Tool for creating learning modules developed on the basis of open source OpenScholar software

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Keywords
e-learning, learning module, OpenScholar, open source software

1. ABSTRACT

The article deals with developmental work of Sisu@UT tool (https://sisu.ut.ee) for creating learning modules developed on the basis of free open source OpenScholar software project. The tool enables the creation of interactive learning modules that support all the stages of the learning process and help students to achieve learning outcomes. Teachers of the University of Tartu can experience web-based cooperation when using the tool. The main functionalities of OpenScholar software and some integrated modules/plugins (quiz, webform and glossary module, multiple content editor and popup plugins) are introduced. Sisu@UT tool contains many other custom developments to the core of OpenScholar required to be used effectively in e-learning. These include the addition of metadata, site categories, developed custom themes and included Drupal's Sweaver editor.

Sisu@UT (that has received very positive feedback from its users) is the only free open source software which enables to add and change interactive features online inside the same web site/learning module. It makes the management of learning modules easier and less time consuming than other similar offline tools or online tools that do not enable to add interactive elements.

2. INTRODUCTION

An increasing number of university teachers have started the development and publishing of electronic study materials that support independent learning. Study materials that are stored in web or repository are easily accessible to students and other interested parties and teachers can supplement different e-courses with them.

Polsani (2003) states that it is evident that learning objects are the most meaningful and effective way of creating content for e-learning. There are several content models developed for academic environments. According to Verbert & Duval (2008) in new economy didactical model, a learning module is defined as a logical structure with a didactic aim, consisting of individual learning components. A learning component is defined as a small learning object that combines a small number of information objects, to form one of the following features: motivation, basic knowledge or theory, example, exercise, references, further material, open questions, problems, and virtual laboratory. A learning module is related to a Cisco RLO or lesson. Cisco (2001, as cited in Muzio *et al*, 2002) discusses that a reusable learning object (RLO), which is defined as a collection of reusable information objects (RIOs), overview, summary, and assessment that supports a specific learning objective. A RIO is defined as a collection of content, practice, and assessment items assembled around a single learning objective. RIOs are built on templates “depending on what is being communicated, whether content, fact, process, principle, or procedure.”

The creation of a learning module should proceed from students. The student is the one who starts working with them, who should be motivated and activated by the materials. The materials should help the learner in becoming smarter. What the student is ready to do without direct teacher supervision depends on their prior experience, habits, expectations and environment. It should be considered that according to expectations-values theory learning takes place if the subject matter is valuable for the students and enables them to experience success in (Biggs & Tang, 2007).

The foundation of successful learning is interactivity. The key is student interaction with learning materials in the context of learning modules. Interactivity creates cognitively involving experience which direct result is better learning (Liu & Shrum, 2002). Interactivity allows students to direct their learning process, activates the student and enhances their motivation (Allen, 2003). Learning module is interactive when it reacts to student activity (mouse clicks, input, etc) and is directed by student. For instance, interactivity enables to move within the learning module with the help of glossary or navigation buttons, manage the timeline of videoclip or animation, fill fields or click choice buttons, open additional windows.

Cooperation between university teachers is crucial while creating learning modules. Polsani (2003) argues that as the nature and functional requirements of knowledge are ever-changing in the knowledge economy, no single academic or subject expert can generate total knowledge adequate to the tasks. Therefore knowledge experts should develop only 'events' of knowledge that can combine with other 'events' to develop into a 'program' on demand. This 'events' approach should be seen as a strength rather than weakness, since it is a contribution to collective knowledge that is flexible, functional and adaptable. Multidisciplinary and cooperative model of development to create knowledge that is appropriate for the emergent network society.

The necessity to start launching cooperative interactive learning modules that support learning created the need for free software that enables to do all this on-line.

3. DESCRIPTION OF DEVELOPMENT PROCESS AND SOFTWARE MAIN FUNCTIONALITIES

In December 2012 we started with software development. The objective was to install it to the server of the University of Tartu and not use the means provided on in other servers (there are plenty of these) and develop functionalities that enable to produce quality learning modules and websites. The new means could have become a good alternative for the existing eXeLearning software that is to be installed in your computer and used *offline*.

