Project report: InBookModE Kira-digi project[1]

Summary

This pilot aimed at developing a BIM-based learning platform. Building Information Modeling (BIM) has become a central element of Architecture Engineering and Construction (AEC) related teaching and practice. BIM refers to product data models, which include information-rich 3D representation and visualization of the physical world in the virtual world. BIM tools have become a knowledge resource that not only require teaching and learning in terms of their efficient use, but BIM tools can also become a good source of interactive learning about the core domain area (e.g. architecture, civil engineering, mechanical services, etc). However, effective teaching and learning in the context of BIM and core domain knowledge remains a critical gap. This pilot aimed to address this gap. While we succeeded in meeting the target of developing a proof of concept, and presenting it, a full-scale trial with students in a course is still to be achieved. We expect a full-scale trial and user validation during this summer.

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1. Recap of the Aims and practical goals of the Kira-digi Project

The desired results and objectives from the pilot project, as initially outlined, were:

1. Completion of a working prototype for the proposed learning platform (supports learning about BIM as well as about AEC)

2. Empirical test with various user groups using the working pilot. This empirical study will assess the effectiveness of the learning platform in creating a wider and better understanding of BIM as well as construction knowledge.

3. Identify operative strategies on how the web-based learning platform can be developed further to enhance wider technology adoption, acquisition of skills and learning.

2. Self-evaluation of the achievements of the goals

1. Objective 1, A working prototype was successfully implemented, and it can be argued we have extended the scope of the working prototype beyond the initial targets. As explained later through images, several interesting features have been already implemented which extended the scope beyond the original targets of pilot. Nonetheless, these features were found to extend the opportunities for learning via BIM-based content. For example, the multi-player immersive discussion around a BIM model is one such additional feature.
2. Objective 2, empirical test with various user groups using the working pilot was only partly achieved within the project timeframe. Sample content was developed by members of the project team. A demonstration of the possibilities with the InBookModE platform was presented in the A!OLE Gala at Aalto University. However, a full-scale user testing with students is yet to be achieved. We realized that such testing will require some refinement in the current working prototype, and these refinements and content planning is currently under progress.
3. Objective 3, identify operative strategies on how the learning platform can be developed further, has been successfully achieved through agile development, design iterations and feedback from the

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[1] This technical report only presents the details of what has been done. A separate file details the financial report of the project.

demonstrations and sample content development. These operative strategies will be tested later this year, once testing with students commence in the summer.

