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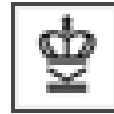
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**A NEW DIGITAL METHOD TO RECOVER THE STATE OF ART:
SYSTEMATIC LITERATURE REVIEW (SLR)**

**UM NOVO MÉTODO DIGITAL PARA RECUPERAR O ESTADO DA ARTE:
PESQUISA SISTEMÁTICA DA LITERATURA (PSL)**

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Resumo

Este artigo descreve uma Pesquisa Sistemática da Literatura (PSL), uma metodologia a ser utilizada no levantamento de artigos, monografias, dissertações e teses, em bases de dados científicas, para fornecer uma bibliografia de referência para a construção do estado da arte. Um estudo de caso sobre o estado da arte foi aplicado com objetos de aprendizagem aplicados às plataformas Stewart, utilizando métodos de Engenharia de Software, um campo de pesquisa bastante específico e interdisciplinar. As bases existentes na literatura entre os anos de 2009 e 2012 foram analisadas. A proposta metodológica baseou-se na adaptação de um protocolo de revisão que sugere para uma boa PSL, seguindo alguns passos da revisão sistemática tradicional, sendo: planejamento, leitura primária, formulação de questões para verificar se o trabalho se enquadra no assunto e se é classificável ou não. O uso da PSL auxiliou no processo de levantamento bibliográfico trazendo resultados bem-sucedidos e publicações relevantes com fatores de alto impacto, constituindo uma base sólida para diversos trabalhos nos campos de pesquisa.

Palavras-Chave

Método – Revisão de literatura – Levantamento digital da literatura

Abstract

This article describes a systematic literature review (SLR), a methodology to be used in the survey of articles, monographs, dissertations and theses, in scientific databases, to provide a reference bibliography for the construction of of state of art. A case study on the state of the art was applied for learning objects applied to Stewart platforms, using Software Engineering methods. The bases existent in the literature between the years of 2009 and 2012 were analyzed. The methodology propose was based on the adaptation of a revision protocol that suggests for a good SLR, to follow some steps, being: planning, primary reading, formulation of questions for checking if the work fits the subject and classification. The use of SLR assisted in the bibliographic survey process bringing successful results and relevant publications with high impact factors, thus making a solid basis for several works in the research fields.

Keywords

Method – Review literatura – Digital review

Introducción

Nowadays, human society is living the information age, where innumerable technologies have been easing society tasks. Likewise, data load evolves as the use of electronic devices and data traffic increases. And this is due to the use of Internet as a worldwide phenomenon, bringing the opportunity to build and spread knowledge in a collaborative, fast and efficient way¹.

Due to the large amount of data accumulated by the use of these devices and made available on the network, searching, sorting, organizing and structuring algorithms of this data are created in order to help an individual find the data he/she is looking for in the world wide web.

Thus, the techniques of Natural-language Processing (NLP) emerge, where are used to prepare the textual data, in which some type of knowledge is sought, and whose main goal is to provide a higher level of understanding of the natural language through the use of computational resources², and the usage of techniques, obtaining fast text processing³.

In this way, the seek for information transcended the bonds, once only physical, with the reading of books, magazines and articles found in scattered libraries, passing now with the aid of technology and the new era the ease of obtaining this information in quick and effective time.

Thus, integrating NLP to Systematic Review concepts, it is intended to perform a Systematic Literature Review (SLR), a scientific method that is intended to be agile, consistent and fast, promoting the development of quality academic papers. Following and when necessary adapting the guidelines⁴. According to him, a Systematic Literature Review or SLR is a process of search and evaluation in available literature related to issues of particular interest. An important reason for conducting such study is to identify the fields of greatest investigation/ research.

So, this article intends, using SLR, to survey the existent databases in literature, between the years of 2009 and 2012, for the construction of multimedia learning objects applied to Stewart platforms, using software engineering methods.

1.- Literature review

With the emergence of new Information and Communication Technologies (ICT), its use is increasingly an imperative model in today's society, since technology brings with it

¹ D. Tapscott y A. D. Willians, Wikinomics: como a colaboração em massa pode mudar seu negócio (São Paulo: Nova Fronteira, 2006).

² R. E. S. Santos, Técnicas de processamento de linguagem natural aplicadas ao processo de mineração de textos: uma revisão sistemática, UFRPE/UAST. Monografia. 2012.

³ A. P. Machado; R. Ferreira; I. I. Bittencourt; E. Elias; P. Brito y E. Costa, Mineração de Texto em Redes sociais virtuais Aplicada à Educação a Distância. Revista Digital da CVA - Ricesu v. 6, n. 23 (2010), julho.

⁴ S. P. Shashank; P. Chakka y D. V. Kumas, A Systematic Literature Survey of Integration Testing in Component-Based Software Engineering. Int'l Conf. on Computer & Communication Technology. ICCCT'10. IEEE. 2010.

the improvement and effectiveness of procedures that were previously carried out with a greater demand for time, such as performing calculations and building well-defined and formatted documents⁵.

With this, the advancement of ICT has led the information society the ease to adapt traditional procedures and transpose them into the electronic media⁶. In this way, academic procedures such as the use of bibliographic research in books, magazines, articles and other periodicals will no longer be restricted to the physical environment.

However, electronic media including Internet, produces a large amount of data, largely stored unstructured, and without formatting. In addition, another relevant feature for this media is that this collection can be accessed from anywhere in the world.

However, the problem is the large amount of data, currently called Big Data, which is data that exceeds the processing capacity of conventional database systems. Dumbill⁷ brings a problem when searching for information on this data volume.

As an example, search engines were built to help find what the user wants, within the greatest possible relevance, according to their wishes. For this, an entry, which here will be called "search expression" or "search key" is required, and through it the website algorithm performs the search.