Several content management systems (CMS) were tried and tested including BuddyPress (based on Wordpress), ImpressPages Multisite and OpenScholar. OpenScholar was the one oriented to academic institutions, based on acknowledged and flexible Drupal content management system and proved to be the most suitable for further development as its functionalities provided more than just creation of learning modules.

OpenScholar is developed and maintained by The Institute for Quantitative Social Science in collaboration with HPAC and HUIT at Harvard University with contribution from open source community. OpenScholar is designed as a tool for building academic web sites, such as a scholar's personal site or an academic project site. OpenScholar tools and features foster online collaboration and provide relevant site sections, such as "Publications", "Events", "Blog", "Classes" and much more.

The product was named Sisu@UT and it is installed in university server. The address is http://sisu.ut.ee. One can enter with the user name and password of the university network. Sisu@UT is meant for creating learning modules, portfolios, projects web sites and web sites aimed at studies.

It is easy to start to create a web site for a university network user. One must log into Sisu@UT, click on the link, create a page, choose the URL for a web site, accept the conditions of usage and with one button press the template for the web site has been created. Further on, one can add and change content pages. The following functionalities are available for the user:

- The user can choose between design templates equipped with university symbolics and change design of a web site,
- The user can create a bilingual (Estonian and English) web site,
- The user can exploit different applications – page, quiz, dictionary, media gallery, events, blog etc.

- The user can manage menus,
- The user can determine the widgets and their position in web site,
- The user can share the right to change the site with other users,
- The user can make the web site public and place the logo of it onto the opening page of Sisu@UT.

Web sites of Sisu@UT are divided into categories of *Medicina*, *Humaniora*, *Socialia*, *Realia et naturalia* and *Varia*. Underneath each category one can find topics that help to position all the web sites at once. In addition to that, one can search for web sites of interest.

4. RELEVANT ASPECTS

4.1. Innovation aspects

Sisu@UT is very scalable solution. A multitenant architecture that allows academic institutions to host thousands of websites in a single instance of the application. It is like university repository for open access learning content.

Sisu@UT supports collaborative approach model in creation content for e-learning that is appropriate for the emergent network society. Each learning module may have one or more users who can administer the web site (add content, modify content). Educational technologist is usually one of the team members as well, giving pedagogical advice and technical support.

Sisu@UT is the only free open source software which enables to add and change interactive features online inside the same web site/learning module. It makes the management of learning modules easier and less time consuming than other similar offline tools or online tools that do not enable to add interactive elements.

4.2. Pedagogical aspects

Our aim is to enable teaching staff to create learning modules that support effective and engaging learning. We have integrated some extra modules to OpenScholar software for this purpose.

Learning module designed for effective learning supports content- and structure-wise achieving learning outcomes and all the stages of the learning process: attracting attention and motivating; reviewing and actualisation of prior learning (essential prior knowledge); input; directing learning; reinforcement and practice; assessment. A good learning module is guiding, illustrated, interactive, providing feedback. It is suitable for independent learning (Villems *et al* 2012; Horton, 2011).

Sisu@UT enables to build learning modules in accordance with *SCATE* model (Mimirinis & Dafoulas, 2005) that includes all significant instructional events:

- Scope – introduction, objectives, prerequisites, requirements
- Content – text, audio, video, graphics, animation, etc.
- Activity – activities for reinforcement and practice, self-check and application tasks, e.g. practical tasks and self-tests
- Thinking – reflection and argumentation, e.g. questions integrated in text, cognitive tasks
- Extra – references to additional materials

Instructional events can be supported by different technological functionalities (Table 1).

Table 1. Sisu@UT functionalities supporting pedagogical ideas in instructional events (according to Gagné).

Instructional event (Reigeluth, 1983)	**Sisu@UT functionalities supporting pedagogical ideas**
Gaining attention and informing learners of the objective	pages, media elements (text, pictures, videos, audios, animations)
Stimulating recall of prior learning, presenting the stimulus material	pages, media elements (text, pictures, videos, audios, animations), quiz module, glossary module, popup plugin, dynamic content visibility plugin
Providing learner guidance, eliciting performance	pages, media elements (text, pictures, videos, audios, animations), popup plugin, dynamic content visibility plugin, glossary module
Providing feedback	quiz module, popup plugin, dynamic content visibility plugin
Assessing performance	quiz module, dynamic content visibility plugin, webform module
Enhancing retention and transfer	pages, media elements (text, pictures, videos, audios, animations), dynamic content visibility plugin

4.3. Technological aspects

OpenScholar is an open source Software as a Service (SaaS) platform built on top of Drupal (https://drupal.org/). It is a web site builder application that allows end users to create dynamic and customizable web sites easily. Each site comes with a suite of apps, widgets and themes, enabling users to build and manage feature-rich web sites.