4.   What has been achieved? Explanation of the implemented platform

A learning platform with separate authoring and reader interface and login has been implemented. The system is based on integration between open BIMServer (to access IFC data), Unity for interactive game interface, and PHP. Currently, the reader is implemented for windows desktop interfaces and has to be installed as an executable file. The following figures show the current implementation, each supported with a brief description.
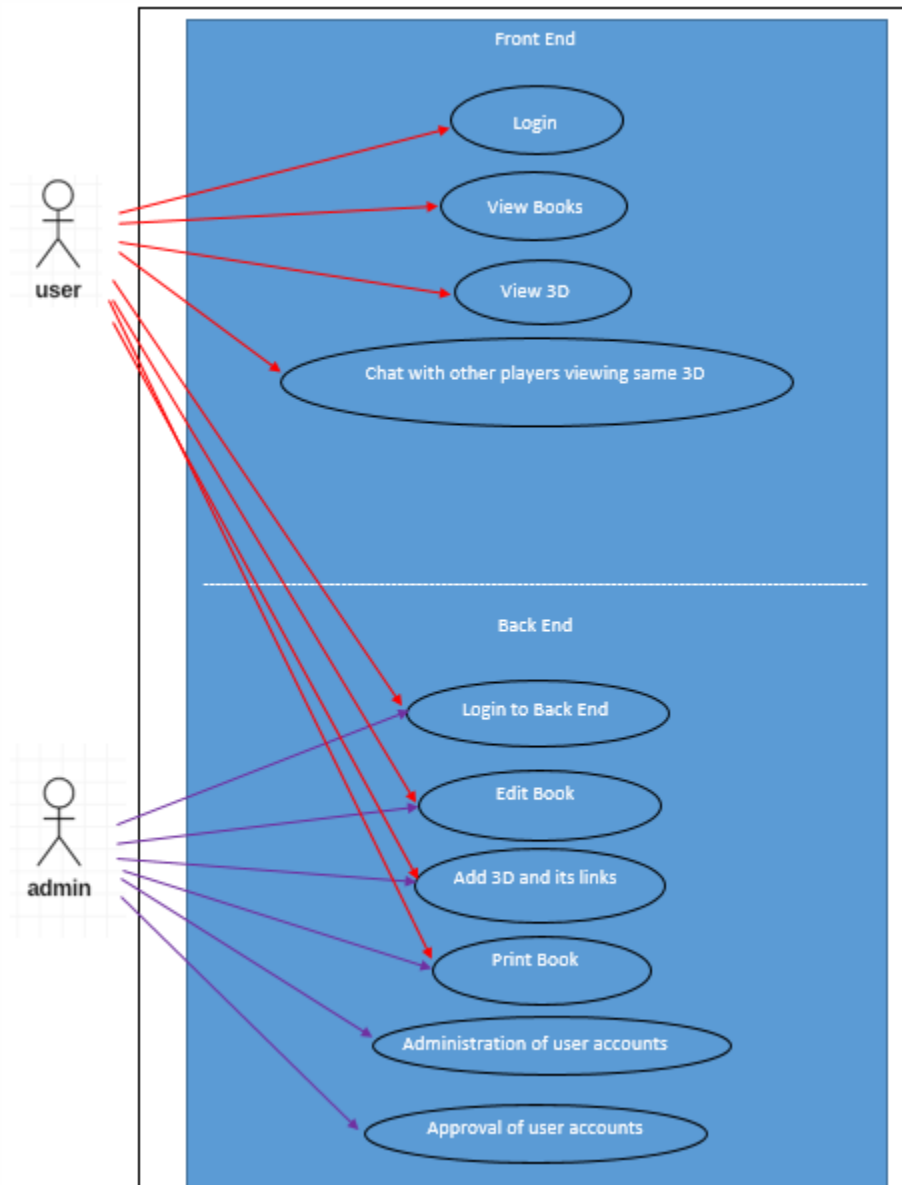

Figure 1: Use Case Diagram showing how different users interact with the system.

The 'user' in Figure 1 refers to students, who can login (Figure 2) into the InBookModE library, access the books and the interactive 3D models associated with the books. A bookshelf has been implemented where all books chosen by the students are maintained (Figure 3).

The 'admin' refers to the teachers and content providers who have access to the back end. These actors have the ability to create book content, including uploading and connecting BIM models relevant to the book contents, link the model data with the book data. These admin users as well the system admin users can also maintain user accounts, and check details of usage patterns.
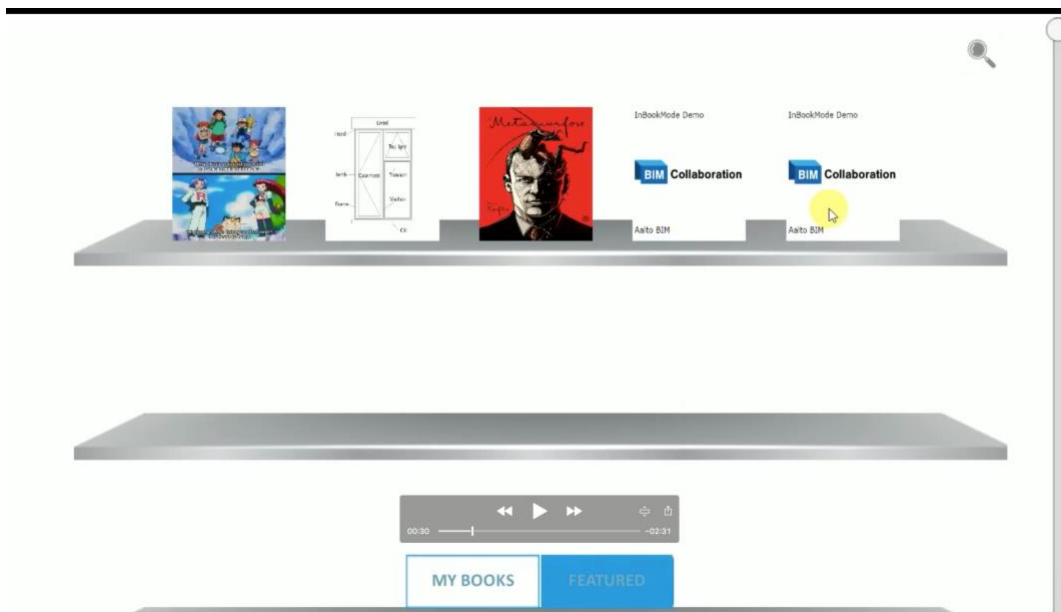

