IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 6, Issue 4 Ver. IV (Jul. - Aug. 2016), PP 32-39
www.iosrjournals.org

Heterocycles in organic chemistry: construction of a pedagogical proposal from virtual resources

Aldo Sena de Oliveira, Patrícia Bulegon Brondani, Ana Carolina Araújo da Silva, Eduarda Giese, Mauricio Raitz Junior, Morgana Sofia Zilse, Nilton Máximo Júnior
Department of Sciences and Education, Center Blumenau/Federal University of Santa Catarina, Brazil

Abstract: *In this article we present the construction of a teaching material for heterocycles studies through the development of a learning object. We believe that learning objects can assist in the introduction and development of chemical concepts. In Organic Chemistry classes there is the need to use different ways to maximize the representations on the symbolic level, from multiple resources that enable the correlation between the subject heterocycles and the everyday activities. We have created a program in Microsoft Power Point that aims an easy interaction of the files with any other operating system (Windows, iOS or Android). The elaborate proposal suggests that the use of learning objects as support for teachers in the classroom, contributes to the learning especially in organic chemistry teaching.*
Keywords: *chemistry education, learning object, heterocycles.*

I. Introduction

In recent years there has been an increase in the promotion of information, with the advent of new technological features that maximized forms of access, making possible new forms of organization and structuring of educational practices. This increased access to information allows a greater democratization of content being important for transformation of new educational spaces in postmodernity.

This postmodern context is characterized by an increase in the interaction of individuals in relationships established by the "cyberculture." This interaction denotes multiple possibilities of use of technology in building virtual spaces containing forums, webchats, videos and other tools hosted on the Virtual Learning Environment (VLE) of great importance in distance education [1].

This expansion in the use of technological tools occurred concomitantly with the increase in the supply of distance-learning undergraduate programs. The new context generated from these digital inserts provided an opportunity of change in the conventional format of the courses, allowing them to have a more dynamic character.

In order to adapt educational practices for education in contemporary society, built on this multiplicity of technological resources, we observe a (re)structuring of teaching-learning process. This restructuring is based on the preparation of new didactic and pedagogical proposals that make use of Information and Communication Technologies (ICTs), considering the diversity of resources.

In this sense, some authors [2] [3] demonstrated the use of ICTs as a possibility for a new teaching-learning paradigm, enabling a resource for educational innovation. Their increasing use in learning contexts effectively contributes to the incorporation of new methodologies [4].

Despite the existence of this multitude of features observed in some cases, teachers agree that there is a gap between the technological tools available and educational environments, especially in countries in favored socio-economic and political conditions. Still, these technological advances allow the existence of educational societies in network integration between media, which may be potentiating considering the multiple learning.

In the context of these learning it is important to note that often the student makes frequent use of these technologies outside the school environment, to discover new worlds, report findings, communicate through social networks, play games, among others. This student experience can be harnessed in the discussion of curriculum content, through activities in virtual environments that allow for understanding, for example, of the abstract concepts often used in chemistry disciplines, physics and mathematics [1].

It is very important to emphasize that the mere incorporation of ICT in the classroom does not guarantee the transformation in education. A number of studies have pointed to inadequate postures of teaching practice that minimize the formation process (by reducing the fun aspect) and of little significance and internalization of curriculum proposals. Thus, it highlights the importance of continuing training in the teaching process in order to adapt the school activities with postmodern education. It is important that teachers develop the skills of reflection on practice and learn about the different features that can be used in the classroom [5].

From this perspective, the teacher can reflect on their practice incorporating the different technological tools in virtual environments, such as a possibility to pluralize ways of understanding the student.

In this sense, the goal of this article is socialization of building process of a virtual interactive tool to maximize learning forms in organic chemistry area. For this, the students of the Chemistry undergraduate course from the Federal University of Santa Catarina (Campus Blumenau) have developed a tool for easy access, with reduced size that can be accessed by any form offline computer. The following features of this interesting tool will be presented as well as its relation with the teaching of chemistry, from the contemporary need to operationalize meaning strategies of subject contents, such as the use of virtual resources and educational materials.

II. Learning objects and digital repositories

Classically learning objects (OA) are entities, digital or not, that can be used, reused or referenced during teaching with technological support (IEEE 2002). One of the greatest scholars in the field pointed that the focus in the production of OA should be in its reusability as letters of an alphabet. OA should preferably be capable of be reused and must necessarily be interpreted and processed by different learning environments. There are international standards that corroborate this claim as Learning Design (IMS, 2015th), SCORM (ADL, 2015) and Common Cartridge (IMS, 2015b) [6].

