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A KNOWLEDGE BASE FOR EVALUATION AND DESIGN OF INSTRUCTIONAL MULTIMEDIA SOFTWARE

STÉPHANE CROZAT, PHILIPPE TRIGANO, OLIVIER HU

ABSTRACT. Authors and users of multimedia educational software are in front of the lack of experience in this recent field. Our works are oriented toward the research of relevant literature that could help understanding what is the specificity of such software. We particularly focus on finding criteria that describe satisfyingly the domain, exploring various areas, from usability to picture semantic, cinematography or text theories. The first part of this paper sums up our research along with the set of criteria we organised. We then applied and validated the knowledge we elaborated and structured, making tools to assist in evaluating and designing multimedia pedagogical software. The second part of the paper present our knowledge base and quickly describe some interfaces we built to exploit it.

Keywords: Education, Multimedia, Criteria, Evaluation, Design.

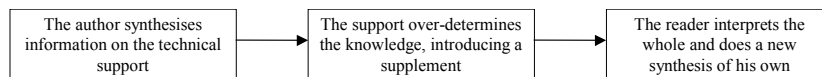
1. INTRODUCTION

Knowledge transfer takes an increasing place in our societies. Different ways of teaching appear, concerning more and more people, beginning earlier and earlier and ending later and later. We do need new tools to answer this new demand. Learning software could be particularly useful in case of distance learning, along-the-life learning, very heterogeneous skills in classes, children helping,... Our thesis is clearly not to pretend that learning software could replace teachers or schools. However, in specific cases, new supports are particularly advantageous, and can be integrated in the classical teaching process. Nevertheless, close to this new policy, we have to take into account that today's learning software are not so much used. There is no reason why this support should not find its role along with the books, the

traditional teaching methods in schools or firms. Thus we think that its relative failure is due to the poor quality of the current products, compared to what they could offer and what the public expects them to offer.

Two main problems can explain this gap. Authors do not know how to write multimedia documents and users do not know how to evaluate their relevancy. People are used to dealing with paper and textual documents. Nonetheless the valid principles for those documents are mostly not transposable to numeric and multimedia documents. The experience in the field of multimedia numeric documents is not wide enough, and we do not have equivalent rules to the ones that exist in the classical domain of edition. However our research intends to determine the bases of such rules.

Each technical support records information on a specific way so that it determines the way it will be interpreted. An information is different depending on the support it is written on. Moreover the act of writing information on a support suppose the addition of a supplementary information, directly linked to the nature of the support [Bachimont 99]. Our purpose here is to study the supplements introduced by the use of multimedia numeric supports.



Adopting the vision of this process, we must admit that the author can not be aware of what will exactly understand the reader. However, understanding the specificity of the numeric support he could better control the final interpretation and try to bring closer together the information he wants to give and the information effectively read.

Our approach is based on a bibliographic research in order to find criteria adapted to each domain. The first part of this paper present a summary of our results, along with the criteria structure. The second part deals with the description of the applications we are developing using this structured knowledge.

2. CRITERIA

2.1. Six themes

Since our ambition was quite complex, we adopted an iterative approach: Firstly, we began with usability oriented studies, then worked on didactics, and ended with multimedia aspects. Each time our method was to extract criteria from the related literature, test these criteria, integrate them into a prototype, and finally evaluate them in real situation. At each step we could start a new cycle, integrating new aspects we thought relevant. Now we hope to have reached a stable structure dividing the global field into six main themes:

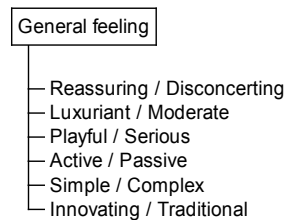
- The "**general feeling**" theme takes into account what image the software offers to the users.
- The "**technical quality**" theme allows the evaluation of the technical realisation of the software.
- The "**usability**" theme corresponds to the ergonomics of the interface.
- The "**multimedia documents**" theme (text, sound, image) enables the evaluation of the contents presentation.
- The "**scenario**" theme deals with the writing techniques used in order to design information.
- The "**pedagogy**" theme finally inspects the pedagogical resources mobilised in the learning context.

For each of these themes we selected and structured a set of criteria and sub-criteria, as described below.