Among these websites, some have specialized in areas, such as: video, image, and text website engines, etc. In the academic area these web portals store or reference periodicals, theses, dissertations, books, etc. As an example in Brazil, the portal for the Coordination for the Improvement of Higher Education Personnel (CAPES), which has the portal called Periodicals CAPES, which stores periodicals from many magazines, bodies and conferences, having a collection of 193 bodies and digital libraries, including SciELO, IEEE, Scopus, Springer and ProQuest.

In this way, this article aims to verify, using SLR in the existing literature (between the years of 2009 and 2012), multimedia learning objects construction techniques applied to Stewart platforms, using software engineering methods. The chosen subject represents a research problem that is exposed below.

2.- Research problem

For a long time, fields of knowledge have been building methodologies to aid teaching and learning. Teaching and knowledge retention methods have already been tested and many have been approved by the academic society⁸.

⁵ V. Rocio, *Tecnologias da comunicação e informação*. Repositório Aberto, Universidade Aberta (Lisboa: Ed. Autor, 2010). Available in: <<http://hdl.handle.net/10400.2/1586>>. Access in: 20 Jan 2017.

⁶ J. Werthein, *A sociedade da informação e seus desafios*. Ci. Inf., Brasília, v. 29, n. 2, Aug. 2000. Available in: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-19652000000200009&lng=en&nrm=iso>. Access in: 05 Jan 2017.

⁷ E. Dumbill, *What is big data? An introduction to the big data landscape*. O'reilly radar. May. 2012. Available in: <<http://radar.oreilly.com/2012/01/what-is-big-data.html>>. Access in: 01 Mar 2017.

⁸ I. C. A. S. Frade, *Métodos de Alfabetização, métodos de ensino e conteúdos da alfabetização: perspectivas históricas e desafios atuais*. Educação, Santa Maria, V. 32 - n 01. (2007) 21-40.

While there are many ways to convey knowledge, there are still fields that need to be explored in order to seek improvements for learning.

An example of this is medicine, with a large number of surgical procedures already known and many new ones appearing every day. One particular area, orthopedics, has a medical procedure that helps a patient correct poor bone modeling.

As a result, problems of society with poor bone modeling, whether due to genetic problems or accidents have special attention and have been treated with the Ilizarov method⁹.

However, new methods and technologies are in a multidisciplinary way, contributing to the correction of these problems. One of the recent techniques is known as: Stewart's Platform. One of the devices built to work on this platform is the Ilizarov Hexapod System (IHS).

However, society awareness and the teaching to the professionals of this field, are difficult, due to the visual formation of IHS, many patients fear and do not know how the process works from the implantation to the recovery. On the other hand, professionals who need improvement to handle it also find it difficult to structure it in 3D (three dimensions).

To tackle this dysfunction it is necessary, through the Multimedia Learning Objects (MLO), to use MLO in 3D. Regardless of the perspective or focus of analysis, with an impact on more technical or pedagogical aspects, the production and use of MLO seem like an expanding scenario in a context of growing integration of e-learning practices in higher education institutions, involving in its grant and implementation, researchers and professionals associated to the field of multimedia development and teaching fields¹⁰.

However, since the process of developing 3D MLO involves software and processes for computational development, it is necessary to use techniques or models of software engineering used for the process of developing traditional software, for desktop or enterprise systems. Thus, the final object will be built with quality through the use of software development methodologies already known as Scrum, XP (Extreme Programming) and TDD.

3.- Methodology: Systematic Literature Review

The systematic review protocol for SLR performance was adapted to use as a model. The model developed in Figure 1 represents this adaptation originally presented by Biolchini¹¹.

⁹ D. K. Lee; E. T. A. Duong y D. G. Chang, The Ilizarov Method of External Fixation: Current Intraoperative Concepts. AORN Journal. Vol. 91, nº 3 (2010) Mar.

¹⁰ A. Jesus; M. J. Gomes y A. Cruz, Objetos de Aprendizagem - Uma Proposta de Design Pedagógico. II Congresso Internacional TIC e Educação. Instituto de Educação da Universidade de Lisboa. 2012.

¹¹ J. Biolchini; P. G. Mian; A. C. C. Natali y G. H. Travassos, Systematic Review in Software Engineering. Relatório Técnico (Programa de Engenharia de Sistemas e Computação) Universidade Federal do Rio de Janeiro. UFRJ. Rio de Janeiro. 2005.