Learning objects can support teaching and enable forms of knowledge construction, assuming simple units, but of great educational significance. In this context, educational objects have wide scope by allowing use in various contexts, including composing learning objects. In this case, a bank of educational materials is an interesting alternative for the production of learning objects as well as being a research environment for teachers and students.

In recent years, there was a significant increase in research of education field, involving the use of Virtual Learning Objects (OVAs). This research, much demonstrates the importance of using the potential of Information and Communication Technologies (ICT) regarding the development of strategies for teaching. Noteworthy is the interactional role of these proposals that promote integration between the student and the virtual environment, allowing a dynamic character for education.

Virtual repositories have multiple digital content sharing possibilities that differentiate mainly scientific repositories that manage digital content, providing submission services, restoration and preservation [7]. These repositories are instruments used in the dissemination of scientific literature in digital format being developed and endorsed by the name of open philosophy. This philosophy employs the open access issue that was discussed for some time in scientific communities. Costa (2008, p. 216) [8] postulates that "open access [...] must remove price barriers as permission (use)." For the same author, in accordance with the precepts of the declarations of Berlin, Bethesda and Budapest, the term open access is defined as "access of digital literature, online, free of cost and free of unnecessary copyright restrictions and license use".

Faced with these prospects came the need to develop a material that would help students understand the content of heterocycles, which is inserted in the discipline of organic chemistry. Our intention is to assist the construction of meaning in a complex topic. Nowadays, this can be an innovative teaching strategy in the attempt of trying to promote a process of knowledge construction, from virtual learning spaces.

III. Heterocyclic in Organic Chemistry

Approach a subject as chemistry of heterocycles, despite its importance, can be considered difficult due to structural complexity and variety of heterocyclic structures and mechanisms that can lead to this compounds. Heterocycles are one of the most important classes of organic compounds, as they can provide many chemical reactions and they often appear in natural products such as sugars, hemoglobin, chlorophyll, vitamins and alkaloids (caffeine, cocaine, strychnine, etc.). Heterocyclic rings are also present in synthetic drugs, such as antibiotics (penicillin, amicetina, erythromycin, etc.). These compounds are intermediates in several organic reactions and can be used as catalysts.

In Brazil, this subject is rarely presented in high school level, unless the heterocycles are used as examples of nomenclature and some applicability. However, for higher education, this subject is continually taught in organic chemistry because of its importance.

IV. Routes methodological

The learning object with Heterocycles theme was elaborated in discipline of Organic Chemistry II, for Chemistry undergraduate course from the Federal University of Santa Catarina, Brazil. The methodology for the use of educational tool is based on heterocycles study and its applicability. The student can easily download and access the interactive proposal image with the help of a slide viewer. The presentation takes place in an automatic way to address a screen, in which the student must interact with clicks in order to identify heterocycles in representative imaging of applications (Figure 1).

Figure 1: Home of the virtual tool for contextualization of heterocycles theme.

The interaction between the click and a determined object picture brings up the chemical structure of a heterocycle as GIF (Figure 2).

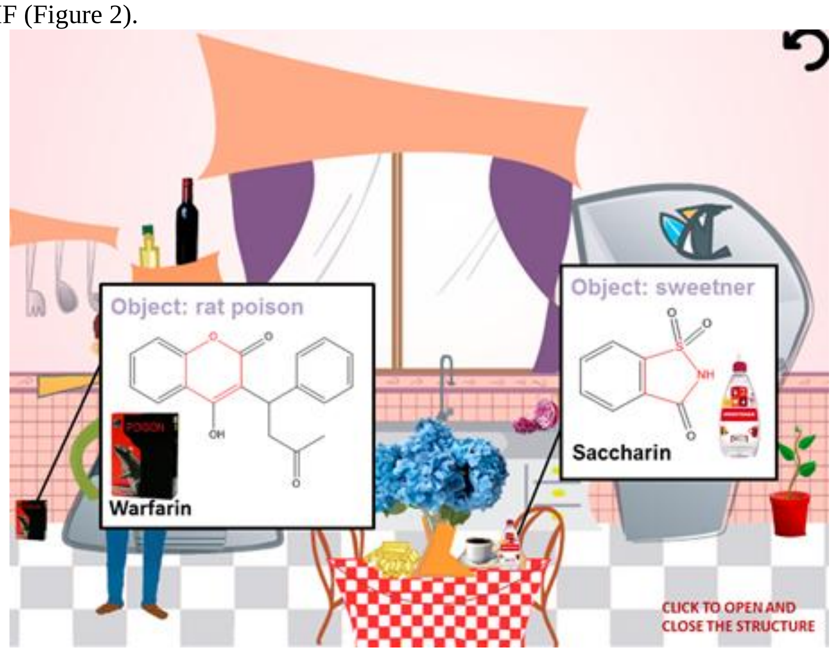

Figure 2: Identification of heterocycles through clicks in determined areas of the picture.