2.2. General feeling

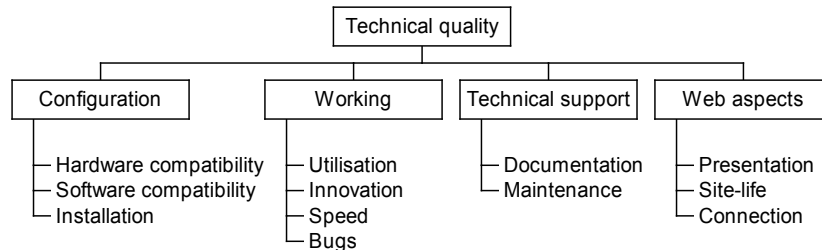
Several experiences we made drove us to the idea that software provides a general feeling to the users. This feeling is issued of graphical choices, music, typographic, scenario structure,... The important fact is that these feelings the user feels deeply affect the way he learns. Our experiences revealed that the general feeling was mainly instinctive, easily describable by the users, quite homogeneous inside a large population, and deeply remaining with time.

In order to better understand this phenomenon we studied various fields, such as visual perception theories [Gibson 79], image semantic [Cossette 82], musicology [Chion 94], cinematography strategies [Vanoie, Goliot-Lété 92],... With these theories and the practical experiences we drove, we managed to submit a list of six pairs of criteria. They make it possible to describe quite satisfyingly what one feel in situation of use of learning software.



2.3. Technical quality

Good software is first of all working software. So we decided to begin with giving the technical criteria software has to satisfy. When one uses slow, hard to configure or bugged software, the reject is generally obvious. Literature, in software design, abundantly deals with these aspects, we submit here one proposition of criteria organisation.



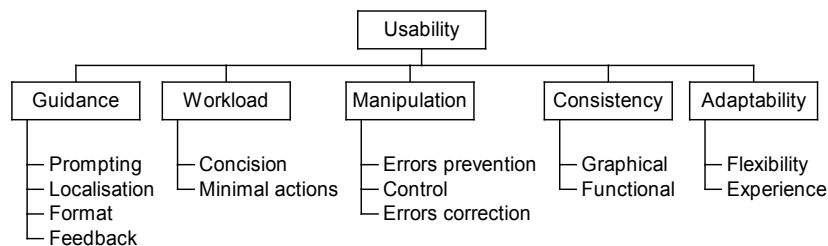
Definitions

- Configuration: Management of software integration in hardware.
- Working: Quality of program running.
- Technical support: Set of means the user gets for the technical use of the piece of software.

- Web aspects: Technical particularities linked to the use of Internet inside the piece of software.

2.4. Usability

A large set of criteria exists in the field of usability of user interfaces. In our context, our problem was to find a compromise between general criteria [Ravden & al 89] and too precise rules [Vanderdonckt 94]. To build the following set, we used in depth the INRIA works [Bastien, Scapin 94], adapting their criteria to our multimedia and educational context.



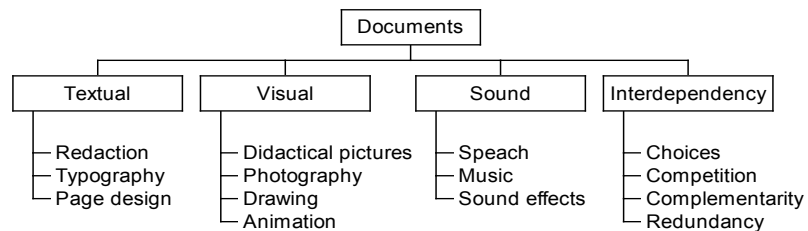
Definitions

- Guidance: Means available to advise, orient, inform, instruct, and guide the users throughout their interactions with a computer.
- Workload: Interface elements that play a role in the reduction of the users' perceptual and cognitive load.
- Manipulation: Control users have on the processing of their actions by the system, and means to detect and prevent manipulation errors.
- Consistency: Way the interface choices are maintained in similar contexts.
- Adaptability: All means available to behave contextually and according to the users' needs and preferences.

