Criteria for Selection of a Web 2.0 Tool for Process Modeling Education

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Abstract. Collaborative learning activities can raise students' motivation and help them to achieve better results. Faced with many available tools that support these activities, teachers need to choose the most suitable one. This paper presents a criterion-based procedure for selection of a Web 2.0 tool for collaborative activities in the domain of process modeling. The procedure defined a set consisting of domain specific criteria and general criteria important for assessing Web 2.0 tools for any application domain. The importance of each attribute included in the criteria is expressed numerically using weights. The established criteria are applied to nine Web 2.0 tools intended for diagramming in order to select a tool that will be used for process modeling education as part of the e-learning environment consisting of Moodle LMS and the educational recommender system ELARS.

Keywords: Collaborative learning activities; e-learning; Web 2.0; process model; ELARS

1 Introduction

One of the subjects included in the education of future software engineers is business system analysis. By using different elicitation methods, analysts extract knowledge and requests from users and, on the basis of the knowledge about the business system, create process model. To be successful in this field, students should acquire theoretical knowledge, as well as communication and collaboration skills essential for teamwork. In order to raise students' motivation to learn, achieve better academic results and gather more knowledge about the subject matter, educational process should be enriched with new and interesting contents and collaborative learning activities, such as collaborative modeling [1, 2].

Commercial solutions for collaborative process modeling can be unavailable to universities or students due to high cost. There is a range of Web 2.0 tools that can be used as alternative since they have potential to enhance collaborative modeling activities [1], [3]. Web 2.0 tools offer many possibilities that can enrich teaching and learning process. These tools have less functionalities than commercial tools, but are inexpensive or even free. Faced with many options, teachers have to choose the most suitable tool for realization of planned learning activities.

This paper presents a research that aims to provide a criterion-based procedure for selection of a Web 2.0 tool for collaborative learning activities in the e-learning environment consisting of Moodle LMS and the educational recommender system ELARS [4]. The procedure includes a set of general criteria important for educational environment, as well as a set of specific criteria related with the specific domain of process modeling. If applied to selected Web 2.0 tools, the procedure indicates the most suitable solution.

2 Background

In order for students to develop practical skills needed for process model design, during their education they will solve practical assignments such as requirements gathering (interview, document analysis) and drawing of data flow diagrams of different levels. Our prior teaching practice included individual design of process models through a number of paper-based assignments. Considering the benefits that collaboration may bring to students' learning and the fact that using paper-based medium might limit the way in which participants can contribute to model building during collaborative modeling [5], students could benefit from learning activities like collaborative modeling/diagramming which are performed using collaborative modeling tools [2].

In practice, collaborative modeling is performed during development of complex information systems by a number of team members which actively contribute to the creation of a model [5]. In that process, as well as during communication with users, team members need to use adequate social skills. It is important to develop these skills during higher education by creating opportunities for students to communicate, elaborate and defend their opinions [6].

Traditional approach to process modeling in software industry assumes using of commercial tools that are installed to our computer. Since their price is rather high, they are mostly used by companies that need safe software with high quality and support. Higher price usually means plethora of useful features, options that support professional and complex diagramming, and possibilities for creating different sorts of diagrams. These tools offer modern design, collaboration support for larger teams and versioning. Programs such as Microsoft Visio [7], SmartDraw [8], Flowcharter [9] and Edraw [10] are some of the most popular commercial tools for process modeling.

Other than commercial tools, support for students' activities during teaching and learning can also be provided by Web 2.0 tools [3], [11], [12]. Web 2.0 tools have many features which enable students to become active participants of a learning process. Web 2.0 tools support social networking, interactivity and communication and also help in harnessing collective intelligence [13]. Examples of such tools are blogs, wikis, social networks, etc. [3]. The use of Web 2.0 in education can result in students' higher engagement and more interest and courage to contribute [14]. Since there are numerous available tools, teachers need to consider many options and have the obligation to make the choice that will enable achievement of learning outcomes.

3 Research methodology

To support decision making about the Web 2.0 tool that will satisfy the needs of the process modeling education, this research determined a list of relevant attributes. The list includes attributes referring to general features of Web 2.0 tools and domain specific attributes like available shapes to draw parts of the process model (concepts). Special attention was paid to the fact that the selected tool will be used for collaborative learning activities.

The importance of each attribute included in the criteria is expressed numerically using weights. For each criterion and each Web 2.0 tool it should be estimated does the tool satisfy it fully (2 points), partially (1 point), or not at all (0 points). Then, weights of each criterion should be applied to the number of points. The calculated sum of points represents result. In order to select the most suitable tool, comparison of results should be made.

Domain related and general criteria are described in the reminder of this section. General criteria can be used for assessing Web 2.0 tools for any application domain, but each application domain requires specific criteria. This paper deals with the process modeling education so it elaborates the criteria considered for that application domain. Weights used to calculate results can be readjusted depending on the attribute relevance. It is possible that some criterion is extremely relevant and recognized as strictly needed. In that case, it should be used as key criterion to exclude some of the tools that do not satisfy it. In case that more than one tool reaches the highest number of points, more detail analysis should be performed. It is recommended that points assigned for the most important features (those with the highest weight) are compared.