Building competitive academic web sites can be difficult and is potentially costly. OpenScholar is a free, open-source solution with state-of-the-art technology out of the box. The user interface is logical and intuitive, making it feasible for scholars to self-create, self-design and self-manage their own web sites and their content without having to know any programming code or HTML. OpenScholar is highly customizable from both programming and theming standpoint. Developers and designers can implement their own features and themes.

When we first saw the OpenScholar platform, we instantly saw the huge potential of this software being used in creating learning modules. Although by default OpenScholar is missing important parts for this purpose. We have modified OpenScholar to be better used for creating learning modules. In most cases we use this software to create learning modules but it also enables to create conference sites, personal e-portfolios and other types of websites. We integrated some extra modules to give added value to the self-paced learning.

Drupal Quiz module

The Quiz module (https://drupal.org/project/quiz) provides tools for authoring and administering quizzes through Drupal. A quiz is given as a series of questions. Creating custom quizzes and ability to test learners' knowledge is a very essential part of independent learning. OpenScholar by default is not providing this option, therefore we added it by integration to this module. Questions can be served as one question per page or all questions at once. There are many other advanced options like adding a time limit, ability to skip questions, repeat until correct, etc to customize the behaviour and look of the quiz. Quiz attempts and scores are stored in the database and can be reviewed later by the quiz creator.

There are 9 question types: multiple choice, drag and drop (with lines), true or false, matching, short answers, grouping, image target, cloze, direction. Multiple choice type enables to design questions with one or more right answers. Short answer with regular expression type allows to check answers within a specific range or numerical answer together with a text (e.g. number and unit) (Figure 1).