Figure 2: Login page for reader mode (front end)

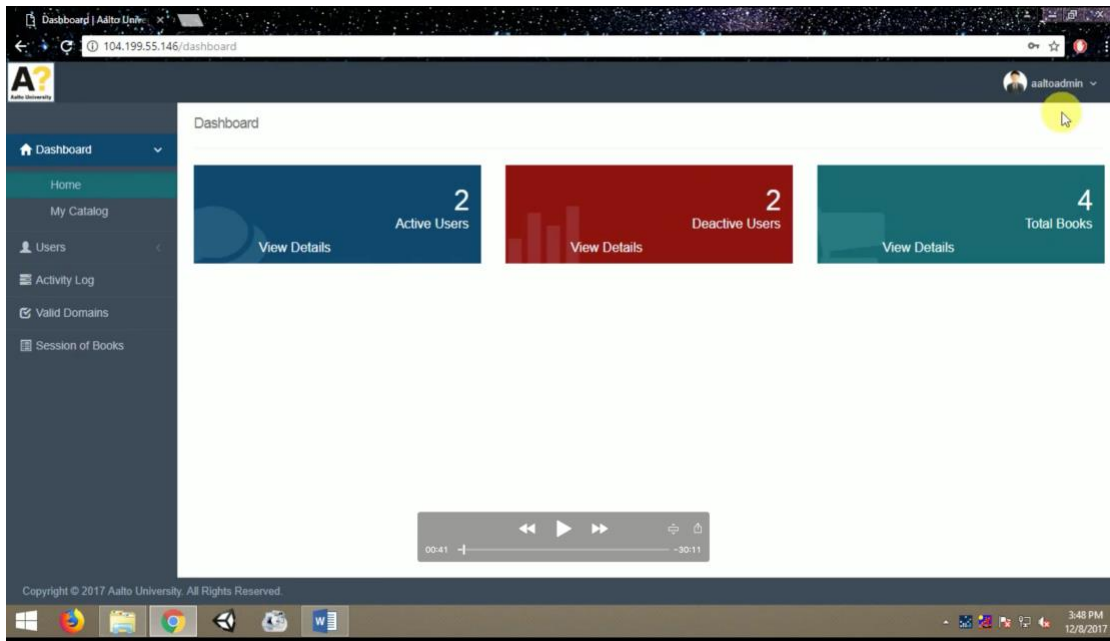*Figure 3: Bookshelf of each user (includes featured books as well as own selections)*