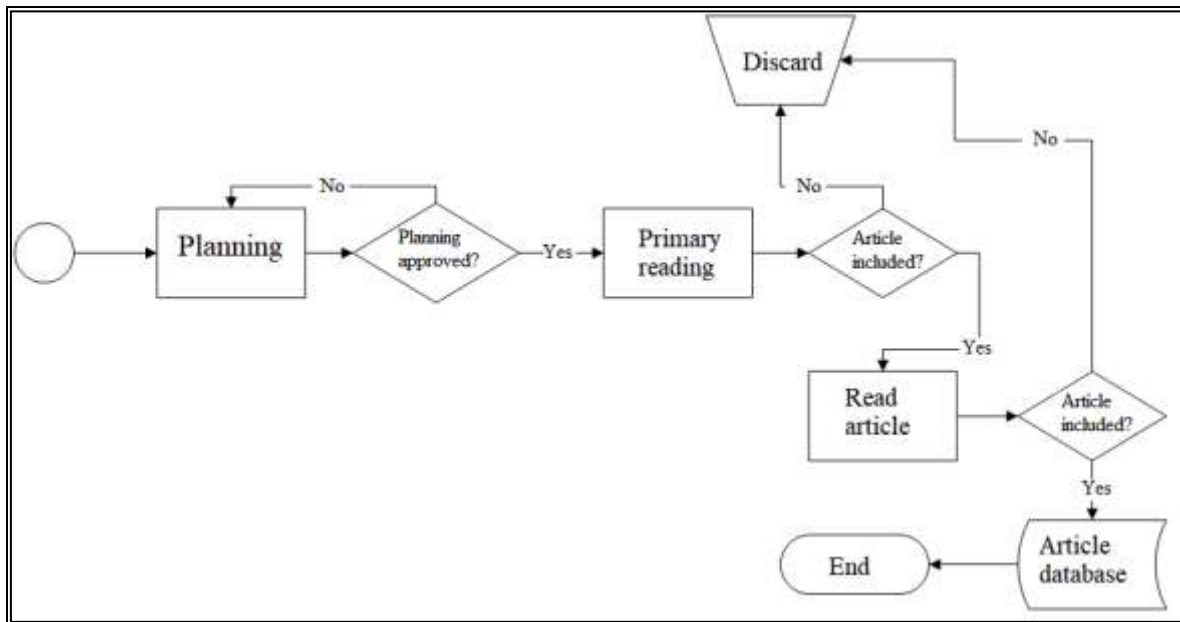


Fig. 1
SLR protocol. Source

The first step is planning. In this phase, the criteria that determine what one wants to find when carrying out the systematic literature research, as well as the problem situation, the research sources, and the amplitude of the results will be discussed and chosen. Planning goes through an approval process with the study's advisers or mentors, and if rejected, it needs to be reworked until its approval is agreed upon.

After the approval of the planning, the primary reading of the articles is performed, that the reading criteria are defined in the planning phase, so if the article is chosen as selected it goes to the full reading phase of the article, otherwise it will be discarded.

In the reading phase of the articles the selection process is useful in formulating the questions that, if the articles respond to some of them, it is classified as included in the article base, if the article is not classified by the criteria and questions planned it is discarded.

With the adapted model, three fields that involve the research problem will be used: Learning Objects, Stewart Platform and Software Engineering, these fields can be defined according to the work proposal that one wishes to research.

3.1.- Criteria formulation

The SLR protocol was developed to verify if there are techniques in the literature for the construction of multimedia learning objects applied to Stewart platforms, using software engineering methods. For this, the following criteria were prepared by field in Tables 1, 2 and 3.

Field: Learning Objects
Criteria:
1 Techniques used to build Multimedia Learning Objects; 2 Works that use 2D or 3D learning objects; 3 Works that use 2D or 3D learning objects in the health field.

Table 1
Learning Objects Criteria

Field: Stewart Platform
Criteria:
1 Existing applications that use hexapod platforms; 2 Existing applications that use Stewart Platform; 3 Existing applications that use Stewart Platform in the health field.

Table 2
Stewart Platform Criteria

Field: Software Engineering
Criteria:
1 Techniques used for the software development process applied to 3D modeling;

Table 3
Software Engineering Criteria

3.2.- Criteria amplitude

The criteria amplitude defines and limits the found results, and they are divided into:

- Intervention: application of Multimedia Learning Objects techniques, Stewart Platform and Software Engineering;
- Effect: identification of the used techniques;
- Publication period: publications of the last decade;
- Results: analyze articles, verifying those that meet the search criteria;
- Applications: the research will work as a basis for the preparation of a bibliographic basis for studies in the mentioned fields.

3.3.- Source selection criteria

In order to carry out this study, digital libraries that bring together impact factor journals measured by the Journal of Citation Reports (JCR) will be accessed as search sources, such as IEEE Xplorer (IEEE) and the periodical library of Capes (Coordination for the Improvement of Higher Education Personnel - CAPES). The works were selected using the textual search expression presented in Table 4.

Keyword	Generic search/technique textual expression
Learning Objects	AND (“Multimedia” OR “2D” OR “3D” OR “in Health”)
Stewart platform	“Stewart Platform” OR “Stewart Platform Manipulator” OR SPM AND “Flight simulation” OR “Flight path” OR “Orthopedic Procedure”
Software Engineering	“Software Engineering” AND “Gathering requirements” OR “Monitoring processes” OR “Monitoring of processes modeling 3D” OR “3D”

Table 4
Construction of the SLR search textual expression

In CAPES periodicals portal, the ordering of periodicals was given in order of relevance to the search criteria inserted.

3.4.- Studies inclusion criteria

Studies returned by textual expression of search that reported techniques application experiences related to the fields of item A.

- The first inclusion criterion is to select the fifty most relevant periodicals for each search criterion;
- The second periodical inclusion criterion was the reading of the title and abstract, where the relevant articles were collected;
- The third criterion is the reading of articles for final selection, classification and use in the desired academic work.

3.5.- Selection process

The selection process was carried out based on the criteria established in response to some pre-formulated questions for classifying or discarding the work.

In addition, the articles were selected in the sources mentioned previously, following the reading order: title and abstract. At this stage it was possible to identify articles that could be discarded because they had no relation with the topic being studied. In case of doubt, the work was classified as included or excluded in meetings with the advisors. The selected papers were then read and a selection was made by level of importance, according to the established criteria and publication date. At this stage some articles may also be discarded. Some of the questions that make part of the analysis of the results and that classify as choice or disposal the articles for each field are:

a.- Field: Learning Objects

Questions:

- In what ways are the techniques applied?

- What are the advantages and disadvantages observed in the techniques?
- What are the learning objects applied in the health field?

b.- Field: Stewart Platform

Questions:

- In what ways are the techniques applied?
- What are the advantages and disadvantages observed in the techniques?
- Is there experience with using Stewart Platform in the health field?
- Field: Software Engineering

Questions:

- Is there experience with using Software Engineering techniques in the 3D Computing field?
- What are the possible candidate techniques to adaptation for using with 3D modeling?