2.5. Multimedia documents

Texts, images and sounds are the constituents of the learning software. They have to be taken into account for the information they carry. However the way they are presented is also an important point, since it will influence the way they are read. To build this part of the ques-

tionnaire, we had to explore various domains, as the semantics of images [Baticle 85], the textual theories [Goody 79], the didactical images works [Costa, Moles 91], the photography [Alekan 84], the audio-visual [Sorlin 92],... Our works also point out that in a multimedia environment each document is always presented along with other documents at the same time. The set of documents presented together generates a web of relations that influences the global signification. These interdependencies between documents are as important as each separate document's characteristics, in the process of interpretation.

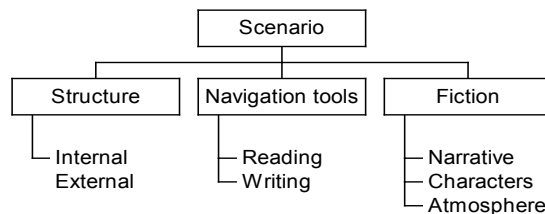


Definition

- Textual documents: Documents based on written text.
- Visual documents: Documents based on pictures and graphs, fixed or animated.
- Sound documents: Documents based on oral text and any other hearing solicitation.
- Interdependency: Set of relationships that exist between these documents in a multimedia environment.

2.6. Scenario

We define the scenario such as the particular process of designing documents in order to prepare the act of reading. The scenario does not deal directly with information, but with the way they are structured. This suppose a original way of writing, dealing with non-linear structure, dynamic data, multimedia documents,... Our studies are oriented toward the various classification of navigation structures [Durand & al 97] [Pognant, Scholl 97], and the fiction integration in learning software [Pajon, Polloni 97].

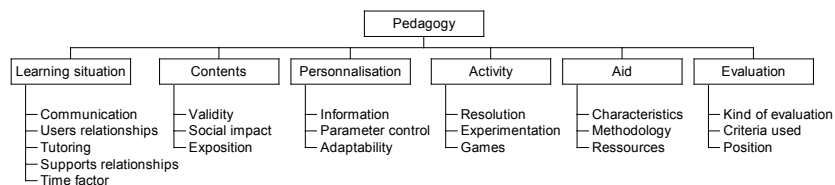


Definition

- Structure: Hyperdocument organisation and set of links between the documents that compose it.
- Navigation tools: Set of means provided to the user in order to help him in the appropriation process.
- Fiction: Integration of an imaginary and not directly link with the subject dimension in the way the documents are presented.

2.7. Pedagogy

Literature offers plenty of criteria and recommendations for the pedagogical application of computer technology, for instance [Dessus, Marquet 91], [Marton 94], [MEDA 90], [Park & al 93]. We also used more specific studies, such as works on interaction process [Vivet 96], or practical experiences [Perrin, Bonnaire 98]. This last theme is expected to describe the specific didactical strategy of the software. Our goal is not impose such or such strategy, stating it is the better one. This normalising approach can not be applied (whereas it was possible for usability or technical aspects), for two main reasons: We do not have enough experience with learning software to impose a way of doing things and the definition of a didactical strategy is totally context-dependent. That means that our criteria only provide a main grid to have a systematic approach in determining what is relevant in one particular case.



Definition

- Learning situation: Description of human and material device in which the software is to be used.
- Contents: Relative to the information provided by the software.
- Personnalisation: Adaptation of the training to the user in order to have it more efficient.
- Activity: Diversity and the quality of the provided activities.
- Aid: Set of means the user gets to help him in his learning process.
- Evaluation: Set of means available to estimate the level and skills of the users.

3. APPLICATIONS

3.1. Evaluation and design

This research gives us a set of principles to take into account in order to deal with pedagogical multimedia documents. We have identified two problems in the introduction: The first one is the difficulty for users to choose a product: How to discriminate poor contents hidden behind an attractive interface? On the other hand, how to feel in front of good pedagogical software, but which is hard to use? How to find the most adapted software for a requested situation? Does the learning software really use the potentiality of multimedia technology? The second aspect is oriented toward the designers, in order to submit them a set of rules to refer in the development process. For instance, our criteria make it possible to give recommendations for text typography, scenario choices or ergonomic rules to strictly follow.