3.1 Domain related criteria

Predefined graphical concepts (library) for process modeling – This criterion is concerned with the library with predefined graphical concepts. Four basic concepts are used during process modeling, according to DeMarco and Yourdon [15], [16]: data flow (line or vector), process (ellipse or oval), external system (rectangle) and database (two parallel lines), as shown in Fig. 1.

Fig. 1. Basic graphical concepts for process modeling

Database symbol: two parallel lines – This criterion is relevant if the tool does not have process modeling library. In that case, symbols found in general library can be used. This does not pose a problem for the process (ellipse or oval symbol), external system (rectangle) and dataflow (line). But database represented by two parallel lines cannot be found in the general library. Therefore, it is considered a separate criterion.

This criterion is characterized by low weight factor, because users can invest some effort and draw their own symbol using line and text label, or import it as an image instead. Other methodologies use another symbol for database representation: a cylinder. Cylinder is one of the basic concepts in the general library and in case of following such a methodology, this criterion is not necessary.

Adding connectors to shapes – In order to establish a connection between shapes, connect points are used. Manually adding connectors to shapes enables creating a larger number of contact points between shapes and that benefits to the clear view on the model, less switching of the lines, user receives a more dynamic response when he/she changes position of one shape on the model, etc. This attribute facilitates diagramming process.

Adding text to shapes – Each object (concept) on the model should have a name. Therefore, it is important to have the possibility to add text to each shape.

Image import – In case of a missing graphical concept, image (concept) import may be very important. Image import can be from the computer, from the Web or from other tools for process modeling, such as Microsoft Visio. This criterion enables personalization of diagrams by using personal shapes and images that can positively influence the diagram appearance.

Export to other formats – After finishing the model, it should be documented in the most suitable format, such as portable document format (PDF), or image format such as JPEG or PNG. Any diagram created online after the export to other format can be used independently of the Web 2.0 tool that was used for its design.

3.2 General criteria

General criteria cover functionalities needed to support communication and collaboration during teamwork, as well as version control.

Number of files – Each account registered within the Web 2.0 tool has the possibility to create a certain number of files (documents, presentations, maps, diagrams, etc.). Transition to paid version of the tool usually raises this number. When assessing this criteria, tools that support at least 5 files are graded with maximum number of points, tools that support at least 3 files are graded with medium number of points, while tools that support less than 3 files are graded with zero points.

Comments and notes – Making comments and notes is helpful during the process of finding the best solution between several available ideas.

Number of collaborators – Criterion concerned with the limited number of collaborators is important, but usually the limit can be superseded with transition to paid model of Web 2.0 tool. When assessing this criterion, tools that support unlimited number of collaborators are graded with maximum number of points, tools that support at least 3 collaborators are graded with medium number of points, while tools that support teams with less than 3 collaborators are graded with zero points.

Real-time collaboration – This attribute refers to the support to simultaneous work of a number of users. This criterion is essential for team collaboration because with it organizational efforts are diminished.

Communication between collaborators via chat – This attribute ensures an environment in which collaborators can comment their work and work of others and express their own attitude and ideas (in a form of written conversation).
History – This feature ensures the tool will remember every change made and enable users to return to any older version. This criterion is important for team collaboration, but also for individual work to facilitate error correction and desirable changes.
Individual contribution – This feature is very important for education in case teacher wants to assess contributions of individual students to the final results. The most articulate view for assessment of individual contributions will ensure review of individual activities of each team member. The teacher should be able to see to what extent each team member contributed to the final solution.
User help and support – This criterion deals with detail user manual or tutorials in written or video format provided on official tool webpage. In general, user support can be provided via e-mail or online forum intended for additional information and advice to the users, in case of any problems during their work.
Desktop version – this feature serves for faster access to the tool without the need to open web browser.

4 Research results

The criterion-based procedure for selecting the best-fitted Web 2.0 tool for collaborative process modeling was applied to nine Web 2.0 tools intended for diagramming. These are Gliffy [17], Creately [18], Cacoo [19], Draw.io [20], Lovely charts [21], Flowchart.com [22], GenMyModel [23], ProcessOn [24], Diagramo [25]. This analysis assessed the level of supported features in basic free versions of the tools. Web 2.0 tools in their free version usually have some limitations that will more or less influence the diagramming process. Additional fee removes these restrictions. Prices for basic paid version range from 5 USD per month.

Although upgrading to paid versions offers more possibilities, in this research the existence of free version was used as key criterion. Research results are shown in Table 1. Weights assigned to each criterion are shown in parenthesis, following criterion name. Criteria indicated as partially satisfied (1 point) can be covered with qualitative description as well. For the tools analyzed in this research, qualitative analysis is given below.

