

Educational Microcontent for Mobile Learning Virtual Environments*

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Abstract

The article relates a theoretical and conceptual research, whose main objective was to develop a model to guide the production of educational microcontent to be used in virtual learning environment with mobility, from interconnections between Pedagogy, Communication and Semiotics. It discusses technologies and mobile devices, mobile learning, microlearning, microcontent and hypermedia, educational microcontent and hybrid languages. It highlights the challenges related to the introduction of mobile devices in educational practices. It considers the physical constraints and the fragmented nature of mobile interaction, under which microcontent is, at the same time, accessible and gifted with pedagogical elements. Educational microcontent is analyzed from the hypermedia perspective, considering the dominance of hybrid languages in digital media. A methodology of educational microcontent production for virtual learning environment is presented, considering the predominance of hybrid languages. This methodology is constituted by the processes: pedagogical architecture and architecture of languages, which represent the main flows of activities and tasks. The research conclusions indicate that: a) the model developed presents the conceptual and theoretical elements essential to the production of microcontent education for mobile learning; b) the concepts and grounds presented in the research are considered preliminary conceptual and theoretical elements; c) the developed model provides grants to developing new research proposals and has the potential to encourage new academic research projects; d) the model has the possibility of being used in didactic-pedagogical projects that focus, for example, collaborative learning and co-authorship.

Keywords

Hypermedia, Language, Mobile Devices, Technology of Distance Learning, Educational Media

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1. Introduction

The rapid development of information and communication technologies (ICT) has caused significant improvement in the creation, access, dissemination and sharing of knowledge and expertise around the world. From the appearance of personal computers in the 1980s to their popularization in the following decades, there has been a technological revolution. Since the rise of commercial Internet, from the mid-1990s to the beginning of the second decade of this century, ICT has recorded both colossal technological developments, as well as continuing and enormous social, economic, political and cultural transformations across the world.

Arising from this ongoing technological revolution, many types of mobile devices and wireless communication have emerged, such as mobile phone, smartphone, tablet, PDA, palmtop, etc., which were quickly introduced and merged with ICT dominant, continuing to cause ongoing technological changes across society.

Alongside this scenario, the phenomenon of the increasing mobility of people, objects and information resources is highlighted, whose immediate impacts open new perspectives for the processes of teaching and learning, particularly with respect both formal and continuous training for those professionals who perform their work on mobility (Zanella, Schlemmer, Barbosa, & Reinhard, 2009).

Among the outlined challenges, and within this scope of mobile learning, there are aspects related to how the content should be organized *vis-à-vis* their technological capabilities as well as their limitations to the dissemination of information. The problems are concentrated mainly in didactic and pedagogical issues, and in aspects of language, diversity of platforms, design, among others.

In this context, this study is inserted, with its conceptual nature, which addresses the need and the importance of discussing the concept of microcontent—an unexplored theme, as carrier format of learning objects for mobile devices. The main objective of this research is to provide a model for producing educational microcontent for virtual learning environment with mobility, outlining the main points arising from the interconnection Pedagogy, Communication and Semiotics. The specific objectives are: a) contributing to the concept of sedimentary microcontent as a basic and essential element to mobile learning; b) generating a methodology for producing educational microcontent for mobile learning virtual environments.

The research was conducted under the qualitative approach in two steps. The first stage of this research was to review the literature in aspects of Pedagogy, Communication and Semiotics, as described below. Regarding issues surrounding Pedagogy, the author sought to identify those studies in the literature whose views were converging with the fundamentals of Freire's Pedagogy and Lev Vygotsky's socio-interactionist theory which could corroborate with the research's objective.

With regard to the issues of Communication, the review of literature devoted its attention to the pursuit of theoretical understanding of the current landscape of cyberspace, especially in terms of media convergence. Digital culture has been analyzed from the perspectives of transmediatic convergence, convergence culture, participatory culture, collective intelligence and interactivity, among other approaches.

In the field of Semiotics, the author identified the need to seek theoretical and conceptual elements that could be incorporated into the reading and comprehension of signs and language, especially the matrices of languages present in digital media. There are three matrices of language: sound, visual and verbal (Santaella, 2009).

In the second stage of the research, the author adopted the concepts extracted from the first step and created a methodology for the production of educational microcontent for mobile learning virtual environments based on a transdisciplinary approach. This methodology was represented by the technique of operational process to highlight key actions that must be organized, also punctuating the flow of the main activities and tasks that must be performed to produce microcontents.