4.- Results

For this study, the sources mentioned in section 4.3 were accessed. It is worth noting that the fifty first articles were selected for each search criterion, the most relevant ones were chosen and then the final articles were selected for using as the bibliographic base of the subject field. It is worth mentioning that all the references of the selected papers presented below are available at the electronic address "<http://www.citeulike.org/user/sbie2013>" referenced by numbering. The results from the SLR were divided by the fields that involve the research problem in order to detail the criteria and results for each search expression used in the chosen data selection sources¹². Thus, 44 articles classified as Learning Objects were identified, where 32 were found in CAPES periodical portal and 12 in IEEE Xplorer, of which 11 were selected from CAPES and 6 from IEEE, with publication predominance in 2010, a summary can be seen in Figures 2, 3 and Table 5.

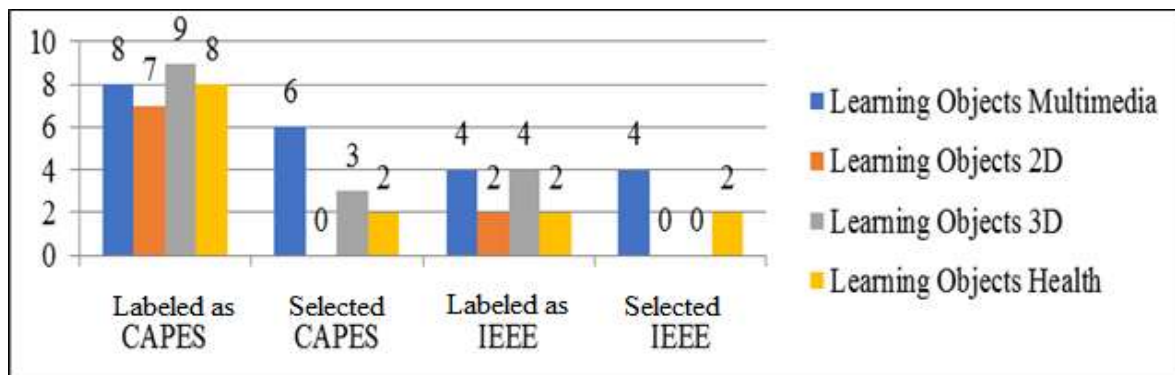


Figure 2
Results of applying search criteria to Learning Objects

¹² S. Shashank Phani; Praneet Chakka y D. Vijay Kumar, A systematic Literature Survey of Integration Testing in Component-Based Software Engineering. Int'l Conf. on Computer & Communication Technology. ICCCT'10. IEEE. 2010.

Techniques	Reference (s)	Year (s)
Learning Objects Multimedia	¹³	2007, 2010, 2010, 2013, 2005, 2005, 2003, 2010, 2010, 2010
Learning Objects 2D	--	--
Learning Objects 3D	¹⁴	2011, 2010, 2009
Learning Objects Health	¹⁵	2010, 2011, 2010, 2010

Table 5
Selected articles by technique: Learning Objects

¹³ T. Cochrane, Developing interactive multimedia Learning Objects using QuickTime Computers in Human Behavior, Vol. 23(6) (2007) 2596-2640. DOI: 10.1016/j.chb.2006.08.007; S. Nangia, MERLOT in the classroom: enhancing foreign language instruction through online learning objects. Michigan Academician, Spring, Vol. 40(1) (2010), 105(1); A. Baki y Ü. Çakirogly, Learning objects in high school mathematics classrooms: Implementation and evaluation. Computers & Education, Vol. 55(4) (2010) 1459-1469. DOI: 10.1016/j.compedu.2010.06.009; M. Barak y S. Ziv, Wandering: A Web-based platform for the creation of location-based interactive learning objects. Computers & Education, Vol.62 (2013) 159-170. DOI: 10.1016/j.compedu.2012.10.015; T. Cochrane, Interactive QuickTime: developing and evaluating multimedia learning objects to enhance both face-to-face and distance e-learning environments. Interdisciplinary Journal of Knowledge, and Learning Objects, Annual, Vol.1 (2005) 33(22); M. Haughey y B. Muirhead, B. The Pedagogical and Multimedia Designs of Learning Objects for Schools. Australasian Journal of Educational Technology, Vol. 21(4) (2005) 470-490; J. Najjar y E. Duval, Actual Use of Learning Objects and Metadata An Empirical Analysis. Computer Science Department, K.U. Leuven, B-3001 (Leuven: IEEE. 2003) y N. Y. Yen; T. K. Shih; R. L. Chao y Q. Jin, Ranking Metrics and Search Guidance for Learning Object Repository, vol. 3 no. 3 (2010) 250-264. DOI Bookmark: <http://doi.ieeecomputersociety.org/10.1109/TLT.2010.15>; R. Santiago y L. A. André, Architecture for Learning Objects Sharing among Learning Institutions—LOP2P. vol. 3 no. 2 (2018) 91-95 – UNIVALI. Universidade do Vale Do Itaja 'i. DOI Bookmark: Available in: <http://doi.ieeecomputersociety.org/10.1109/TLT.2010.9> y S. Pedrammehr; M. Mahboubkha y N. Khani, Improved dynamic equations for the generally configured Stewart platform manipulator. Journal of Mechanical Science and Technology, Vol.26(3) (2012) 711-721. DOI: 10.1007/s12206-011-1231-0.

¹⁴ C. Cechinel; S. Sánchez-alonso y E. García-Barriconal, Statistical profiles of highly-rated learning objectsutor. Computers & Education, Vol.57(1) (2011) 1255-1269. DOI: 0.1016/j.compedu.2011.01.012; G. Olimpo; R. M. Bottino; J. Earp; M. Ott; F. Pozzi y M. Tavella, Pedagogical plans as communication oriented objects. Computers & Education, Vol.55(2) (2010) 476-488. DOI: 0.1016/j.compedu.2010.02.011 y Z. Pizlo; T. Sawada; Y. Li; W. G. Kropatsch y R. M. Steinman, New approach to the perception of 3D shape based on veridicality, complexity, symmetry and volumen. 2009. DOI: 10.1016/j.visres.2009.09.024.