Cacoo does not have the library with predefined graphical concepts, but it is possible to download Data Flow Diagram Stencil from Cacoo store (uploaded by other users). Database symbol can be found in the same stencil.

Criterion *Adding text to shapes* was assessed as partially satisfied by Flowchart.com because text label on the data flow symbol (line) is not glued to the line, i.e. it does not automatically change position in case of line repositioning.

Number of files is limited in free version of some tools: Gliffy and Creately limit the number of diagrams to 5, Cacoo limits the number of sheets to 25, Lovely charts uses the limit of 1 diagram and ProcessOn 9 private (unpublished) diagrams (with the possibility to increase this number by friend invitations, “likes”, etc.), GenMyModel

defined the limit on number of objects to 20 per project and in free version only 1 project is allowed.

Comments and notes are available in Gliffy only on some shapes (data flow and entire diagram are excluded). Lovely chart supports comments only in its Premium version. Creately and GenMyModel, in their free version allow 3 collaborators and free version of the Cacoo tool allows diagram sharing with 15 collaborators.

Table 1. Research results

Web 2.0 tool / **Criteria (weight)**	GLIFFY	CREATELY	CACOO	DRAW.IO	LOVELY CHARTS	FLOWCHARTS.COM	GENMYMODEL	PROCESSON	DIAGRAMO
Domain related criteria									
Predefined graphical concepts for process modeling (3)	0	2	1	0	0	2	0	2	0
Database symbol: two parallel lines (1)	0	2	1	0	0	2	0	2	0
Adding connectors to shapes (2)	2	2	2	2	2	2	2	2	2
Adding text to shapes (3)	2	2	2	2	2	1	2	2	2
Image import (1)	2	2	2	2	2	2	0	2	2
Export to other formats (1)	2	2	2	2	2	2	2	2	2
General criteria									
Number of files (3)	2	2	2	2	0	2	0	2	2
Comments and notes (1)	1	2	0	0	0	0	2	2	0
Number of collaborators (3)	0	1	2	2	0	2	1	2	2
Real-time collaboration (3)	0	2	2	0	0	2	2	2	0
Communication between collaborators via chat (1)	0	0	2	0	0	0	2	2	0
History access (3)	0	2	0	2	0	2	0	1	0
Individual contribution (3)	0	0	0	0	0	0	0	0	0
Help & support (2)	2	2	2	2	0	2	2	1	0
Desktop version (1)	0	2	0	0	2	0	0	0	0
SUM	**25**	**51**	**42**	**36**	**16**	**47**	**29**	**49**	**26**

0 - not satisfied, 1 - partially satisfied, 2 - fully satisfied

Criterion *Real-time collaboration* is not part of the free version of Lovely charts, although its Premium version does support real-time collaboration. Assessed version of Draw.io does not support real-time collaboration nor chat communication, but real-time version of the tool does support it (drive.draw.io).

In general, Web 2.0 tools for diagramming do not satisfy the *Individual contribution* feature, but this feature can be compensated with the possibility to access any prior version created by any team member (History access). ProcessOn offers access to history data, only if the version itself is created by the user.

Help and support is indicated as low-level for two tools, compared to others, and as medium for one tool, therefore their grade is not satisfied and partially satisfied, respectively. Medium grade is based on the fact that only short tutorial is available and web site of the tool was adapted to native language and letters of the country it was developed in, without an easy option to change it to English language.

According to the results, the tool Creately turned out to be the best choice.

5 Conclusion and future work

Web 2.0 tools can be an excellent alternative for desktop programs since they offer many features. They are easily accessible online and user friendly. Many Web 2.0 tools are free for use, and their full upgrade is less expensive then commercial tools. Free versions of Web 2.0 tools have limited possibilities but they can be the reasonable solution for students and their assignments that need fast and simple diagram design. For more complex diagramming, larger projects and collaboration of large teams, their upgrade is necessary. Criteria-based approach like the one described can help to make the best decision. The procedure for selection of the most suitable Web 2.0 tool presented in this paper may serve as a guideline for any educational domain, especially if the list of criteria is adjusted with domain relevant attributes. The importance of each attribute can also be adjusted by changing weights.

The proposed procedure was applied to the selected set of Web 2.0 tools for diagramming and it resulted with the ranked list. The tool Creately reached the highest number of points. Creately was used as a support for collaborative diagramming during several assignments within the course Process modeling. Preliminary results showed that students participate in collaborative modeling rather than individual activities performed in traditional environment and that Creately satisfied their needs during these assignments.

Future work will include efforts to enable automatic collection of activity data from Creately using ELARS recommender system. ELARS provides personalization of e-learning activities by recommending several types of items (optional e-learning activities, collaborators, Web 2.0 tools and advice). Based on activity data retrieved from Web 2.0 tools using APIs and RSS channels, ELARS estimates a level of student's (group member's) engagement in collaborative activities [12]. Thus, besides personalization, the system can be used to support teachers during evaluation of quantitative aspects of student's work.

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