Santaella's theoretical and applied contributions were analyzed by Santaella (2009, 2011c, 2008), of phenomenological semiotic nature, derived from Peirce's three categories of firstness, secondness and thirdness. Therefore, from the perspective of semiotics, in particular, matrices of languages and thought, the proposed model for educational microcontent production underlies the methodology of semiotic analysis (Santaella, 2008). With the adoption of this proposed methodology the author sought to explore and explain the communicative and educational potential of microcontent for mobile learning virtual environments.

From the point of view of Pedagogy, the proposed methodology reflects a critical and dialogical approach to support different approaches and practices, among which are inserted learning methods, such as mobile learning, microlearning, meaningful learning, collaborative learning, situated learning, authentic learning, informal learning, pervasive learning, etc... From this perspective, the proposed methodology was elaborated building

on the theoretical foundations of abstracted analysis of the literature (Freire, 2011; Vigotski, 2009; Vigotskii, Luria, & Leontiev, 2010; Alves, 2012), in relation to Freire's Pedagogy and Lev Vygotsky's socio-interactionist theory. Concerning the different approaches and pedagogical practices such as those around the mobile learning, the methodology is supported by theoretical and practical contributions identified by the analysis of the literature (Naismith, Lonsdale, Vavoula, & Sharples, 2006; Meirelles, Tarouco, & Silva, 2006; Schlemmer, Saccol, Barbosa, & Reinhard, 2007; Hug, 2007; Buchem, & Hamelmann, 2010; Guy, 2009; Sánchez-Alonso, Sicilia, García-Barriocanal, & Armas, 2006; Leene, 2006a, 2006b).

Regarding the aspects of Communication, the author sought to reflect on those aspects of cyberculture which best characterize hypermedia and hypermediatic language, from the perspective of transmediatic convergence, convergence culture, participatory culture and collective intelligence. In particular, the theoretical basis for the construction of the model stems from the literature review undertaken in Lévy (2007); Lemos (2010); Santaella (2011a, 2010); Santaella & Lemos (2010); Jenkins (2011).

2. Theoretical Reference

2.1. Mobile Devices

Cell phones around the world are at the center of the universal movement of massive use of technology. In Brazil, this wave is driven largely by the increased purchasing power of low-income population. This circumstance is the opening of opportunities for creating new spaces dedicated to educational practices, which may favor the rise in educational levels of the country's mobile phone, in particular, becoming an attractive option for students, by reason of being relatively inexpensive and therefore more affordable when compared to equipment such as personal computer and laptop.

From the point of view of educational practices, the mobile Web 2.0 is also promising to leverage educational processes, especially in public education. In addition to being portable and personal, mobile technologies support learning activities involving students, teachers, researchers, managers and other actors and agents that interact to enhance the development of new learning.

Mobile technologies can also facilitate collaborative participation and the creation of new knowledge in different educational contexts, allowing the student to take part in the learning process (Silva et al., 2009; Torres & Amaral, 2011). Mobile devices have the advantage of being applicable to the process of teaching and learning, even beyond the classroom or formal education space (O'Malley et al., 2005).

2.2. Mobile Learning

The phenomenon of the increasing mobility of people, objects and information resources, among many challenges of research, brings new perspectives to the processes of teaching and learning, especially with regard to formal and continuous training of those professionals who perform their work in mobility (Zanella, Schlemmer, Barbosa, & Reinhard, 2009).

Studies with mobile workers pointed to the existence of time constraints for taking part in formal training courses and interacting in learning processes (Hardless, Lundin, & Nuldén, 2001). However, in an increasing number of situations, physical displacement is not always necessary, which may represent timesaving. Therefore, the use of mobile devices means openness to new ways of learning, whether formal or informal.

This new type of learning has been designated mobile learning, and it is defined as: "Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies" (O'Malley et al., 2005). According to Reinhard, Saccol, Schlemmer, Barbosa, & Kristoffersen (2007), mobile learning refers:

[...] The learning processes that occur necessarily supported by the use of items of furniture technologies, and whose main characteristic mobility of human actors, which can be physically/geographically distant from other actors as well as physical spaces formal education, such as classrooms, training rooms or workplace.