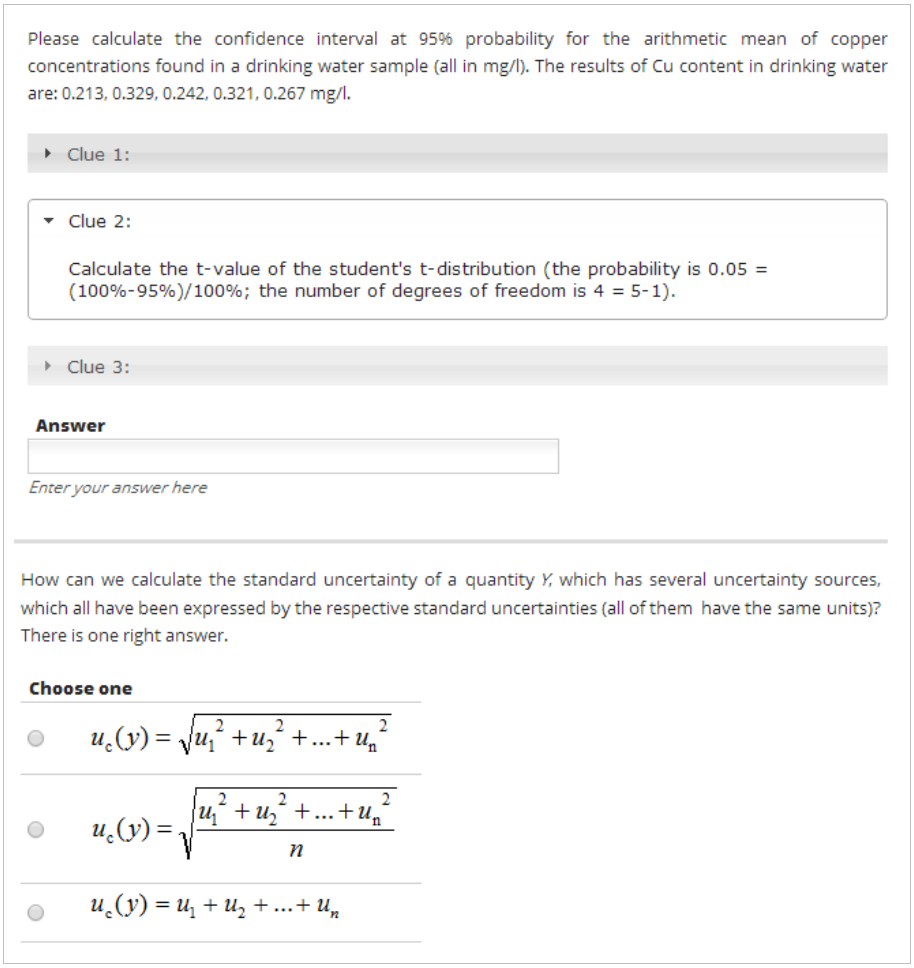

Figure 1. Examples of quiz questions: short answer with regular expressions, multiple choice (https://sisu.ut.ee/measurement/13-tests-and-exercises).

Webform module

Webform is the module for making surveys in Drupal (https://drupal.org/project/webform). After a submission, users may be sent an e-mail "receipt" as well as sending a notification to administrators. Results can be exported into Excel or other spreadsheet applications. Webform also provides some basic statistical review and has an extensive API for expanding its features.

Some good examples could be contests, personalized contact forms, or petitions. Each of these could have a customized form for end-users to fill out (Figure 2).

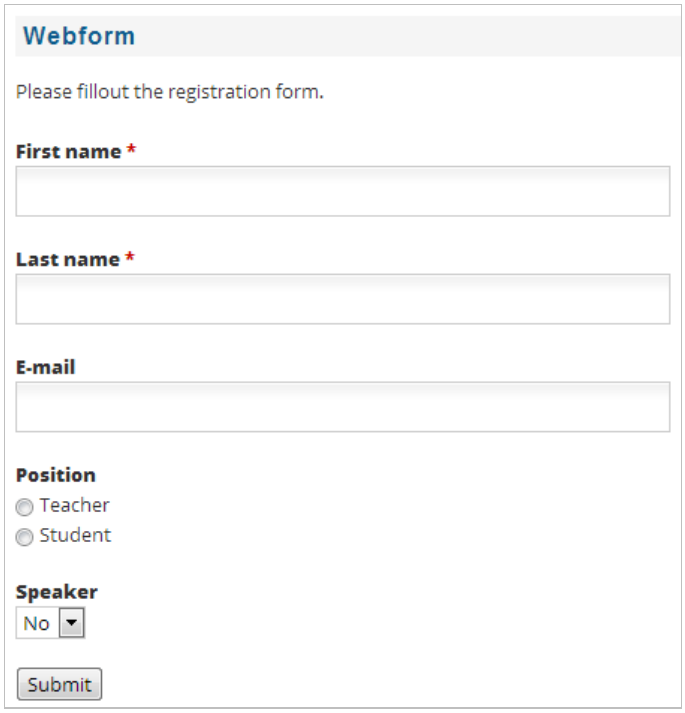

Figure 2. Example on webform

Glossary module

Glossary is the module for creating dynamic glossaries for learning. Our university developed it for personal needs and purpose. Teachers can easily add terms and descriptions to the glossary and all the words in the content that are related to terms can be automatically linked with term descriptions (Figure 3 and Figure 4). Glossary has much other advanced functionality to meet the teachers' needs.