¹⁵ R. J. Windle; H. Wharrad; D. McCormick; H. Lavery y M. Taylor, Sharing and Reuse in OER: Experiences Gained from Open Reusable Learning Objects in Health. Journal of Interactive Media in Education, ERIC (U.S. Dept. of Education). 2010; R. J. Windle; H. Wharrad; D. McCormick; K. Dandrea y H. Wharrad, The Characteristics of Reusable Learning Objects That Enhance Learning: A Case-Study in Health-Science Education. British Journal of Educational Technology, Vol.42(5),(2011) 811-823. DOI: 10.1111/j.1467.10.01108.x. ERIC (U.S. Dept. of Education). 2011; P. E. Battistella; A. Wangenheim y C. G. Wangenheim, Evaluation of Free Authoring Tools for Producing SCORM-Conform Learning Objects. Vol5. No 4 (2010). ITEE/IEEE y A. Kybartaitė; J. Nousiainen y J. Malmivuo, Learning Objects for the Virtual Campus of Biomedical Engineering, IEEE Multidisciplinary Engineering Education Magazine (MEEM), submitted. 2010.

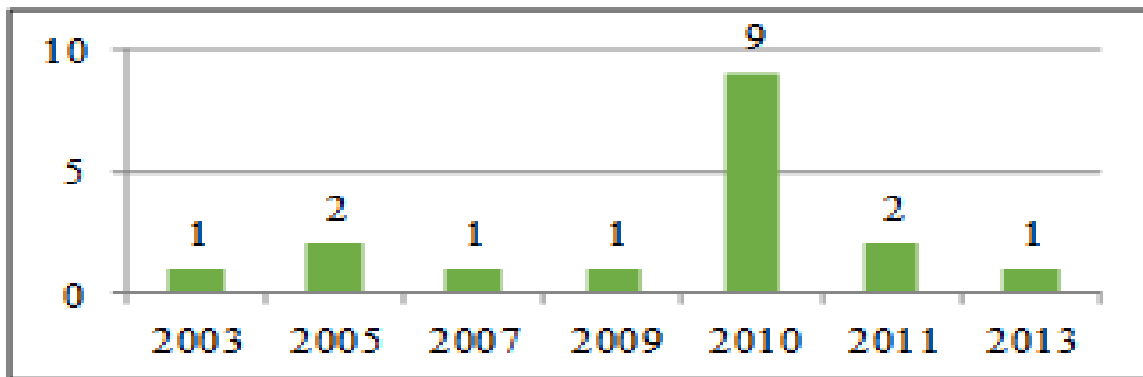


Figure 3
Chronological evolution for Learning Objects.

For the Stewart Platform field, 45 classified articles were identified, where 32 were found in CAPES periodical portal and 13 in IEEE Xplorer, of which 15 were selected from CAPES and 11 from IEEE, with publication predominance in 2009 and 2012, a summary can be seen in Figures 4, 5 and Table 6.

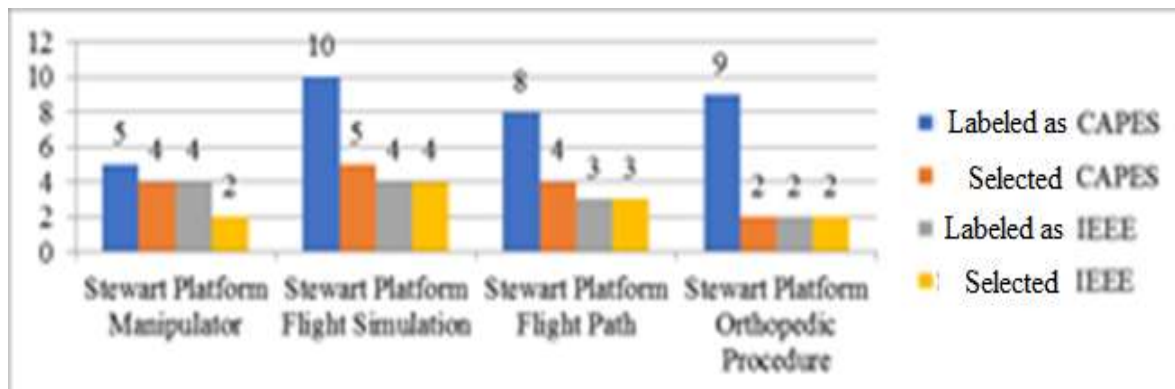


Figure 4
Results of applying search criteria to Stewart Platform.

Techniques	Reference (s)	Year (s)
Stewart Platform Manipulator	¹⁶	2011, 2012, 2010, 2012, 2010, 1993

¹⁶ J. Yao; Y. Hou; H. Wang; T. Zhou y Y. Zhao, Spatially isotropic configuration of Stewart platform-based force sensor. Mechanism and Machine Theory, Vol.46(2) (2011) 142-155. DOI: 10.1016/j.mechmachtheory.2010.10.002; S. Pedrammehr; M. Mahboubkhah y N. Khani, Improved dynamic equations for...; Z. Jia; S. Lin y W. Liu, Measurement method of six-axis load sharing based on the Stewart platform. Measurement, Vol.43(3) (2010) 329-335 DOI: 10.1016/j.measurement.2009.11.005; A. Torri; M. Banno; A. Ueda y K. Doki, A small-size self-propelled Stewart platform. Electrical Engineering in Japan, Vol.181 (2012) 37-46. Identificador: DOI: 10.1002/eej.21261. John Wiley & Sons, Inc; D. S. Negash y R. Mitra, Integral sliding mode controller for trajectory tracking control of Stewart platform manipulator Industrial and Information Systems (ICIIS), International Conference on Topic(s): Communication, Networking & Broadcasting; Digital Object Identifier: 10.1109/ICIINFS.2010.5578628, Page(s): 650. 2010 y R. S. Stoughton y T. A. Arai, modified stewart platform manipulator with improved dexterity. robotics and automation, IEEE transactions. DOI: 10.1109/70.238280. 1993.