However, the mobile learning subject remains a non consolidated field with little theoretical consistency, requiring attention from various areas of knowledge, mainly Education. On the other hand, it is a promising subject due to the possibility of extending the learning activities beyond conventional limits spaces and practices,

and for the many research challenges it presents (Naismith, Lonsdale, Vavoula, & Sharples, 2006; IEEE-RITA, 2010; Hug, 2007; Druin, 2009; Guy, 2009; Saccol, Schlemmer, Barbosa, Reinhard, & Sarmento, 2009; Reinhard, Saccol, Schlemmer, Barbosa, & Kristoffersen, 2007; Schlemmer, Saccol, Barbosa, & Reinhard, 2007). Particularly in Brazil, the enormous challenges to be overcome in order to establish practical mobile learning, involve both technological and economic, educational dimensions, as well as social and cultural ones.

Among the challenges to introduce the concept of mobile learning in pedagogical practices in Brazil are the development and articulation of ICT to educational projects, the unpreparedness of the teacher in the use of new technologies, lack of equipment, artifacts and infrastructure networking, among others. Concerning the opportunities, technologies and mobile devices give rise to the emergence of a new mode of teaching and learning, called mobile learning (or m-learning).

A relevant aspect in mobile learning concerns the content, given the peculiarities of mobile devices, especially those related to the small screen size and keyboard. Thus, the pedagogical content to be aired on mobile technologies must have features of microcontent, so that it meets aspects of mobility, connectivity, design, usability, interactivity, language, among other requirements.

Students in mobility may be favored by better use of the time available, not having the need to hold to fixed physical locations to access learning materials, nor to interact with teachers, other students and other actors of the teaching-learning process (Vavoula, Pachler, & Kukulska-Hulme, 2010). However, for mobile learning to become effective in the educational process it is necessary to rethink the very conceptions of learning and also how this modality can facilitate the construction of knowledge and development of skills in learners. In this sense, mobile learning needs a model of learning that “[...] is reasoned by a systemic-constructivist-interactionist epistemological conception” (Schlemmer, Saccol, Barbosa, & Reinhard, 2007).

Inherent to the concept of mobile learning is the idea that learners are active social agents who emerge as they transform reality, a logical thought linked to the educational process.

2.3. Microlearning

Microlearning is a form of learning that involves aspects of teaching and education, whose focus is directed to the micro level, in particular, microcontents or micromedia (media resources in micro size). Microlearning deals with relatively small learning units and short-term educational activities.

Microlearning is a new research area aimed at exploring new ways of responding to the growing need for lifelong learning or learning on demand of members of our society, such as knowledge workers. It is based on the idea of developing small chunks of learning content and flexible technologies that can enable learners to access them more easily in specific moments and conditions of the day, for example during time breaks or while on the move (Gabrielli, Kimani, & Catarci, 2006).

Microlearning activities, by definition, depend on the access to resources and the learning content, which may occur in moments of pause or break in everyday activities of working students. Since these intervals may occur in different places and at different times, microlearning is definitely the typical way of learning anytime and anywhere (Gabrielli, Kimani, & Catarci, 2006).

Microlearning is considered particularly suitable for informal learning in specific activities in which learners are interested in information content which is short and specific rather than the access to a solid body of knowledge about a particular subject. Microlearning therefore, “[...] means the microteaching experience as a learning and a very effective method of learning for students...” (Hug, 2006), which requires appropriate content and media.

2.4. Microcontent and Hypermedia

The term “microcontent” was first used by Nielsen (1998) to draw the attention of authors to the need for clarity in the allocation of titles, headers, headlines and subject to electronic content such as e-mails and web pages. Nowadays, the term microcontent further relates to a more formal characteristic of how to present content, instead of the quality of this content (Buchem & Hamelmann, 2010).

Examples of microcontent: podcasts, blogposts, wiki pages, text messages, Facebook or Twitter, or digital resources compounds of audible, visual and verbal elements, commonly created, published and shared on the

Web. The resurgence of microcontent term is therefore attributed to the movement of expansion of social networks, mainly the weblogs.

“Microcontents are self-contained pieces of indivisible structured content, which have a single focus and an unique address for (re-)findability” (Leene, 2006b). In this sense, a microcontent should bring together all the information concerning it, as in the case of a business card, where all the necessary data for a contact with the named person must be stated.

The definition of microcontent is inserted in the universe of hypermedia, which, in the literature, refers to a new language, a new communication paradigm. Hypermedia is defined by Santaella (2011b) as the language of the virtual communication environment, i.e. the language of cyberspace, also referred to as hypermediatic language. In hypermedia, due to the digitalization processes that transforms texts, images and data into bit (the smallest unit of information), any resources can be transmitted either in sound, visual or verbal language, encouraging interactivity in distance access.