To reach our goals we structured the criteria in a database (Figure 1). In order to whether evaluate or design, we associated additional information to the criteria base: questions and rules. Answering the

questions help in underlining the qualities and weakness of existing software whereas quoting the rules structure the design process.

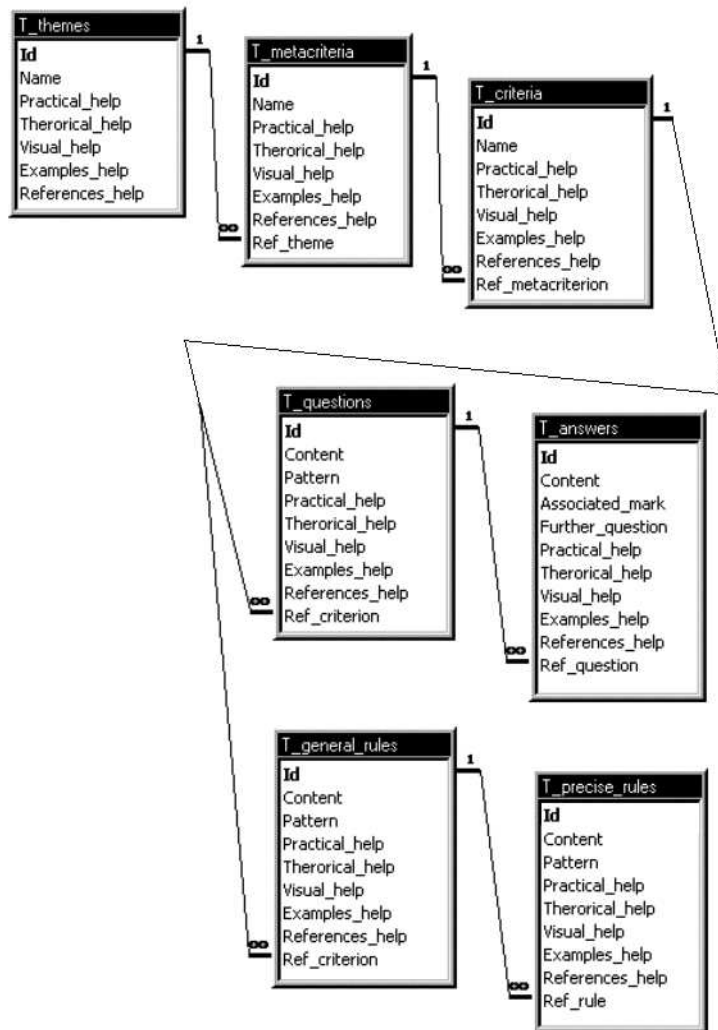


Figure 1: Criteria database structure (simplified representation)

We then developed interfaces to enable the use of the database. At the moment we have a pretty finalised version of the evaluation software (Figure 2), called EMPI (Evaluation of Multimedia Pedagogical Software). We are still working on the prototype of the guidelines version, and till now we just used paper version of database extractions.

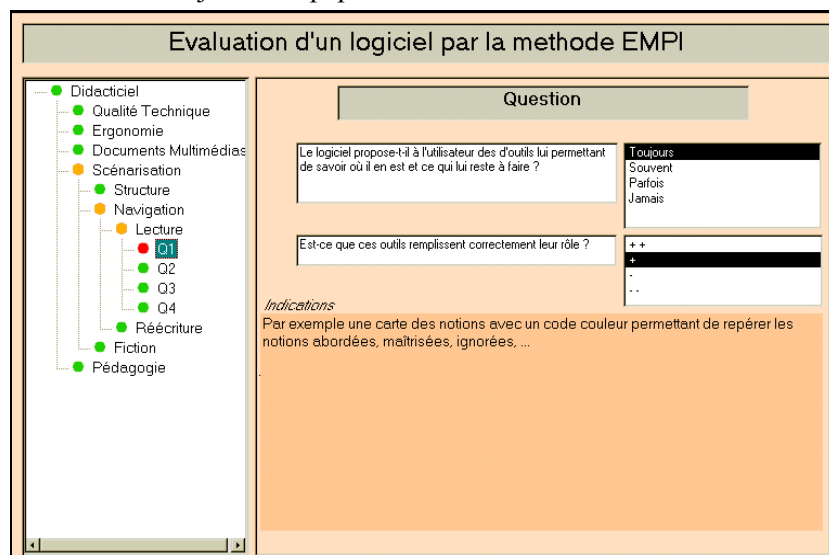


Figure 2: Interface for evaluation (example of question)

Software we develop to exploit the database use basic principles we established through our experiences:

The variable depth: The methods are progressive and allow navigating between the different criteria. At the higher level, we find the themes, and at the lower the questions or rules. The user can work with the precision he wants, deepening or not each aspect, depending on his skills and objectives.