Stewart Platform Flight Simulation	¹⁷	2012, 2012, 2009, 2012, 2012, 2009, 2009, 1999, 2011
Stewart Platform Flight Path	¹⁸	2011, 1998, 2007, 1992, 2007, 2009, 2008
Stewart Platform Orthopedic Procedure	¹⁹	2006, 2009, 1996, 2009

Table 7 Selected articles by technique: Stewart Platform

¹⁷ J. H. Wasilewski; H. S. Kawakami y C. Edward, Stewart: Cultural dynamics pioneer. international journal of intercultural relations. 2012. DOI: 10.1016/j.ijintrel.2012.08.012; K. Klumper; A. Morbi; K. J. Chisholm; R. Beranek; M. Ahmadi y R. Langlois, Orientation control of atlas: A novel motion simulation platform. mechatronics, vol.22(8)(2012) 1112-1123. DOI: 10.1016/j.mechatronics.2012.09.008; J. Lin y C. Chen, Computer-aided-symbolic dynamic modeling for stewart-platform manipulator. robotica, vol.27(3)(2009) 331-341. DOI: 10.1017/S0263574708004736; L. Fraguera; L. Fridman y V. V. Alexandrov, Output integral sliding mode control to stabilize position of a Stewart platform. journal of the franklin institute, vol.349(4) (2012) 1526-1542. DOI: 10.1016/j.jfranklin.2011.04.002; Q. Meng; T. Zhang; J. He; J. Song y X. Chen, Improved model-based control of a six-degree-of-freedom stewart platform driven by permanent magnet synchronous motors. industrial robot: An international journal, vol.39(1) (2012).47-56. Emerald group publishing limited. DOI: 10.1108/01439911211192493; V. E. Omurlu; U. Buyuksahin; I. Yildiz; A. Unsal; A. Sagirli; S. N. Engin y B. Kucukdemiral, A stewart platform as a FBW flight control unit for space vehicles. recent advances in space technologies. 2009. RAST '09. DOI: 10.1109/RAST.2009.5158285; S. Ay; O. E. Vatandas y A. Hacioglu, The effect of radius of joint location on workspace analysis of the 6-6 Stewart platform mechanism. Recent advances in space technologies. 2009. RAST '09. DOI: 10.1109/RAST.2009.5158287; I. Chung; H. Chang y C. Lin, Fuzzy control of a six-degree motion platform with stability analysis. systems, man, and cybernetics. 1999. IEEE SMC '99 conference proceedings. DOI: 10.1109/ICSMC.1999.814111 y R. J. Saltaren; L. J. Puglisi; C. G. Cena; I. P. Regueiro y R. Aracil, Design of a hydraulic 6UPS mechanism for experimental research. Universidad Tecnológica de Panamá, Panamá and Universidad Politecnica de Madrid, Madrid, Spain. CONPACAN XXXI, nov. 2011.

¹⁸ C. Chen y T. Liao, A hybrid strategy for the time- and energy-efficient trajectory planning of parallel platform manipulators robotics and computer integrated manufacturing, vol.27(1) (2011) 72-81. DOI: 10.1016/j.rcim.2010.06.012; B. Dasgupta y T. S. Mruthyunjaya, Singularity-free path planning for the stewart platform manipulator. mechanism and machine theory, vol.33(6) (1998) 711-725. DOI: 10.1016/S0094-114X(97)00095-5; I. Davliakos y E. Papadopoulos, Model-based control of a 6-dof electrohydraulic Stewart-Gough platform. mechanism and machine theory, vol.43(11) (2007)1385-1400; DOI: 10.1016/j.mechmachtheory.2007.12.002; Z. Geng; L. S. Haynes; J. D. Lee y R. L. Carroll, On the dynamic model and kinematic analysis of a class of Stewart platforms. Robotics and autonomous systems, vol.9(4) (1992) 237-254. DOI: 10.1016/0921-8890(92)90041-V.SciVerse; M. Choi; W. Kim y B. Yi, Trajectory planning in 6-degrees-of-freedom operational space for the 3-degrees-of-freedom mechanism configured by constraining the Stewart platform structure. Control, automation and systems. ICCAS '07. 2007. DOI: 10.1109/ICCAS.2007.4406521; S. Ay; O. E. Vatandas y A. Hacioglu, The effect of radius of joint location on workspace analysis of the 6-6 Stewart platform mechanism. Recent advances in space technologies. 2009. RAST '09. DOI: 10.1109/RAST.2009.5158287; A. A. Herdon; M. Cramer y K. Sprong, Analysis of advanced flight management systems (FMS), flight management computer (FMC) field observations trials, Radius-to-Fix path terminators. Digital avionics systems conference. DASC 2008. IEEE/AIAA 27th. DOI: 10.1109/DASC.2008.4702775.