Hypermedia resources, among which the educational microcontent fits, can be accessed from any points internally marked; through them, users can navigate from one item to another or others, thus building their own network of connections and pathways.

2.5. Educational Microcontent

Microcontent is a topic that is slowly being introduced in Education, particularly through mobile learning and microlearning. Both modalities rely on the idea of partitioning the educational content to make it more suited to mobile devices. However, educational microcontent is not restricted to an idea of measure, or size, but rather a unit, a module, and as such it is dependent on the context within it is inserted. Microcontent elements emerge as innovative pedagogical practices of these new modes of learning, which aim at meeting the requirements of dynamic and fast pace of life and the interweaving of multi-platform and multi-tasking aspects of mobile devices, such as cell phone, smartphone, and tablet.

Microcontent of educational purpose, i.e., micro-object of learning can be considered as a regular learning object, therefore, liable to be used in activity microlearning and mobile learning (Sánchez-Alonso, Sicilia, García-Barriocanal, & Armas, 2006). Learning objects, also defined as educational resources, have the advantage of allowing and facilitating the use/reuse of educational content, provided that described by metadata, which make it unnecessary recurrent descriptions of the same object, aiming their retrieval (McGreal, 2004). Thus, the establishment of a relationship between microcontent and microlearning is observed in Buchem & Hamelmann (2010):

Web 2.0 and related technologies change the type of information available on the Web towards small and shorter chunks of content, so-called microcontent, e. g. blog posts, wiki pages. [...] Microcontent is an integral part of microlearning. [...] Traditional models of instruction are often not sufficient for continuous skills update and upgrade as they are cumbersome and confine learners to prescribed and closed systems. Microcontent and microlearning enhanced by Web 2.0 provide a viable solution to fast-paced and multi-task-oriented patterns of learning and working today, enabling learning in small steps and with small units of content through social interaction.

Microcontents, like any learning objects, must keep close relation with the characteristic features of hypermedia, namely: the hybrid nature of the hypermedia (sound languages, visual and verbal); hypertextual alinear architecture, and the extensibility of nodes and associative connections, and interactivity (interface that encourages the active participation). The educational microcontent—basic unit of information must be considered both in its indivisible nature and self-contained content as well as by the incorporation of “technologies that are capable of producing and delivering sound, speech, noise, graphics, drawings, photos, videos etc..” (Santaella, 2011b).

The educational microcontent may consist of a text, a video, an audio, a picture, a graph, a drawing, a photo, etc. In addition, these resources may appear merged into a single microcontent item. In both cases, the recommendations appointed by specialists should be observed in microlearning and mobile learning, as well as the restrictions related to aspects of usability (screen size and keyboard) and mobile connection (pricing, speed, etc.).

2.6. Hybrid Languages

The classification of matrices of language and thought, proposed by Santaella (2009), is based on human perception. Such matrices are intended to clarify the origin of many existing languages, known as hybrids, to be a

mixture of three primary matrices (verbal, visual and sound).

The universe of media produces a variety of multiform hybridization of media and codes, for which there are no more than three semiotic matrices: sound, visual and verbal (Santaella, 2009). This means that the matrices are not pure, nor are the languages. Ever changing, the languages are not always perceived as hybrid manifestations, since the languages are taught separately, “literature and narrative forms in one sector, the art on the other; the cinema on one side, the photo on another, television and video in one area, music in another, and so on” (Vasques Filho, 2006).

The hybrid languages therefore occur from the mixing of the three primary sources: verbal language, visual language, sound language. Multimedia programs (software) are responsible for such mixtures of languages, which include “audible signs (sounds, music, noise), the pictorial signs (all kinds of still and moving images) and verbal signs (oral and written).” (Santaella, 2009).

In the current context of continuous technological, social and cultural transformations, in which the convergence of media is included, it is necessary to introduce reformulations in production practices of audiovisual content, especially considering aspects related to mobility, applications and mobile platforms and the prevalence of hypermedia. In this cultural and technological environment, although the media have their own characteristics, they converge, complement each other, merge, and therefore become dependent on synergy between one another (Jenkins, 2011).

Therefore, while these new media are merging and fragmenting, it opens up space for people to create new relationships with each other. Different media inhabit different platforms with the same content, heading toward transition to hypermedia environments where merging the telecommunications, information technology, Web, television, cinema, mobile phone, video games, etc....