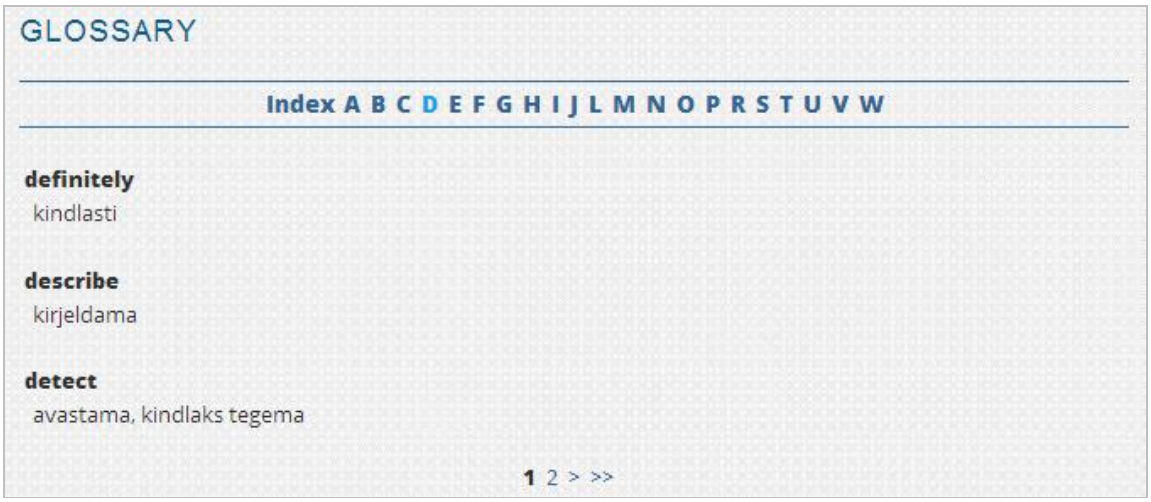

Figure 3. Example of glossary (https://sisu.ut.ee/arstil_inglise/node/3288).

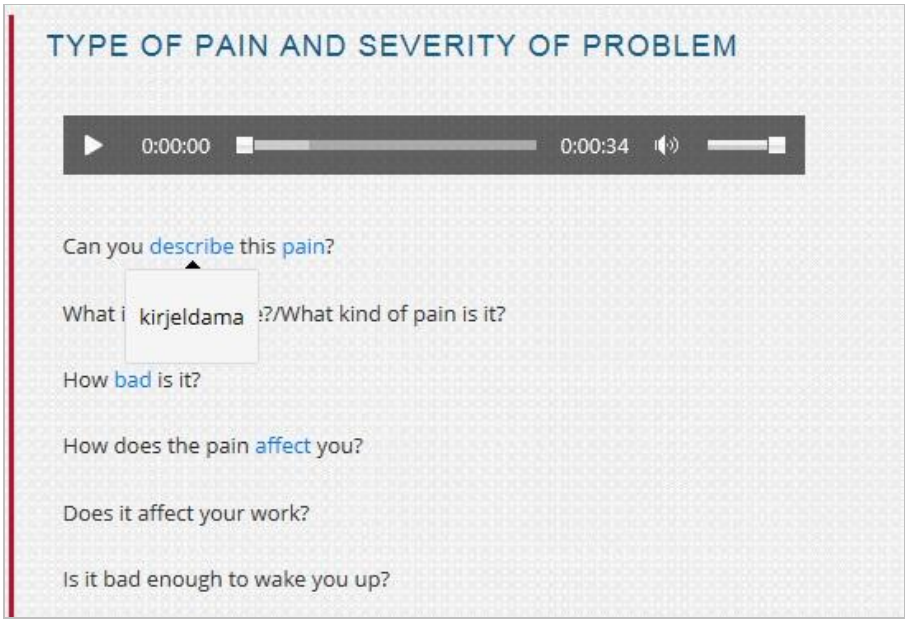

Figure 4. Words in the content that are related to terms are automatically linked with term descriptions in glossary (https://sisu.ut.ee/arstil_inglise/3-asking-about-type-pain-and-severity-problem).

Multiple content editor plugins

For providing a better e-learning experience we customized the TinyMCE content editor with extra plugins. These plugins extend the options of content creation process and allow teachers to embed images, videos and different types of media in other forms not just as plain text.

Here are two most important plugins added to the editor:

Dynamic accordion content visibility plugin (custom built)
Editor plugin (Figure 5) which helps teachers to create dynamic piece of content with onclick visibility change (Figure 6).

