design considerations and applications. Information & Management 42(1): pp. 15-29, 2004.

[7] Skulmoski, Gregory J., Hartman, Francis T. and Krahn, Jennifer. The Delphi Method for Graduate Research. Journal of Information Technology Education, 6, pp. 1-21, 2007.

[8] Hsu, Chia-Chien and Sandford, Brian A. Minimizing Non-Response in The Delphi Process: How to Respond to Non-Response. Practical Assessment, Research & Evaluation 12(17): 62-78, 2007.

[9] Kvale, Stainer and Brinkman, Svend. InterViews. Learning the craft of qualitative research interviewing. 2nd Edition. SAGE publications Inc, pp. 99-158, 2009.

[10] Kasi, V., Keil, M., Mathiassen, M. and Pedersen, P. The post mortem paradox: a Delphi study of IT specialist perceptions European Journal of Information Systems 17, 62 – 78, 2008.

[11] Wilcoxon, Frank. Individual Comparisons by Ranking Methods. Biometrics Bulletin, Vol. 1, No. 6., pp. 80-83, Dec., 1945.

[12] Maroco, João. Análise Estatística Com Utilização do SPSS. 3ª Ed., Lisboa: Edições Sílabo, 2007.

[13] Pestana, Maria Helena and Gageiro, João Nunes. Análise de Dados para Ciências Sociais - A complementaridade do SPSS. 4th edition, Lisbon, Edições Sílabo, 2005

[14] NADEAU, Marc-André. L'évaluation de programme. Théorie et pratique. Québec, Presses de l'Université Laval, 1988.

[15] Kim, Jae-On. and Mueller, Charles W. Factor Analysis – Statistical Methods and Practical Issues. Sage University Paper Series on Quantitative Applications on the Social Sciences. Nº 14. Beverly Hills, CA: Sage, 1978.

[16] Hair, Jr., K. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (1998). Multivariate data analysis. (8th ed.). Upper Saddle River, NJ: Prentice Hall.Nunally, J.C. Psychometric theory. New York: NY: McGraw-Hill, 1978.

[17] Kaiser, H. F. The application of electronic computers to factor analysis. Educational and Psychological Measurement, 20, pp. 141-151, 1960.