Contextual help: A structured help is provided for each criterion, question or rule, in order to define the words we use, give examples,

suggest practical applications of our concepts, provide theoretical references to deepen each part ,...

Weighting: Since each case of utilisation of the base is specific, we allow and guide users in determining what is more important in their own context. They can state if the rules are to follow absolutely or just to be cared, if an evaluation point is essential or standard.

Strictness: Whereas for technical or usability points we can give strict rules to apply, didactic or scenario aspects are more context-dependent. So we manage the difference between strict rules and simple recommendations.

3.2. Validation program

The methods we presented were and are still tested in situation. The evaluation part already benefits from a large set of validations. Local experiences concerned about ten evaluators using thirty software. Two wider experiences involved about fifty evaluators using the same piece of software. The comparison between the results permits to point out the weak and strong aspects of the questionnaire. A deeper exploitation of the last results is being made in order to finalise a commercial version for the end of the year.

Although the design part is not yet finished, we are testing a paper version of a set of recommendations used in a project for the realisation of a multimedia application to teach basics of algorithmic. It is still early to point out conclusions, however we can already remark that the criteria are useful as a checklist to verify that every important point has been taken into account.

4. CONCLUSION AND PERSPECTIVES

The experience in the domain of multimedia instructional software remains quite weak. Nevertheless we intend to participate in elaborating basic knowledge about it. The criteria we submitted and organised can be useful as a starting point for deeper research, in the purpose of better understanding of their specificity. It is also a starting point for

realising applications that could be of great use in the actual context of skyrocketing developments and uses of multimedia products.

Since the evaluation method is pretty operate, we work on finalising a first version of the designing tool. We are also working on complementary tools, to assist in specifying the requirements for a development project, organising the way software will be articulated within a determined pedagogical device, writing multimedia structured documents,... Our long-term objective is to integrate all these tools in a unique method that could follow the process from the requirements' specification to the final evaluation of the product.

REFERENCES

- [Alekan 84] Henri Alekan, « Des lumières et des ombres », Le sycamore, 1984.
- [Aumont 90] Jacques Aumont, « L'image », Nathan, 1990.
- [Bachimont 99] Bruno Bachimont, « Herméneutique du support et ingénierie des connaissances : de la différance numérique », (à paraître).
- [Bachimont 99] Bruno Bachimont, « L'intelligence artificielle comme écriture dynamique : de la raison graphique à la raison computationnelle », in « Au nom du sens », Actes de Cerisy la Salle, Grasset, Ed Jean Petitot, à paraître.
- [Baker 98] Michael Baker, « Système d'EIAO distribué », CAPS'98, Université de Caen, juin 1998.
- [Baron, Bruillard 96] Georges Louis Baron, Eric Bruillard, « Informatique et éducation : Regards cognitifs, pédagogiques et sociaux », INRP, 1996.
- [Barthes 85] Roland Barthes, « L'aventure sémiologique », 1985.
- [Bastien, Scapin 93] Bastien C., Scapin D., « Ergonomic Criteria for the Evaluation of Human-Computer Interfaces », Rapport Technique INRIA n°156, juin 1993.
- [Bastien, Scapin 94] Bastien C., Scapin D., Evaluating a user interface with ergonomic criteria. Rapport de recherche INRIA n°2326 Rocquencourt, aout 1994.
- [Baticle 85] Yveline Baticle, « Clés et codes de l'image : L'image numérisée, la vidéo, le cinéma », Magnard, Paris, 1985.
- [Bazin 75] André Bazin, « Ontologie de l'image photographique », Cerf, 1975.
- [Berbaum 88] Berbaum J., Un programme d'aide au développement de la capacité d'apprentissage, Grenoble, Université de Grenoble II, Multigraphié, 128p, 1988.
- [Bertin, Barbut 67] Jacques Bertin, Marc Barbut, « Sémiologie graphique : Les diagrammes, les réseaux, les cartes », Gauthier-Villars, Mouton, 1967.
- [Bonsiepe 93] Gui Bonsiepe, « The role of design in human user interfaces », Design Recherche n°3, février 1993.