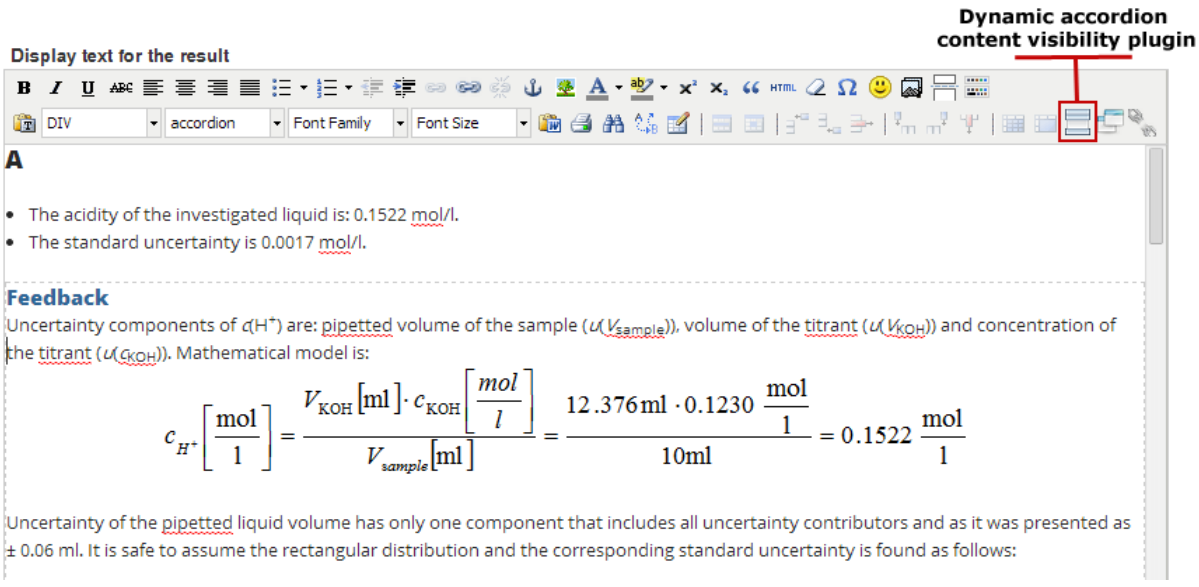

Figure 5. Editing view of dynamic accordion content visibility plugin.