Figure 4: Snapshot of admin interface

As seen in Figure 4, the admin or the teacher can see details such as who are the active and non-active users, what are activity logs, how long do users spend on which book, what is the total number of books, etc.
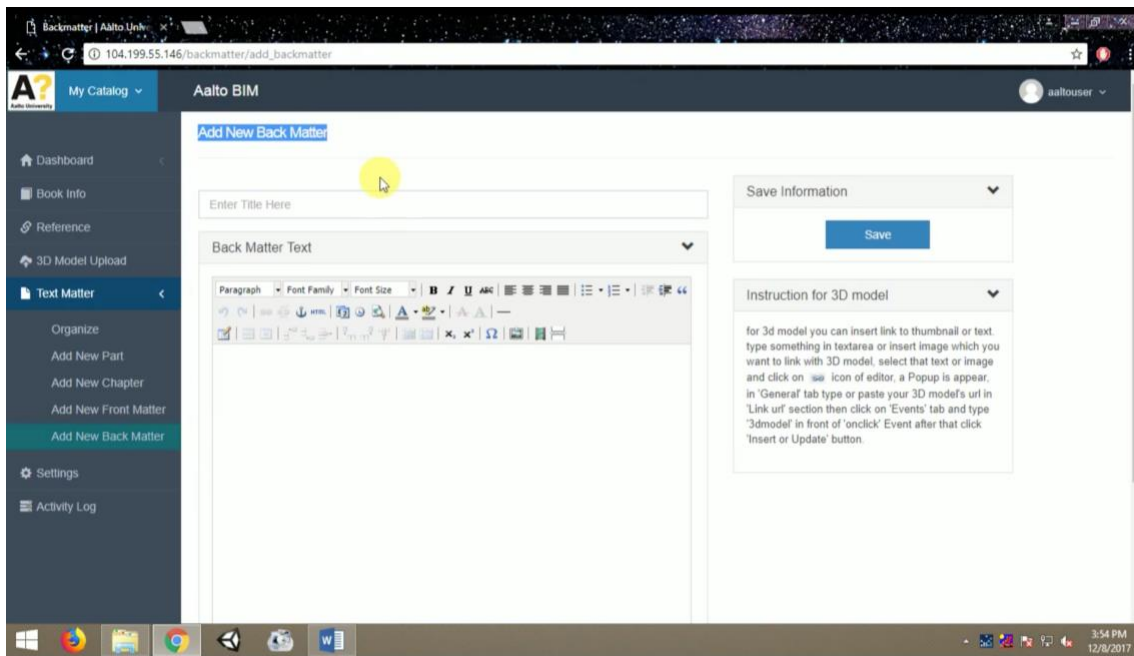