- [Boullier 97] Dominique Boullier, « L'ajustement technique entre les êtres et les choses : entre compétence et objet », Séminaire Costech, UTC, octobre 1997.
- [Bourdieu 65] Pierre Bourdieu, « Un art moyen : Essai sur les usages de la photographie », Les Editions de Minuit, 1965.
- [Bourron & al 95] Y. Bourron, J.P. Chapuis, J.L. Ruby « pédagogie de l'audiovisuel et du multimédia », Les Editions d'Organisation, 1995.
- [Bruillard 97] Eric Bruillard, « Les machines à enseigner », Hermès, 1997.
- [Carrière 93] Jean-Claude Carrière, « Raconter une histoire », FEMIS, 1993.
- [Carrière, Bonitzer 90] Jean-Claude Carrière, Pascal Bonitzer, « Exercice du scénario », FEMIS, 1990.
- [Chion 94] Michel Chion, « Musiques : Médias et technologies », Flammarion, 1994.
- [Christin 95] Anne-Marie Christin, « L'image écrite : Ou la déraison graphique », Flammarion, 1995.
- [Cornu 90] Geneviève Cornu, « Sémiologie de l'image dans la publicité », Les Editions d'Organisation, 1990.
- [Cossette 83] Claude Cossette, « Les images démaquillées », Riguil Internationales, 2^{ème} édition, Québec, 1983.
- [Costa, Moles 91] Joan Costa, Abraham Moles, « La imagen didáctica », Ceac, Barcelone, 1991.
- [Crozat 98] Stéphane Crozat, « Méthode d'évaluation de la composition multimédia des didacticiels : Proposition pour l'analyse des documents, de la scénarisation et des impressions générales. », Mémoire de DEA, UTC, septembre 1998.
- [Crozat & al. 99] Stéphane Crozat, Olivier Hû, Philippe Trigano, « EMPI, un guide logiciel d'aide à l'évaluation du multimédia pédagogique. », AIPU'99, Montréal, mai 1999.
- [Crozat & al. 99] Stéphane Crozat, Olivier Hû, Philippe Trigano, « A Method for Evaluating Multimedia Learning Software. », ICMCS'99, Florence, juin 1999.
- [Crozat & al. 99] Stéphane Crozat, Olivier Hû, Philippe Trigano « EMPI: A questionnaire based method for the Evaluation of Multimedia Interactive Pedagogical software. », PDPTA'99, Las Vegas, juillet 1999.
- [Cucca 82] Antoine Cucca, « L'écriture du scénario », Editions Dujarric, 1982.
- [Debray 94] Régis Debray, « L'œil naïf », Seuil, 1994.
- [Deleuze 83] Gilles Deleuze, « L'image mouvement », Les Editions de Minuit, 1983.
- [Depover 94] Depover C., Problématique et spécificité de l'évaluation des dispositifs de formation multimédias, Educatechnologie*, vol.1, n°3, septembre 1994.
- [Dessus, Marquet 91] Dessus P., Marquet P., Outils d'évaluation de logiciels éducatifs. Université de Grenoble. Bulletin de l'EPI. 1991.
- [Dubois 83] Philippe Dubois, « L'acte photographique », Edition Labor, Bruxelles, 1983.
- [Eco 92] Umberto Eco, « Les limites de l'interprétation », Grasset, 1992.
- [Feat 97] Jym Feat, « Pour une navigation intuitive », H²PTM'97, Hermes, 1997.
- [Fraïssé 97] Sylvain Fraïssé, « Une approche systématique pour la conception de documents hypermédias », H²PTM'97, Hermes, 1997.