The choice of the object to be clicked is free, and the students can check where are the heterocycles. So any object can be clicked in a complete random order. But only some objects originate the GIF containing a chemical structure. In the whole image twelve objects generate GIFS in order to contextualize the chemistry in everyday life.

The proposed content of the objects enables an interdisciplinary approach between chemistry and biology, as can be seen in figure 3 that presents the chemical structure of the DNA.

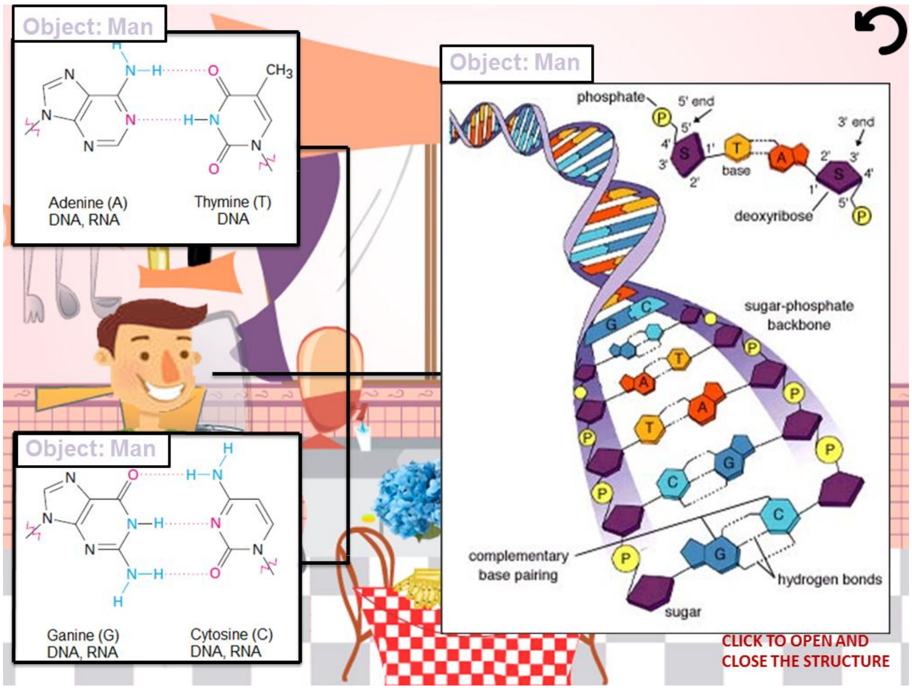

Figure 3: Identification of heterocycles and chemical interaction in the DNA.

In figure 4, we can see the contextualization between chemistry and health. In this way, the figure can denotes the importance of heterocycles that are present in the structure of some drugs and their reactivity.