Figure 5: Adding new book matter through the admin account

As seen in Figure 5, the admin account allows login into the authoring mode, whereby the teachers can create new content. The interface allows content developers to organize their book and preview as it progresses. Help tips such as how to add 3D content etc are also provided.
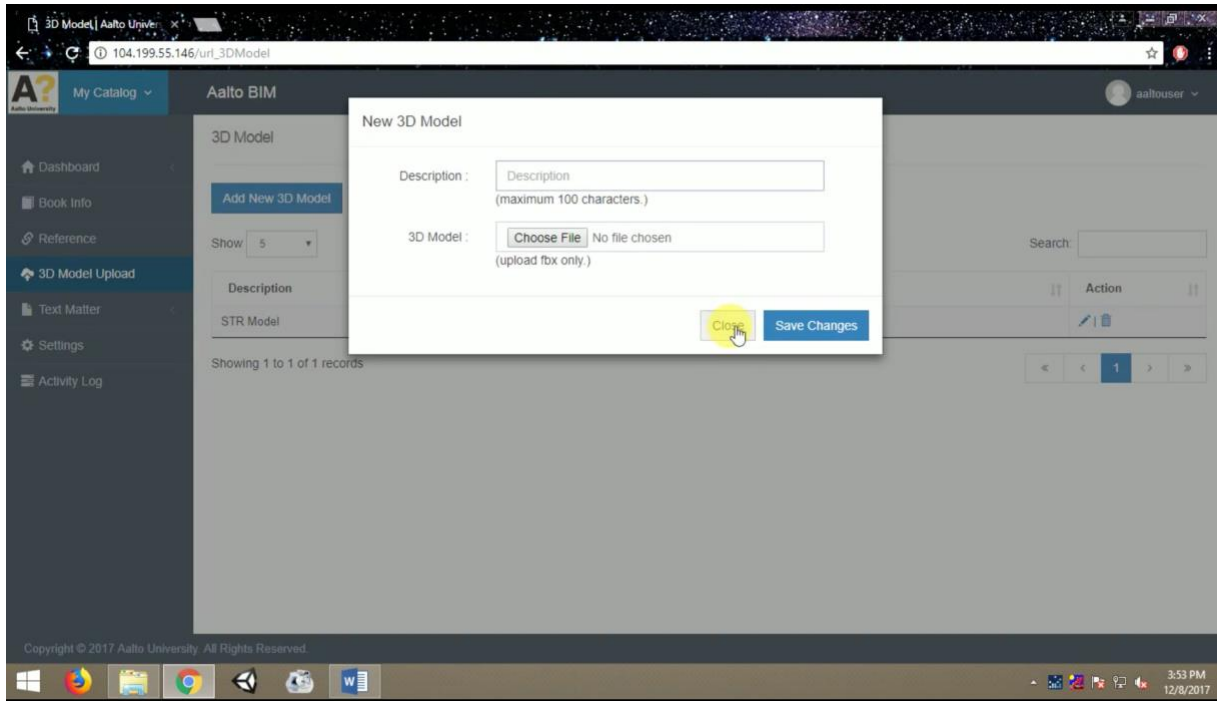
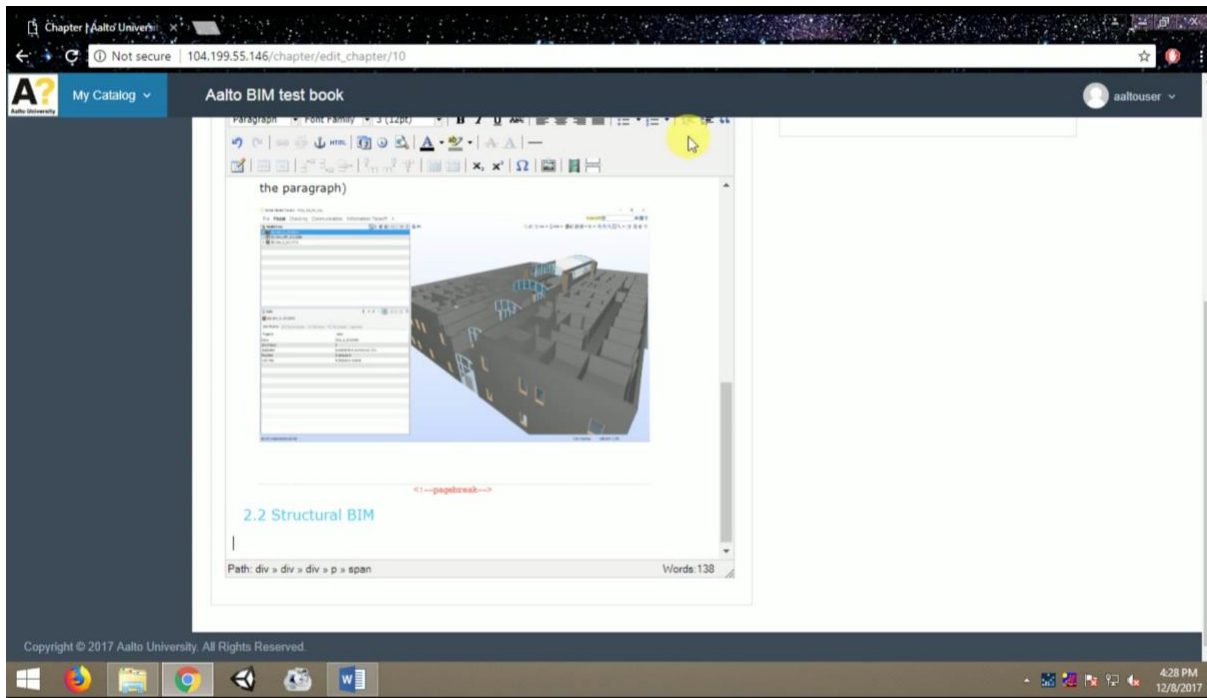*Figure 6: Snapshot from pop-up dialogue box while adding new 3D model*