- [Gaudreault, Jost 90] André Gaudreault, François Jost, « Le récit cinématographique », Nathan, 1990.
- [Gibson 79] James J. Gibson, « The ecological approach to visual perception », LEA, Londres, 1979.
- [Glikman, Baron 96] Viviane Glikman, Georges-Louis Baron, « Technologie nouvelles en éducation », INRP, 1996.
- [Gombrich 60] Ernst H. Gombrich, « L'art et l'illusion », Gallimard, 1960.
- [Goody 79] Jack Goody, « La raison graphique : La domestication de la pensée sauvage », Les Editions de Minuit, 1979.
- [Helbo 75] Andre Helbo, « Sémiologie de la représentation : Théâtre, télévision, bande dessinée », PUF, 1975.
- [Hennion 93] Antoine Hennion, « La passion musicale : Une sociologie de la méditation », Edition Métailié, 1993.
- [Hû 97] Olivier Hû, « Méthodologie d'évaluation du multimédia pédagogique », Mémoire de DEA, UTC, 1997.
- [Hû & al 98] Olivier Hû, Philippe Trigano, Stéphane Crozat, « E.M.P.I. : une méthode pour l'Evaluation du Multimédia Pédagogique Interactif », NTICF'98, INSA Rouen, novembre 1998.
- [Hutchins 95] Edwin Hutchins, « Cognition in the wild », MIT Press, 1995
- [Kivy 89] Peter Kivy, « Sound sentiment : An essay on the musical emotion », Temple University Press, Philadelphia, 1989.
- [Kolski 97] Christophe Kolski, « Interfaces homme-machine », Hermès, 1997
- [Livet 88] Pierre Livet, « Image, perception et représentation », Intellectica n°5, 1998.
- [Marton 94] Marton Ph., La conception pédagogique de systèmes d'apprentissage multimédia interactif : fondements, méthodologie et problématique, Educatechnologie*, vol.1, n°3, septembre 1994.
- [McAdams, Deliège 88] Stephen McAdams, Irène Deliège, « La musique et les sciences cognitives », Pierre Mardaga, Belgique, 1988.
- [MEDA 90] MEDA, « Evaluer les logiciels de formation », Les Editions d'Organisation, 1990.
- [Metz 77] Christian Metz, « Essais sémiotiques », Klincksieck, 1977.
- [Moles 72] Abraham Moles, « Théorie de l'information et perception esthétique », Denoel, 1972.
- [Moles, Rohmer 81] Abraham Moles, Elisabeth Rohmer, « L'image, communication fonctionnelle », Casterman, 1981.
- [Pajon, Polloni 97] Patick Pajon, Olivier Polloni, « Conception multimédia », cd-rom, CINTE, 1997.
- [Parent-Altier 97] Dominique Parent-Altier, « L'approche du scénario », Nathan, 1997.
- [Park & al. 93] Park I., Hannafin M.-J., Empiically-based guidelines for the design of interactive media, Educational Technology Research en Development, vol.41, n°3, 1993
- [Parker, Thérien 91] Roger C. Parker, Lise Thérien, « Mise en page et conception graphique », Reynald Goulet, 1991.