¹⁹ D. K. Wukich y R. J. Belczyk, An introduction to the taylor spatial frame for foot and ankle applications. operative techniques in orthopaedics, vol.16(1) (2006) 2-9. DOI: 10.1053/j.oto.2006.02.001; P. A. Molloy; A. Roche y B. Narayan, Treatment of nonunion and malunion of trauma of the foot and ankle using external fixation. foot and ankle clinics of north america, vol.14(3), (2009) 563-587. DOI: 10.1016/j.fcl.2009.03.007; G. Brandt; G. Rau; K. Radermacher; S. Lavallee; y H. Erbse, Staudte. Engineering in medicine and biology society. Bridging disciplines for biomedicine. Proceedings of the 18th annual international conference of the IEEE. 1996. DOI: 10.1109/IEMBS.1996.656932 y R. Ye y Y. Chen, Development of a six degree of freedom (DOF) hybrid robot for femur shaft fracture reduction. Robotics and biomimetics. ROBIO. 2009. DOI: 10.1109/ROBIO.2009.4913021

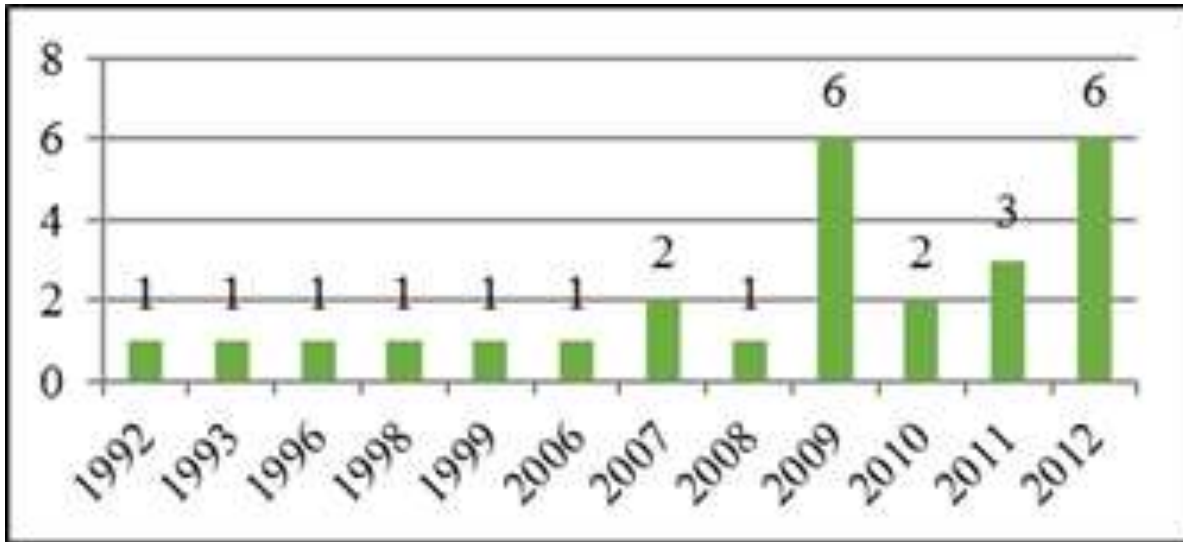


Figure 5
Chronological evolution for Stewart Platform

For the Stewart Platform field, 45 classified articles were identified, where 32 were found in CAPES periodical portal and 13 in IEEE Xplorer, of which 15 were selected from CAPES and 11 from IEEE, with publication predominance in 2009 and 2012, a summary can be seen in Figures 4, 5 and Table 6.

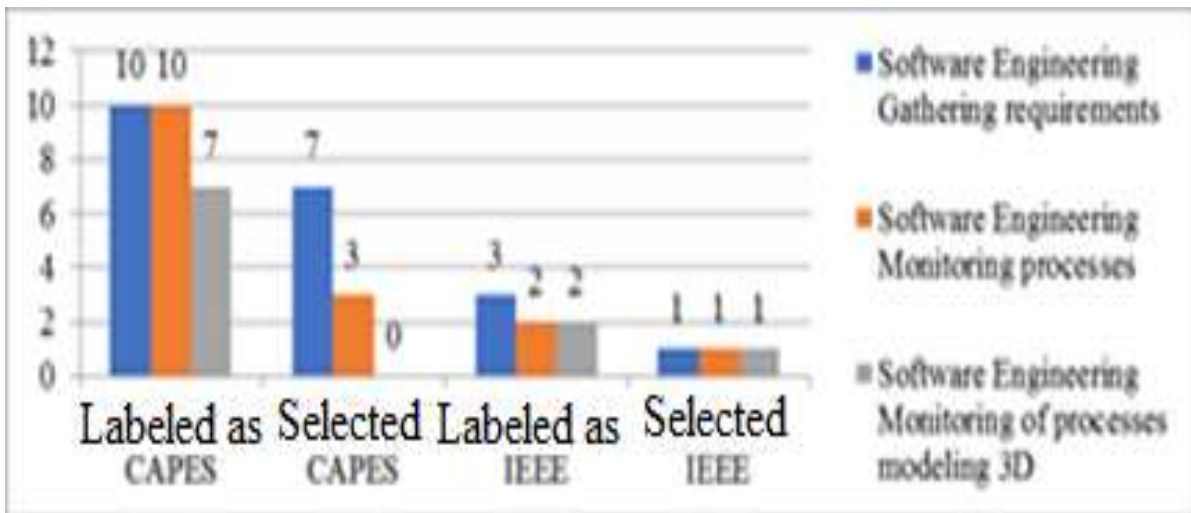


Figure 6
Results of applying search criteria to Software Engineering

Techniques	Reference (s)	Year (s)
Software Engineering Gathering requirements	²⁰	2011, 2011, 2012, 2012, 2012, 2012, 2012, 2010
Software Engineering Monitoring processes	²¹	2011, 2011, 2012, 1999
Software Engineering Monitoring of processes modeling 3D	²²	2009

Table 8
Selected articles by technique
Software Engineering

The classified periodicals come from the primary reading established in the model, the selected ones are those that meet the criteria and the questions of the planning, of which the full reading was done.