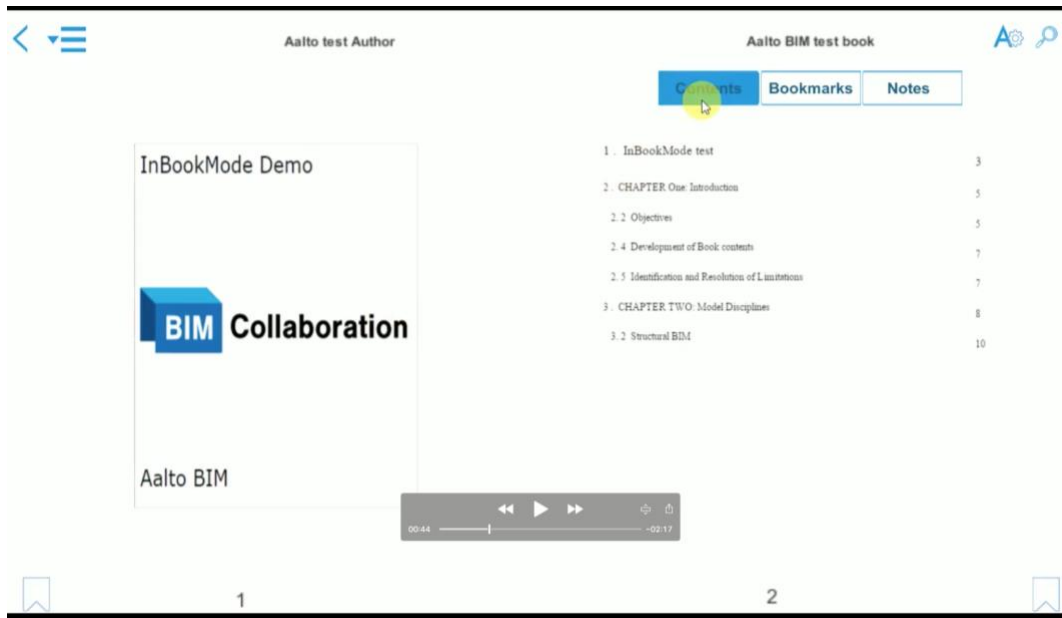*Figure 7: Snapshot of addition and placement of 3D model in the InBookModE*

Figure 8: Snapshot of book interface (sample content)

As seen in Figure 8, the InBookModE has a regular book interface with standard book elements such as table of contents, bookmarks, ability of tagging and taking notes, etc. It is possible to customize the font sizes, font colours, background colours etc.
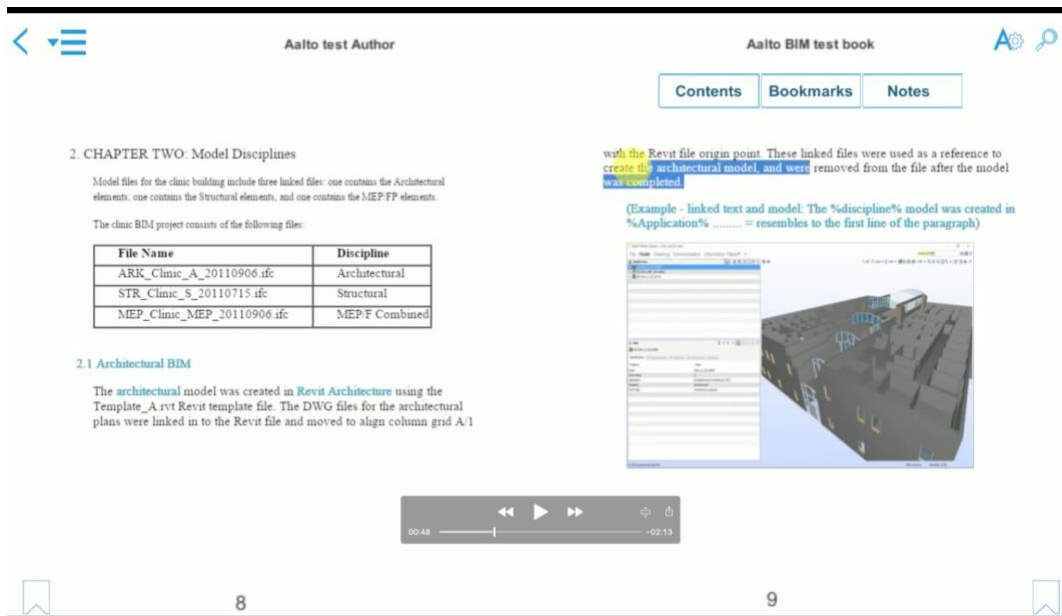

Figure 9: Snapshot of book interface with interactive 3D model (with IFC data)