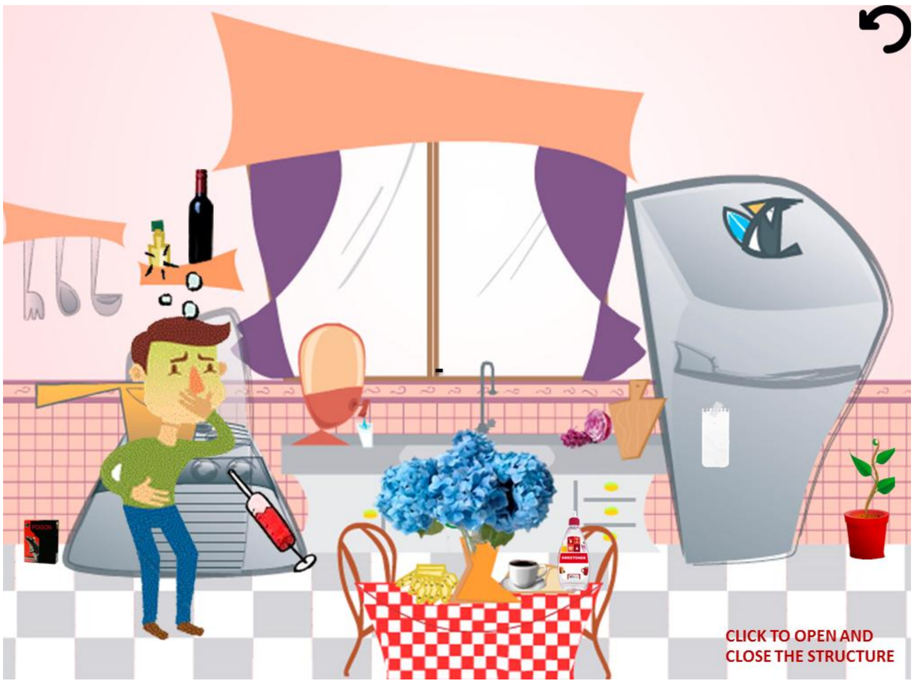

Figure 4: Changing the interactive image for correlation of content with health issues.

Among the objects we also discuss two examples of reaction mechanisms that occur in porphyrin and the anthocyanin, both compounds existent in red cabbage. In this way, the student can start understanding the reactivity of heterocycles.

The arrangement of the objects and their structures enables a conceptual approach about the subject and allows teaching other directly related issues, like aromaticity. The student can as well observe the relation between conjugation systems and colorful compounds. For example, porphyrins are related to blood staining and anthocyanins are responsible for the change of the color in red cabbage extracts in different pHs.

When the student complete the display of all presented objects in the image, occurs a redirection to access the menu (Figure 5). The menu allows the student to observe the rules for heterocycles nomenclature, major mechanisms, exercise or re-applications.

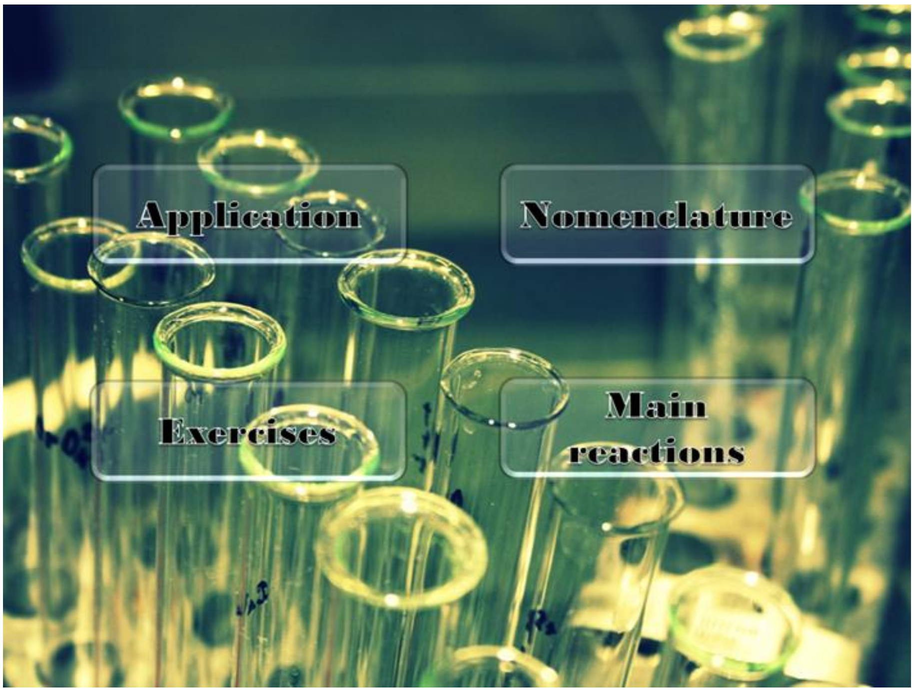

Figure 5: Access menu presentation.

Clicking in the nomenclature icon, the student will be directed to an interactive image where he can choose between viewing nomenclature and exemplification of heterocyclic substances composed of four, five or six ring members (Figure 6). In the last option, heterocycles major structure and their usual names are preseted, and, in the case of non-aromatic heterocycles, their IUPAC nomenclature (Figure 7).

Figure 6: Page showing nomenclature of heterocyclic compounds.