Multi-platform contents, across different technologies, are required to serve in new channels of communication and to increase levels of interaction between people and the content itself. Therefore, producing audiovisual content for mobile learning virtual environments becomes unavoidable because of changes in habit of consuming media that are increasingly and simultaneously interested in different contents, formats and media.

Contrary to what may happen in the traditional media business purposes, in educational activities, in times of hypermedia, the important thing is to produce content that runs on different platforms (devices and vehicles), with increased diffusion capacity, translating into greater possibility access, regardless of the media.

Nevertheless, producing educational microcontent requires the establishment of a production process that involves innovative and dynamic teaching based on semiotic aspects, in which the characteristics and the dialogic nature of hypermedia language are contemplated, aiming at understanding and assimilation of hybrid character, manifested by hypermedia.

3. Production Model of Educational Microcontent

The general outline of the methodology of the production of educational microcontent (PEM) is based on three basic nuclei analysis that represent different points of reflection emerged from the concepts abstracted from the first stage of the research methodology, which refers to the literature review. In this step the three nuclei (conceptual, analytical and methodological) were generated, which correspond to macroprocess production microcontent, which is formed by two distinct processes: pedagogical process architecture and architecture process of languages

The conceptual nucleus constitutes the epistemological basis of the PEM model, since it brings together key concepts guiding the production of educational microcontent.

The analytical nucleus summarizes the assumptions that ensure the assimilation of knowledge and information from the agents (teacher and/or learner) both involved in the educational process as, for example, in the case of languages. This nucleus provides an analytical model focused on collaborative mobile learning, with the assumption of the use of elaborated educational microcontents based on essential elements of semiotics and matrices of language and thought (sound, visual and verbal).

The methodological nucleus is the core of the model, and summarizes practical orientation on the production of educational microcontent. The processes of pedagogical architecture and the architecture of languages occur in this nucleus. The first deals with aspects of the teaching-learning process. The second comprises the aspects that involve languages and digital media. Both processes (Figure 1 below shows a sketch), although distinct, are interconnected, which reinforces the characteristics of transdisciplinarity highlighted in the first stage of the re-

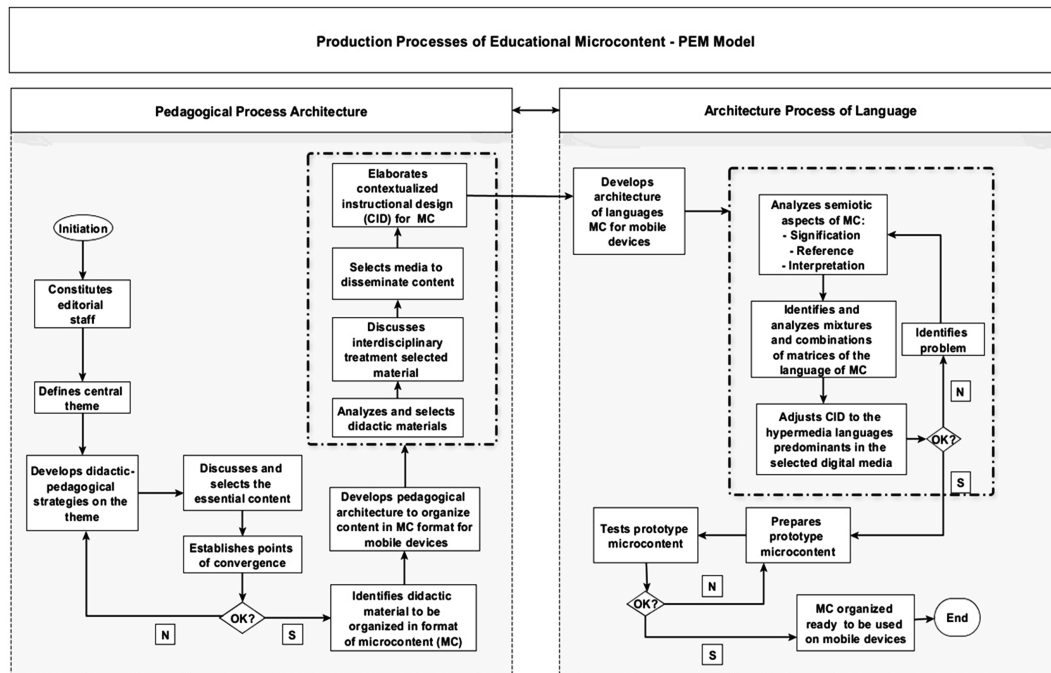


Figure 1. Production processes of educational microcontent—PEM Model.

search methodology consisting of the analysis of the literature.