As seen in Figure 9, the InBookModE platform allows embedding and linking processed BIM models into the book interface. The BIM model is processed to make it lighter, while the GUIDs of the model elements are retained. Using these GUIDs it is possible to fetch relevant BIM data, while allowing interactive navigation of the model. The authors can also link the model elements with parts of the book text. The

model elements can be linked directly to book sections, or paragraphs, or sentences and words, etc. The 3D model can be navigated within the frame or can be viewed on a pop-up window.
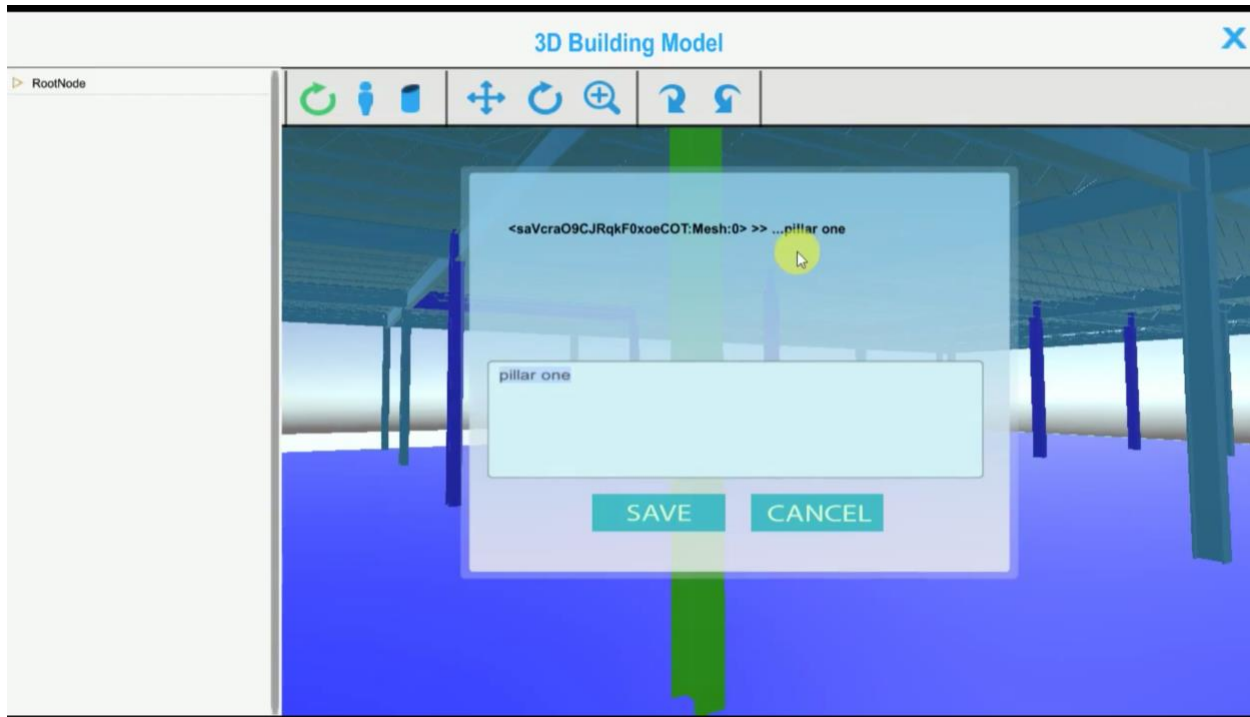

Figure 10: Snapshot of multi-user learning mode

As seen in Figure 10, to enhance interactive experience in learning, a multi-user learning session has been implemented. More than one user, including students and teachers can interact with the same content, and interact with chats. The typed text can be tagged to different model elements and saved for later reference and use. The left side of the interface allows showing model tree structure based on IFC or other classification of the model data.

1. Feedback and testing with potential users

The original plan was to test the InBookModE with various user groups in classroom settings. Nonetheless, the development of the platform took longer than expected, with occasional bugs and technical issues to fix as the implementation progressed. Consequently, a full-fledged testing with students has not been achieved yet, and it is planned for the summer.

However, the research team was able to test the usability and functionality of the working prototype, especially during development of sample content. This was done to explore different implementation features and how usable these were. The images above are based on such sample testing. Currently, two case projects are being detailed with respect to BIM models as well as reports relating to those models. Once the content is ready, it will be transferred to InBookModE as test material as well.