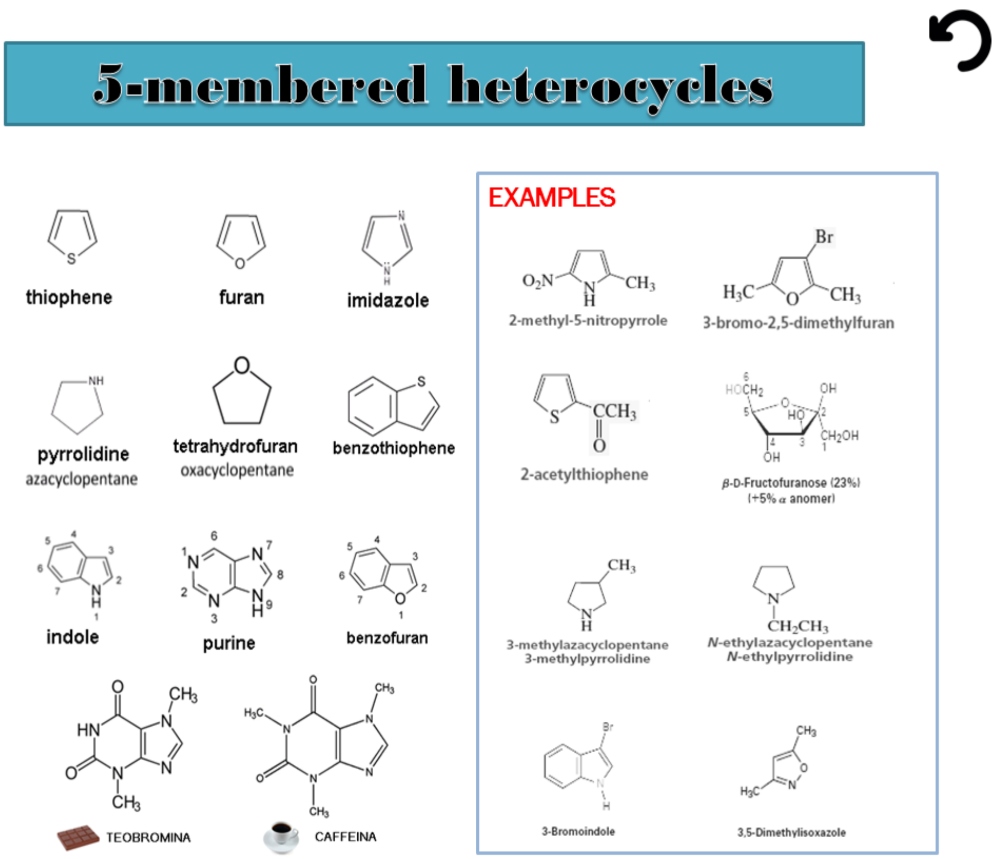

Figure 7: Nomenclature of five membered heterocycles.

In the mechanism icon (Figure 8) some reactions mechanisms for heterocycles with four, five and six ring members can be seeing. There are also a brief explanation and some examples of reactions for aromatic heterocycles. Reactivity against nucleophilic and electrophilic attacks can be as well observed (Figure 9).

Figure 8: Mechanism main screen.

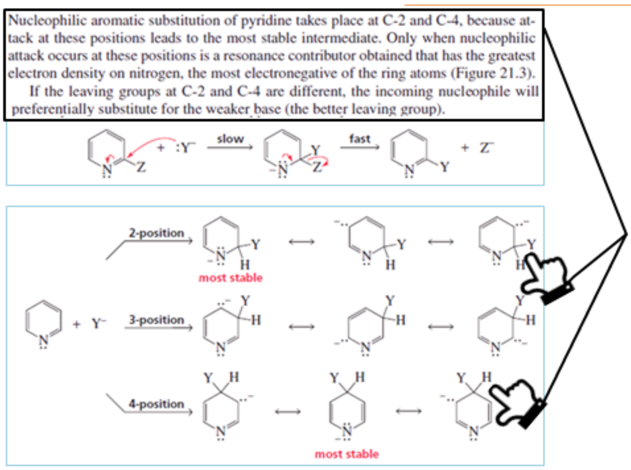

Figure 9: Reactions Mechanisms for six membered heterocyclic.

In order to improve the interaction and learning process, some exercises are available (Figure 10). Clicking on this option, the student will be directed to another screen where he can choose between resolved or unresolved activities. These presented exercises are based on reactions, but also include advanced issues in order to stimulate research on the specific subject (Figure 11).

Figure 10: Exercises about heterocycle chemistry.