3.1. Pedagogical Process Architecture

The concept of pedagogical architecture has been applied in distance education, particularly in the design and development of learning objects. The pedagogical architecture consists of organizational, instructional, methodological and technological elements, which maintains a close relationship between them (Behar, Bernardi, & Silva, 2009). From the point of view of methodological representation of PEMs, starts producing educational microcontent from the establishment of pedagogical architecture, which reflects the main stages that comprise the teaching-learning process. Figure 2 highlights the flows of the pedagogical process architecture.

3.2. Architecture Process of Languages

This process highlights the actions of the production of educational microcontent involving semiotic aspects, such as languages, matrices of language and thought. Also, as mentioned in the previous process, the architecture of languages sought to synthesize, and at the same time, to represent in the form of flows the concepts and theoretical aspects highlighted in the conceptual and analytical nuclei. Figure 3 presents the key actions in this process.

It is an arduous task given the need to materialize in microcontent, analysis object in question, the main points discussed in the proposed model, such as teaching, languages and semiotic aspects of hypermedia, restrictions in relation to digital media (mobile devices), as well as compliance with the technical requirements of informatics. A multidisciplinary team, with the indispensable participation of the teacher (content expert), the instructional designer, and computer technician, should perform this activity.

After developing the prototype it is time to test the microcontent, a task that should be performed in a simulated situation, i.e., prior to the effective use of learning object. The testing phase should last as long as errors and problems persist. The next question to answer is whether the prototype meets the established requirements. If not, return to the immediately preceding activity and repeat the aforementioned procedure. Completed the tests, i.e., corrected the errors and problems, conclude the production phase of the educational microcontent.

Thereafter, the microcontent can be used in mobile learning. This is the end of the methodology, which comprises the processes of production of educational microcontent.

Step 1	Constitute editorial team responsible for producing microcontent.
Step 2	Define central theme microcontent.
Step 3	Develop didactic-pedagogic strategy to approach the topic.
Step 4	Discuss and select the essential content to the formulation of microcontent (preliminary stage) contents.
Step 5	Establish points of convergence between the various selected contents to support the development of microcontent.
Step 6	Identify didactic materials selected to support the structuring of content to be covered in the microcontent.
Step 7	Develop pedagogical architecture, itself, organization of content in format of microcontent for mobile devices. Main activities: - Analyze and select didactic materials. - Discuss with experts aiming at interdisciplinary treatment of selected material. - Select media to be used to disseminate the contents of microcontent. - Prepare the contextualized instructional design, comprising the steps of instructional analysis, instructional design, instructional development, implementation and evaluation.

Figure 2. Main activities of the pedagogical process architecture.

Step 1	Analyse the semiotic aspects of microcontent as to: - Face of significance (iconic, indexical, symbolic) - Face of reference (ways: quantitative, existential, generic) - Face of interpreting (immediate interpretant, dynamic interpretant, final interpretant).
Step 2	Identify the three matrices of language and thought; analyze mixtures and combinations of these matrices (hybrid languages – languages of hypermedia).
Step 3	Adjust contextualized instructional design languages to hypermedia.

Figure 3. Main activities of the architecture process of languages.

4. Conclusions

The PEM methodology, which is based on the pedagogical architecture and architecture of languages, presents essential elements theoretical and conceptual for the production of educational microcontent for mobile learning.

Regarding the development of methodology for the production of educational microcontent, concepts and fundamentals presented in this research are considered preliminary theoretical and conceptual elements.

PEM methodology has the potential to promote new academic research projects in the field of Education. Moreover, it has the possibility to be used in didactic and pedagogical proposals that prioritize, for example, collaborative learning, mobile learning, co-authoring, among other practices.

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References

- Alves, S. M. (2012). *Freire e Vigotski: um diálogo entre a pedagogia freireana e a psicologia histórico-cultural*. Chapecó: Argos. 274 p.
- Behar, P. A., Bernardi, M., & da Silva, K. K. A. (2009). Arquiteturas pedagógicas para a educação a distância: a construção e validação de um objeto de aprendizagem. *RENOTE—Revista Novas Tecnologias na Educação*, 7. <http://seer.ufrgs.br/renote/article/view/14088/7984>
- Buchem, I., & Hamelmann, H. (2010). Microlearning: A Strategy for Ongoing Professional Development. *eLearning Papers*, 1-15. <http://www.openeducationeuropa.eu/en/article/Microlearning%3A-a-strategy-for-ongoing-professional-development?paper=57579>
- Druin, A. (2009). *Mobile Technology for Children: Designing for Interaction and Learning*. Burlington: Morgan Kaufmann, 353 p.
- Freire, P. (2011). *Pedagogia do oprimido* (50th ed.). Rio de Janeiro: Paz e Terra, 253 p.