In addition, the details of the implemented platform was also presented in Aalto University A!OLE learning Gala event (See Figure 11) on 21st December 2017. The event was attended by more than 100 people, and several attended visited the InBookModE demo table.
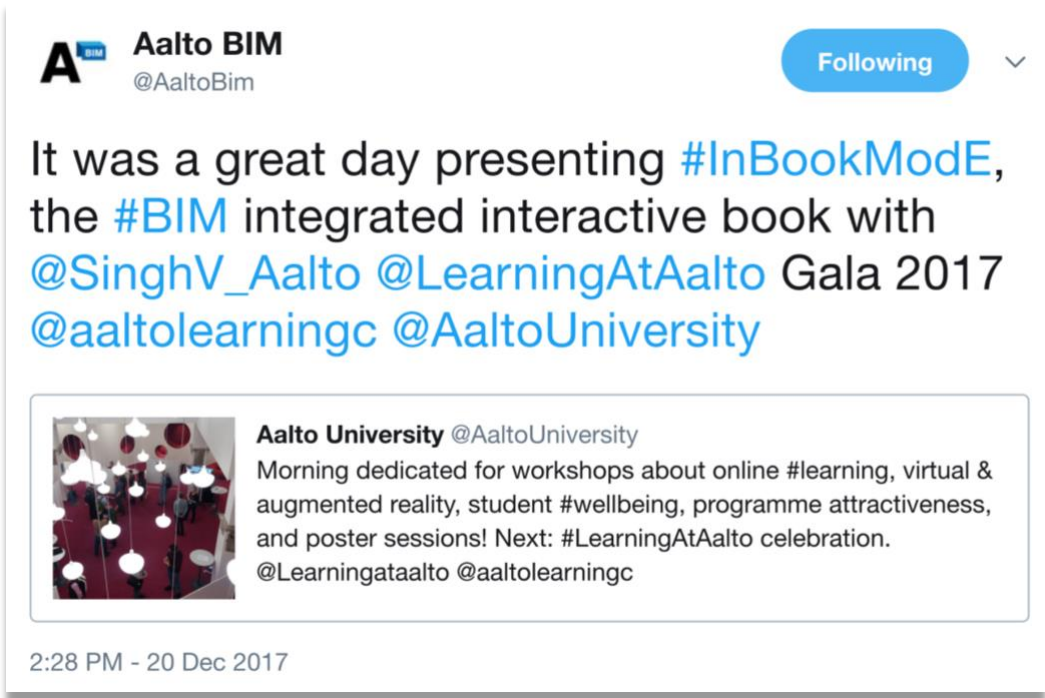
Figure 11: Images related to the A!OLE event where InBookModE demonstration was presented

7. What were the challenges, causes of variations, and lessons learn from the pilot implementation?

1. Technical issues and bugs affected the timeline, especially because this project is based on integration of more than one technologies.

2. Agile development meant that some of initial specifications and targets were revised and new features were added as the implementation progressed. New insights into interactive and blended learning were obtained.

3. The research student working on the Kira-digi project also benefited from inputs he obtained from pedagogy and learning technology related courses at Aalto University. This regular feedback and resulting changes also affected the schedule partly.

4. IFC data and integration with BIMServer leads to some inefficiencies in data handling, especially for online usage. Nonetheless, there is trade-off to be made in using open data formats. In addition, further experiments and trials are needed to identify IFC data sub-set that may be adequate for the purpose of InBookModE. The current implementation has shown practicality and usefulness of the approach, but further research and testing is needed to open the InBookModE for wider community. Until the next few months trials will continue to be conducted within Aalto University and related courses.

8. **Results publication and utilization plan**

One conference paper has been submitted to the International Conference on Product Lifecycle Management. A journal publication based on empirical findings from the pilot is planned for submission by the end of this year. This journal article will contribute towards the thesis of a PhD student working on this project.

The learning platform will be publicly available for wider use by the community by the end of this year. The developed tool will allow open publication of BIM learning content contributed by different authors.

The information about the pilot project, the developed learning platform, and the findings will also be disseminated through social media, website of the research group, and collaborators both within and outside Finland.

Acknowledgement