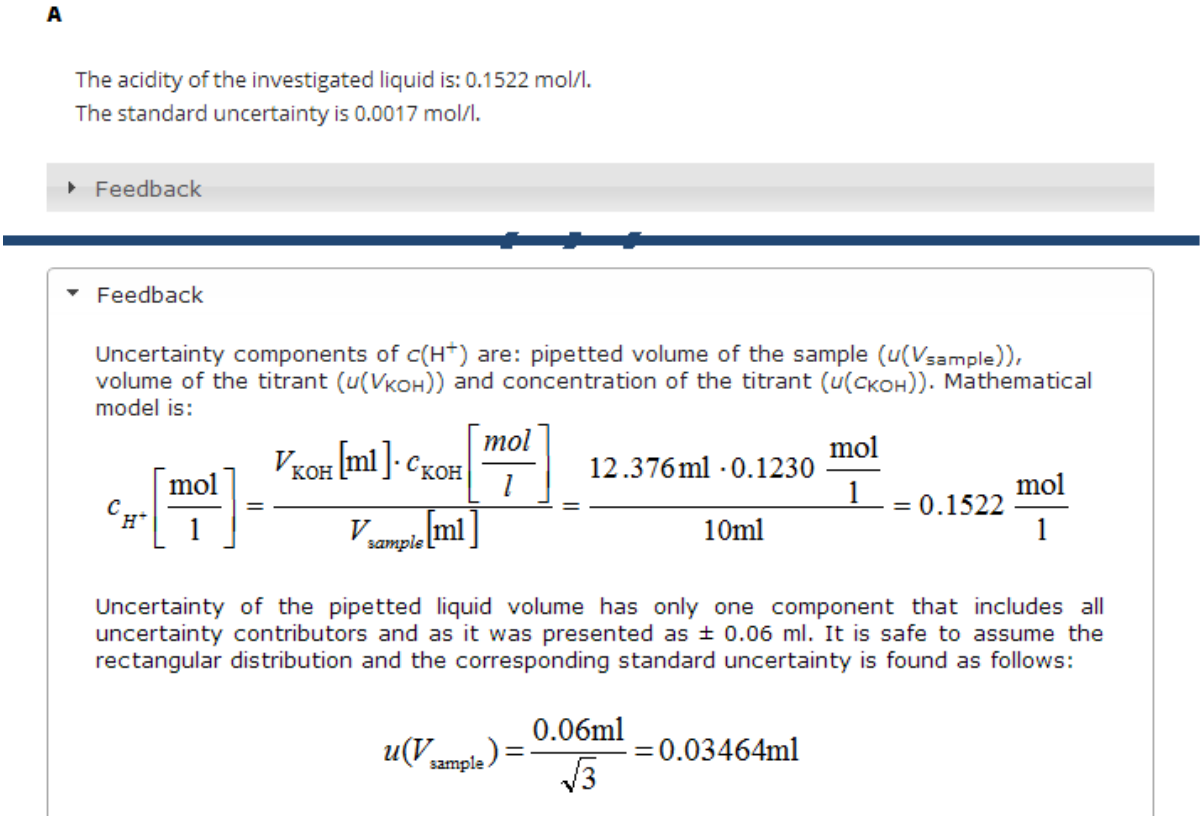

Figure 6. Content example of dynamic accordion content visibility plugin.

Popup plugin (custom built)

Editor plugin which helps teachers to create custom popup links with content (Figure 7 and Figure 8).

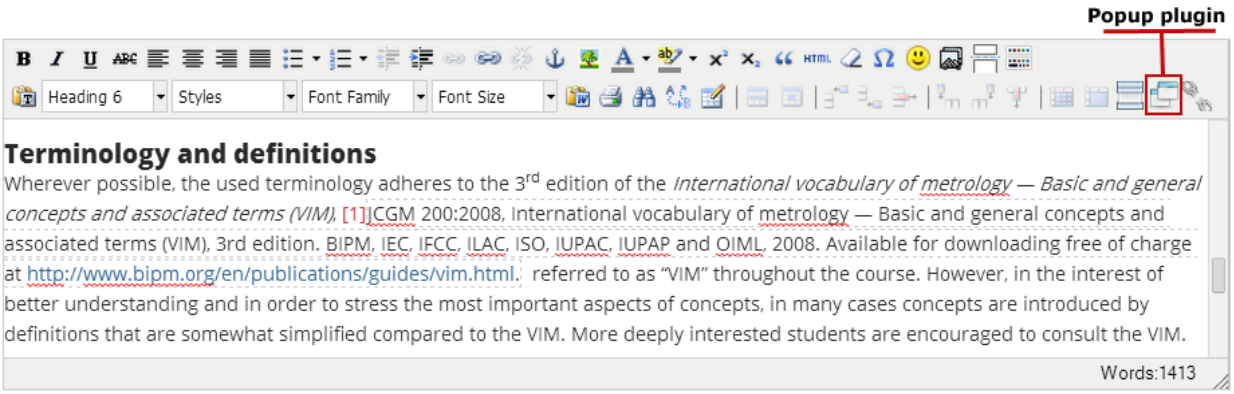

Figure 7. Editing view of popup plugin.

Figure 8. Content example of popup plugin.

Custom development

We have made many other custom developments to the core of OpenScholar required to be used effectively in e-learning. These include addition of metadata, site categories, developed custom themes and included Drupal's Sweaver editor (https://drupal.org/project/sweaver). Sweaver enables site creators to customize the look of the sites. Almost everything can be changed with this tool. So all sites can have a special look and feel (Figures 9...12).

Figure 9. Example 1: Estimation of Measurement Uncertainty in Chemical Analyses. Authors: Ivo Leito, Lauri Jalukse, Irja Helm. https://sisu.ut.ee/measurement

Figure 10. Example 2: Õpiobjekt ja selle omadused (Learning Object and Its Characteristics). Authors: Egle Kampus, Lehti Pilt, Anne Villems, Triin Marandi. https://sisu.ut.ee/opiobjekt

Figure 11. Example 3: Metoodiliste vahendite valmistamine: kaltsunukk (Making of Methodological Tools: Rag Doll). Author: Karin Kiss. https://sisu.ut.ee/kaltsunukk