- Gabrielli, S., Kimani, S., & Catarci, T. (2006). The Design of Microlearning Experiences: A Research Agenda. In: T. Hug, M. Lindner, & P. A. Bruck, (Eds.), *Microlearning: Emerging Concepts, Practices and Technologies after E-Learning: Proceedings of Microlearning Conference 2005: Learning & Working in New Media* (pp. 45-53). Innsbruck, Áustria: Innsbruck University Press.
- Guy, R. (2009). *The Evolution of Mobile Teaching and Learning*. Santa Rosa, CA: Informing Science Press, 296 p.
- Hardless, C., Lundin, J., & Nuldén, U. (2001). *Mobile competence development for nomads*. <http://users.jyu.fi/~pmakkone/cs/e-learning/Apumateriaali/MOBILEARNHICSS34.pdf>
- Hug, T. (2007). *Didactics of Microlearning: Concepts, Discourses and Examples*. Münster: Waxmann Verlag, 424 p.
- Hug, T. (2006). Microlearning: A New Pedagogical Challenge (Introductory Note). In T. Hug, M. Lindner, & P. A. Bruck, (Eds.), *Microlearning: Emerging Concepts, Practices and Technologies After E-Learning: Proceedings of Microlearning Conference 2005: Learning & Working in New Media* (pp. 8-11). Innsbruck, Áustria: Innsbruck University Press.
- IEEE-RITA. Revista Iberoamericana de Tecnologías del Aprendizaje (2010). Madrid: IEEE Education Society, 5, nov. Aprendizaje móvil: tendencias, cuestiones y retos. <http://rita.det.uvigo.es/201011/uploads/IEEE-RITA.2010.V5.N4.pdf>
- Jenkins, H. (2011). *Cultura da convergência* (2nd ed.). São Paulo: Aleph, 428 p.
- Leene, A. (2006a). *Microcontent Is Everywhere!!!: Defining Microcontent*. [Innsbruck, Áustria]. 9 p. <http://www.sivas.com/microcontent/articles/ML2006/MicroContent.pdf>
- Leene, A. (2006b). Microcontent Is Everywhere (on Microlearning). In: T. Hug, M. Lindner, & P. A. Bruck, (Ed.), *Micro-media & E-Learning 2.0: Gaining the Big Picture: Proceedings of Microlearning Conference 2006* (pp. 20-40). Innsbruck, Austria: Innsbruck University Press.
- Lemos, A. (2010). *Cibercultura: tecnologia e vida social na cultura contemporânea* (5th ed). Porto Alegre: Sulina. 295 p. (Coleção Cibercultura).
- Lévy, P. (2007). *Cibercultura* (2nd ed.). São Paulo: Editora 34, 260 p (Coleção TRANS).
- McGreal, R. (2004). Learning Objects: A Practical Definition. *International Journal of Instructional Technology and Distance Learning*, 1, 21-32.
- Meirelles, L. F. T., Tarouco, L. M. R., & da Silva, G. D. G. (2006). Aprendizagem com mobilidade para as atividades de práticas em cursos de licenciatura. <http://seer.ufrgs.br/renote/article/view/13871/7791>
- Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2006). Literature Review in Mobile Technologies and Learning. Bristol: University of Birmingham, 48 p (FutureLab Series, Report, 11). http://archive.futurelab.org.uk/resources/documents/lit_reviews/Mobile_Review.pdf
- Nielsen, J. (1998). Microcontent: How to Write Headlines, Page Titles, and Subject Lines. <http://www.useit.com/alertbox/980906.html>
- O'Malley, C. et al. (2005). MOBILEarn—Guidelines for Learning/Teaching/Tutoring in a Mobile Environment. Nottingham: University of Nottingham, 82 p. (Pedagogical Methodologies and Paradigms, WP). <http://hal.archives-ouvertes.fr/docs/00/69/62/44/PDF/OMalley-2005.pdf>
- Reinhard, N., Saccol, A. Z., Schlemmer, E., Barbosa, J. L. V., & Kristoffersen, S. (2007). *Aprendizagem com mobilidade no contexto organizacional*. 10 p. [São Leopoldo: Unisinos].
- Saccol, A. I. C. Z., Schlemmer, E., Barbosa, J. L. V., Reinhard, N., & Sarmiento, C. (2009). M-Learning Adoption in Brazil. In: Guy, R. (Ed.), *The Evolution of Mobile Teaching and Learning* (pp. 103-118). Santa Rosa, CA: Informing Science Press.
- Sánchez-Alonso, S., Sicilia, M. A., García-Barriocanal, E., & Armas, T. (2006). From Microcontents to Micro-Learning Objects—Which Semantics Are Required? (Semantics for Microlearning). In T. Hug, M. Lindner, & P. A. Bruck, (Eds.), *Micromedia & E-Learning 2.0: Gaining the Big Picture: Proceedings of Microlearning Conference 2006* (pp. 295-303). Innsbruck: Innsbruck University Press.
- Santaella, L. (2011a). *Linguagens líquidas na era da mobilidade* (2nd ed.). São Paulo: Paulus, 468 p. (Comunicação)
- Santaella, L. (2011b). *Navegar no ciberespaço: O perfil cognitivo do leitor imersivo* (4th ed.). São Paulo: Paulus, 191 p. (Comunicação)
- Santaella, L. (2011c). *O que é semiótica*. 31. Reimpr, São Paulo: Brasiliense. 131 p. (Primeiros passos, 103)
- Santaella, L. (2010). *Culturas e artes do pós-humano: Da cultura das mídias à cibercultura* (4th ed.). São Paulo: Paulus, 357 p.
- Santaella, L. (2009). *Matrizes da linguagem e pensamento: Sonora, visual e verbal: Aplicações na hipermídia* (3rd ed.). São Paulo: Iluminuras, Fapesp, 431 p.
- Santaella, L. (2008). *Semiótica aplicada*. 4. Reimpr, São Paulo: Cengage Learning, 186 p.
- Santaella, L., & Lemos, R. (2010). *Redes sociais digitais: A cognição conectiva do twitter*. São Paulo: Paulus, 137 p (Comunicação).