²⁰ T. Hainey; T. Connolly; M. Stansfield y E. A. Boyle, Evaluation of a game to teach requirements collection and analysis in software engineering at tertiary education level. *computers & education*, vol.56(1) (2011) 21-35. DOI: 10.1016/j.compedu.2010.09.008; M. Hannan, Analysis of the collaborative activities in software development processes from the perspective of chronotopes. *Computers in human behavior*, vol.27(1) (2011) 248-267 DOI: 10.1016/j.chb.2010.08.003; K. Schneider; E. Knauss; S. Houmb; S. Islam y J. Jüjens, Enhancing security requirements engineering by organizational learning. *Requirements engineering*, vol.17(1), (2012) 35-56. DOI: 10.1007/s00766-011-0141-0; M. Ramachandran, Guidelines based software engineering for developing software components. *journal of software engineering and applications (JSEA)*, vol.5(1) (2012)1(6); J. Portillo-Rodríguez; A. Vizcaíno; M. Piattini y S. Beecham, Tools used in global software engineering: A systematic mapping review. *information and software technology*, vol.54(7) (2012) 663-685. DOI: 10.1016/j.infsof.2012.02.006; S. Ghai y J. Kaur, Analysis of user requirements gathering practices in agile and Non-Agile software development team. *International journal of computer applications*, vol.58(8) (2012) 13; I. Richardson; V. Casey; F. Mccaffery; J. Burton y S. Beecham, A process framework for global software engineering teams. *information and software technology*, vol.54(11) (2012) 1175-1191 DOI: 10.1016/j.infsof.2012.05.002 y A. Tahir y R. Ahmad, Requirement engineering practices - an empirical study. *Computational intelligence and software engineering 2010. (CiSE)*. DOI: 10.1109/CiSE.2010.5676827

²¹ M. Hannan, Analysis of the collaborative activities in software development processes from the perspective of chronotopes. *computers in human behavior*, vol.27(1), (2011) 248-267. DOI: 10.1016/j.chb.2010.08.003; G. Stephanopoulos y V. Reklaitis, Process systems engineering: From solvay to modern bio- and nanotechnology: A history of development, successes and prospects for the future. *chemical engineering science*, vol.66(19) (2011) 4272-4306 DOI: 10.1016/j.ces.2011.05.049; I. Richardson; V. Casey; F. Mccaffery; J. Burton y S. Beecham, A process framework for global software engineering teams. *Information and software technology*, vol.54(11) (2012) 1175-1191 DOI: 10.1016/j.infsof.2012.05.002 y J. S. Collofello y M. Hart, Monitoring team progress in a software engineering project class. *frontiers in education conference, 1999. FIE '99. 29th annual*. DOI: 10.1109/FIE.1999.839226

²² Z. Quangui; W. Pu; Y. Jianzhuo; F. Liying y Q. Yongsheng, Research on Human-Computer interaction in 3D configuration software. *Research challenges in computer science. 2009. ICRCCS '09*. DOI: 10.1109/ICRCCS.2009.14

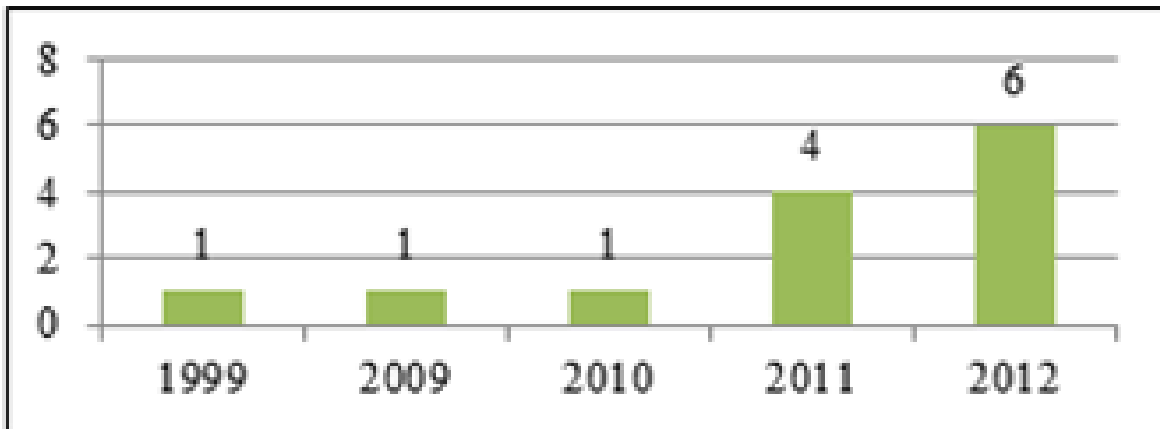


Figure 7
Results of applying search criteria to Software Engineering

5.- Final remarks

Therefore, according to the presented results, it is noticed that the use of the Systematic Literature Review assisted in the process of bibliographic survey for the presented research problem²³, with satisfactory results and recent publications with relevance and impact factor, thus making a solid foundation for many works in the research fields.

In addition, it can be seen that in the Learning Objects field with regard to 2D technique (two dimensions) there were no classified results in the last decade; simply the search criterion was not satisfactory for research of this type of technique. However, Stewart Platform field showed classified results for publications of the last decade using the search keys to find the desired techniques, including old articles, but important for the selected term, from the 26 selected articles about 65.38% of them are between 2009 and 2012.

Finally, Software Engineering field presented only 1 classified article for the monitoring of the 3D modeling process, showing that a greater attention by the academy is needed in this field, considering that there is a great diversity of games and applications which use 3D models, and according to the results it is noticed that there is no development management model that allows to follow specifically 3D projects that involve software or modeling. Thus, SLR shows that there is relevance in the selected periodicals for each field of the research problem, proving that it is possible to obtain a good study basis to develop academic works by using it.

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²³ M. H. L. F. Silva et al., Stewart platforms: Contributions to the learning process in problems of orthopedics. CISTI'15. DOI: 10.1109/CISTI.2015.7170533. July 2015.

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