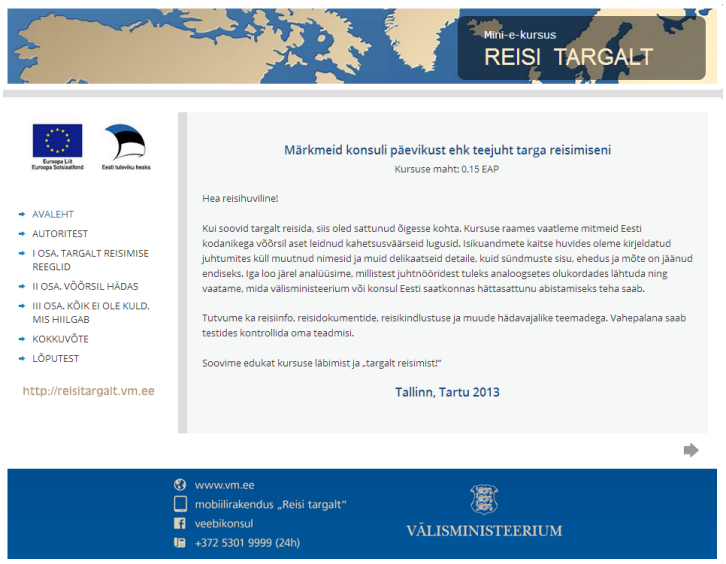

Figure 12. Example 4: Reisi targalt (Travel wisely). Author: Ministry of Foreign Affairs. https://sisu.ut.ee/reisitargalt

4.4. Usefulness and benefits of the innovation

Sisu@UT tool became usable in August 2013. By the end of the year Sisu@UT contained already 109 public learning modules or websites. This indicates that the need for such tool is immense and the planned target has been achieved. Other Estonian higher education institutions have expressed interest in Sisu@UT as there has been no alternative free web-based software that might be used for designing learning modules.

Sisu@UT proves to be extremely useful as 185 university employees (mainly university teachers) have exploited it in order to design their learning modules or web sites by the end of February 2014.

Google Analytics statistics indicates that from August 1, 2013 to February 14, 2014 Sisu@UT web pages have been visited 35 353 times (Figure 13). The number of unique visitors has been 17 337. The number of visited web pages has been 344 485. The visitors come from 120 countries all over the world.

Country / Territory	Acquisition	
	Visits ↓	New Visits
	35,353 % of Total: 100.00% (35,353)	17,261 % of Total: 100.26% (17,217)
1. Estonia	29,894	13,330
2. United States	984	871
3. Russia	345	172
4. Finland	343	260
5. India	307	220
6. United Kingdom	283	196
7. Germany	219	162
8. Egypt	131	26
9. Italy	120	60
10. Ukraine	110	99

Figure 13. Sisu@UT visitors of different countries between August 1, 2013 and February 14, 2014. TOP 10 countries according to Google Analytics.

We have received positive feedback from current Sisu@UT users. Margus Pedaste, professor of technology education of the University of Tartu states that he particularly likes the simplicity of the environment and the added value is the possibility to collect data on user numbers with the help of Google Analytics. The head of speciality information department of the library of the University of Tartu Kärt Miil thinks that in retrospective it was not complicated to learn how to use Sisu@UT. Due to Sisu@UT means their team has turned to move towards designing universal publicly accessible study materials. The results have proved to be more complex and well thought-through.

In Sisu@UT means the University of Tartu realised the content of the first two MOOC. The professor of analytical chemistry Ivo Leito, the author of the course „Estimation of Measurement Uncertainty in Chemical Analyses" was thrilled to find out how much the created MOOC contributes to his teaching skills. In the course of designing the learning module, he reconsidered all the teaching done in auditorium. He is positive that thanks to designing MOOC, the students of the field are much better.

It cannot be said that Sisu@UT software is finalised - constant development is a head with the aim to make the means more user-friendly and better functioning. Sisu@UT is currently developed by the Educational Technology Centre of the Lifelong Learning Centre of the University of Tartu.

The future development plans include automatic storage of Sisu@UT web sites records into the University of Tartu digital archive DSpace (http://dspace.utlib.ee). DSpace at University of Tartu is

a repository for all electronic materials including e-theses and e-publications, digitized theses and books, manuscripts and images, etc. Search interfaces such as FirstSearch, Scientific Commons, Base, DART-EUROPE provides integrated access to millions records from more than 1200 contributors worldwide.

Finally, we thank the OpenScholar development team in the Institute for Quantitative Social Science, Harvard University (http://www.iq.harvard.edu/). We hope to continue collaboration with Harvard University and would like to contribute e-learning concepts into OpenScholar.

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