- Schlemmer, E., Saccol, A. Z., Barbosa, J., & Reinhard, N. (2007). *M-learning* ou aprendizagem com mobilidade: Casos no contexto brasileiro. <http://www.abed.org.br/congresso2007/tc/552007112411PM.pdf>
- Silva, M. J. et al. (2009). Adding Space and Senses to Mobile World Exploration. In Druin, A. (Ed.), *Mobile Technology for Children: Designing for Interaction and Learning* (pp. 147-169). Burlington: Morgan Kaufmann.
- Torres, T. Z., & do Amaral, S. F. (2011). Aprendizagem colaborativa e web 2.0: Proposta de modelo de organização de conteúdos interativos. *ETD—Educação Temática Digital*, Campinas, SP, 12, 49-72. http://www.fae.unicamp.br/revista/index.php/etd/article/view/2281/pdf_51
- Vasques Filho, P. F. B. (2006). *TV jovem: Patrolando as três matrizes da linguagem*. 88 f. Monografia (Conclusão da Graduação em Comunicação Social—Habilitação em Jornalismo)—Centro Universitário Feevale, Novo Hamburgo.
- Vavoula, G., Pachler, N., & Kukulska-Hulme, A. (2010). *Researching Mobile Learning: Frameworks, Tools and Research Designs*. Oxford: Peter Lang, 367 p.
- Vygotski, L. S. (2009). *A formação social da mente: O desenvolvimento dos processos psicológicos superiores* (7th ed.). São Paulo: Martins Fontes, 182 p (Psicologia e pedagogia).
- Vygotskii, L. S., Luria, A. R., & Leontiev, A. N. (2010). *Linguagem, desenvolvimento e aprendizagem* (11th ed.). São Paulo: Ícone, 228 p (Educação crítica).
- Zanella, A. S., Schlemmer, E., Barbosa, J. L. V., & Reinhard, N. (2009). *M-learning ou aprendizagem com mobilidade*: Um estudo exploratório sobre sua utilização no Brasil. In Encontro Nacional de Pós-Graduação e Pesquisa em Administração—EnAnpad 2007, 30, 2007, Rio de Janeiro. [Trabalhos apresentados]. Rio de Janeiro: ANPAD. v. 1, p. 1-17. http://gpedunisinos.files.wordpress.com/2009/06/art_m-learning-ou-aprendizagem-com-mobilidade.pdf