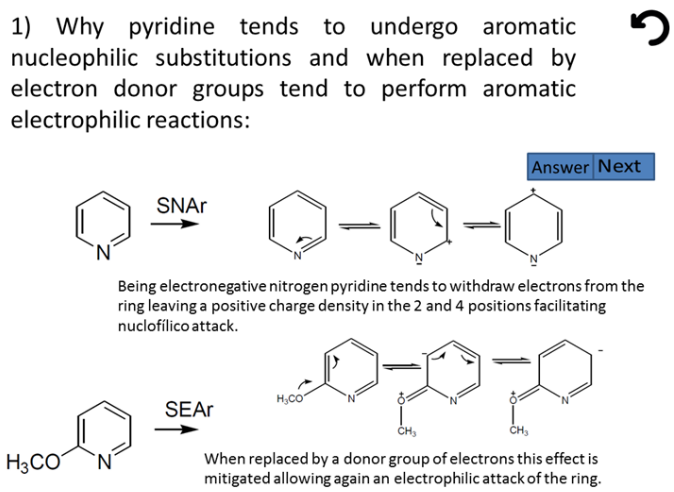

Figure 11: Example exercises of heterocycles (with response).

The application of the presented tool can help in the learning process trough contextualized study applied to undergraduation in chemistry and related areas. Besides that this tool can corroborate with the importance of knowledge about heterocycles reactivity. The proposed contextualization can introduce students to the chemistry that surrounds them, in a differentiated approach . However, as some reactions can only be fully understood after the presentation of content, there must be earlier discussion on the topic in the classroom,.

V. Establishment Of The Program

The program was created in Microsoft Power Point and aims the easy interaction with any other operating system (Windows, iOS or Android). In this way, only the installation of Microsoft Office is needed. Microsoft Office is a widely used program for creating files, especially in the academic world, because it easy handle.

The file can be saved, avoiding the occurence of changes in the slides with clicks anywhere. Only in some specific icons cause the wanted change in the screen layout. The specific icons will lead to a path of different slides, such as nomenclature exercises, devices or applications. Another point to note, is that the file is in loop and the only way to close it is using the key "Esc".

It is also possible to forward the file to another format. Teachers, for example, can make changes based on what is already built, so this tool could be better suited in different situations and realities. A deeper content can be added, as well as more exercises, and even an update of content such as new rules of nomenclature.

VI. Final Considerations

This article presents the construction of a didactic material for heterocycles studies through the development of a learning object. We believe that learning objects can assist in the introduction and development of chemical concepts.

In Organic Chemistry classes in general teachers make use of various features such as: projection screen, drawings on the board, models, etc. to give meaning to a specific content. Often the limitation of teaching the concepts in this area are related to small use of different resources, and in some cases the teacher uses only the board to explain the subject. There is the need to use different ways to maximize the representations on the symbolic level, from multiple resources that enable the correlation between the subject, in this case heterocycles, and the everyday.

The proposed activity was designed in order to allow under graduation students access a fairly and easy source of information about issues related to Heterocycles. There was also a concern to direct the learners, pointing ways and, as far as possible, to promote interaction and spark interest for the subject and the chemical concepts involved.

The proposal suggests the use of learning objects as support for teachers in the classroom. For further research some suggestions are studies on the use of elaborate learning object and its use in the construction of knowledge about heterocycles.

References

[1] A.S. de Oliveira, N.B.C. Branco, M.A. Brito, T.C.R. Souza. Reporting on shared teaching in distance education. *Química Nova na Escola, 36 (1)*, 2014, 37-43.

[2] R.M. Wallace. The Internet as a site for changing practice: The case of Ms. Owens. *Research in Science Education, 32 (4)*, 2002, 465-487.

[3] H.M. Chen, C. Yu, C. S. Chang. E-Homebook System: A web-based interactive education interface. *Computers & Education, 49 (2)*, 2007, 160-175.

[4] H.V. Pragnell, T. Roselli, V. Rossano. Can a hypermedia cooperative e- learnin environment stimulate constructive collaboration? *Educational Technology & Society*, *9 (2)*, 2006, 119-132.

[5] P. Peerenoud. *The training of teachers in the XXI century* (Porto Alegre: Artmed, 2002), 11-33.

[6] D.A. Wiley. *Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy*. In WILEY, D. A. (Org.) The Instructional Use of Learning (2000).

[7] C. L. M. Viana, M.A Márdero Arellano, M. Shintaku. *Institutional Repositories in science and technology: a customization experience of DSPACE* (Proceedings of the International Symposium on Digital Libraries, São Paulo, 2005).

[8] S. Costa. Approaches, strategies and tools for open access via journals and institutional repositories in Brazilian academic institutions. *Liinc em Revista, 4 (2)*, 2008, 218 – 232.