- [Peeters 86] Benoît Peeters, « Autour du scénario : Cinéma, bande dessinée, roman-photo, vidéo-clip, publicité, littérature », Editions de l'Université, 1986.
- [Perrin, Bonnaire 98] Hélène Perrin, Richard Bonnaire, « Un logiciel pour la visualisation de mécanismes de gestion des processus du système UNIX », NTICF'98, INSA Rouen, novembre 1998.
- [Perrousseaux 96] Yves Perrousseaux, « Mise en page et impression : Notions élémentaires », Yves Perrousseaux, 1996.
- [Piaget 67] Jean Piaget, « La psychologie de l'intelligence », Armand Colin, 1967.
- [Piché & al 98] Patrick Piché, Claude Frasson, Esma Aimeur, « Amélioration de la formation au moyen d'un agent perturbateur dans un système tutoriel intelligent », NTICF'98, INSA Rouen, novembre 1998.
- [Pognant, Scholl 96] Patrick Pognant, , Claire Scholl « Les cd-rom culturels », Hermès, 1996.
- [Ravden & al. 89] Ravden S.J., Johnson G.I., Evaluating usability of Human-Computer Interfaces : a practical method. Ellis Horwood, Chichester, 1989.
- [Rhéaume 94] Rheume J., L'évaluation Des Multimédias Pédagogiques : De L'évaluation Des Systèmes A L'évaluation Des Actions, Educatechnologie*, Vol.1, N°3, Sept. 1994.
- [Richaudeau 80] Richaudeau F., Conception et production des manuels scolaires, Paris, Retz, 290p, 1980.
- [Sabry-Ismaïl & al 97] Loay Sabry-Ismaïl, Cécile Roisin, Nabil Layaïda, « Navigation in structured multimedia document using presentation context », H²PTM'97, Hermes, 1997.
- [Saint-Martin 87] Fernade Saint-Martin, « Sémiologie du langage visuel », Presses de l'Université du Québec, Canada, 1987.
- [Sanchez, Lumbreras 97] Jaime Sanchez, Mauricio Lumbreras, « Hyperstories : Interactive narrative in virtual worlds », H²PTM'97, Hermes, 1997.
- [Scapin 86] Scapin D., « Guide ergonomique de conception des interfaces Homme/Machine », Rapport technique INRIA Rocquencourt, n°77, octobre 1986.
- [Scapin, Bastien 97] Dominique Scapin, J.M.Christian Bastien, « Ergonomic criteria for evaluating the ergonomic quality of interactive systems », Behaviour & Information Technology, n°16, 1997.
- [Senach 90] Senach B., Evaluation ergonomique des interfaces Homme/Machine : une revue de la littérature. Rapport INRIA, Sophia-Antipolis, n°1180, Rocquencourt, mars 1990.
- [Sorlin 92] Pierre Sorlin, « Esthétiques de l'audiovisuel », Nathan, 1992.
- [Sperandio 93] Jean-Claude Sperandio, « L'ergonomie dans la conception des projets informatiques », Octares, 1993.
- [Strong 98] Gary Strong, « Human centered systems research and development in the United States », Assises du GDR-PRC I3, juin 1998.
- [Type, Frommer 85] J.H. Mc Type, W.D. Frommer, « Effets on character / background colour combination on CRT character lisibility », HFS'85, proceedings of human factor society, 1985.
- [Valentin & al 93] A. Valentin, G. Vallery, R. Lucongansang, « l'évaluation ergonomique des logiciels », Anact, 1993.

- [Vanderdonckt 94] Jean Vanderdonckt, « Guide ergonomique des interfaces homme-machine », Presses Universitaires de Namur, 1994.
- [Vanderdonckt 95] Jean Vanderdonckt, « Key activities for a development methodology of interactive applications », Chapter 4, in Critical Issues in User Interface System Engineering, D. Benton & Ph. Palanque, Springer-Verlag, Berlin, 1995.
- [Vanderdonckt 99] Jean Vanderdonckt, « Development milestones toward a tool for working with guidelines », Interacting with Computers, Vol.11, N°4, 1999.
- [Vanoye 91] Francis Vanoye, « Scénario modèles et modèles de scénario », Nathan, 1991.
- [Vanoye, Goliot-Lété 92] Francis Vanoye, Anne Goliot-Lété, « Précis d'analyse filmique », Nathan, 1992.
- [Vivet 96] Martial Vivet, « Evaluating educational technologies : Evaluation of teaching material versus evaluation of learning ? », CALISCE'96, San Sebastian, juillet 1996.
- [Vivet, Lehuen 98] Martial Vivet, Jérôme Lehuen, « Allons nous apprendre avec des machines qui apprennent ? », CAPS'98, Université de Caen, juin 1998.
- [Weidenfeld & al. 96] Weidenfeld G., Caillot M., Cochard G.-M., Fluhr C., Guerin J.-L., Lecllet D., Richard D., Techniques de base pour le multimédia, Ed. Masson, Paris, 1996.
- [Winkin 96] Yves Winkin, « Anthropologie de la communication: De la théorie au terrain », DeBoeck Université, Belgique, 1996.
- [Winnykamen 90] Fayda Winnykamen, « Apprendre en imitant ? », PUF, 1990.
- [Winograd 87] Terry Winograd, « A language/action perspective on the design of cooperative work », Human-Computer Interaction, 1987.

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