How to convey a complex message in terms readily understandable by people with different backgrounds? An experienced trainer should understand the type of audience in front of her; in class, students are usually the same age, but in cases of courses dedicated to acquiring specific knowledge, the chance is to face people of different ages, different ambitions, passionate or not and with different skills. How to better manage and enhance their differences? Thinking that they can all learn from each other, the best option is to open discussion with them in order to stimulate their curiosity.

Within the present article, a feedback on an educational course related to Building Information Modeling (BIM) methodology is given. In that case the audience included a mixed bunch of young students having several backgrounds, some of them were University students, some others just finished the surveyor school. The challenge here was finding a good mean of communication to meet the needs of both kind of audience.

First of all, when approaching lessons, a clear statement of who and what is going to be presented is paramount; in order to be listened when explaining something, it is important to establish a connection, a relationship with the audience to reach the point they trust you and are willing to believe in what you are saying. For this reason, the first part of the course consisted of a presentation of the team staff working at the University laboratory with the speakers. The aim was to highlight the organization of research projects, the relationship with students, the innovative technologies for Virtual and Augmented Reality (VAR) purchased and currently available at the lab. This communication used several forms of support, mainly multimedia, in order to be more effective in conveying the message. The learning assessment included two different tools. In the first exercise students were asked to provide a slide individually, deepening a preferred topic; in the second exercise students were asked to work in group and produce specific documents by a specific amount of time.

The whole experience showed how much important is including BIM-oriented educational audience in order to educate the new generation of professionals.

Keywords: Education, BIM, Support tools, VAR, Communication, Awareness, Creating interests.

1 INTRODUCTION

The introduction of using Building Information Modelling (BIM) methodology [1] in educational courses is fostering students concerning the improvement of knowledge on technical and operational aspects such as modelling/model management, functional concerns such as collaboration, implementations in terms of process standardization, administrative procedures, data and network support, managerial concepts and R&D [2]. In these terms, several experiences of BIM adoption in university training are available around the world [3].

This is due to the transition on data sharing in building process, characterized by new ways of teaching based on Information and Communication Technologies (ICTs). Of course, the wide range of concepts, tools and workflow needed for BIM adoption in the labor market requires that educational figures are able to teach and diffuse these innovative contents in proper courses.

In this transitional period, the construction sector is wondering how BIM education scope can help to bridge the gap between the construction industry and the education sector.

In these terms the idea of BIM learning is often used more than BIM education at international level due to underline needs to be learned rather than on how, where and when learning occurs [2].

The creation of the BIM learning triangle (Figure 1) brings out the triangular interaction between BIM learners, BIM learning providers and the BIM learning spectrum [4] and highlights the key fields of this learning workflow.
For these reasons, the inclusion of BIM contents into educational courses programs provides a considerable value for the creation of the future actors of the building industry. This integration generates a series of questions about the BIM education scope, teaching strategies, principles and methods that support BIM education [5].

In these terms, the drawing field can be considered as a transversal discipline able to exploit new technologies of graphic representation to optimize informative communication during the BIM education courses. Exploring different contents about construction and project planning, different institution are integrating their BIM curriculum to provide several BIM competencies in their courses. Moreover, through the Project Based Learning (PBL) applications [6] students can develop their creative capacity by dealing with complex or poorly structured real issues, working in small groups.

2 METHODOLOGY

The challenge here was to deal with a heterogeneous audience with several backgrounds both in terms of theory, knowledge on what implementing BIM methodology means, and in terms of practice, knowledge on which tools can be considered BIM-oriented and how they work. Furthermore, students were also different in terms of ambitions, so even more complicated because they all had different topics of interests; for instance, students who just finished the surveyor school were more interested in practicing with modelling tools, while students from university managed to understand the importance of the establishment of a methodology and standardization process. How to better communicate with such a diverse audience? Difference is not a problem if it enhances the results in knowledge and it is properly located in “sets” with specific purposes.

2.1 Presentation of lecturers. Our Lab!

First of all, when approaching lessons, a clear statement of who and what is going to be presented is paramount; in order to be listened when explaining something, it is important to establish a connection, a relationship with the audience to reach the point they trust you and are willing to believe in what you are saying.

For this reason, the starting point for the experience presented within this study was the presentation of the laboratory where researches work on several BIM-oriented topics. The drawingTOf thefuture is a laboratory of research and teaching at “Politecnico di Torino” within the DISEG (Department of Structural, Geotechnical and Building Engineering) Department. The several research projects carried out revolve around the following keywords: BIM and its forms, HBIM (Heritage/Historical Building Information Modelling), InfraBIM (Infrastructural Building Information Modelling, DIM (District Information Modelling) etc., GIS (Geographic Information System), Interoperability, FM (Facility Management), VAR (Virtual and Augmented Reality), MR (Mixed Reality) etc. The coordinator of the research group is Prof. Anna Osello; the main focus is on the built environment, collecting and
representing all possible information on architectures, cities or infrastructures with the aim to optimize the data management process. Within this context, researchers move in multidisciplinary-oriented approach, using innovative methods and tools, to identify effective and efficient solutions.

In order to establish a connection with the audience, the aim was to create an exciting atmosphere, presenting the laboratory at its best through videos and pictures of technologies implemented.

This phase was paramount to make students understand the lecturers' background and the working environment of everyday life in the lab. The direct relationship among researchers and students is very beneficial and attractive for other students, because they understand that in the drawingTOthefuture lab students are encouraged to work hard but at the same time to enjoy in deepening their knowledge on certain issues by using innovative technologies (Figure 2). This way, lecturers managed to gain the attention of the audience, which in turns facilitated students’ perception of presented information and their capacity of elaborating information. In order to achieve this result, the presentation supports have been prepared in order to be:

- Unexpected, because the way the lab was presented is slightly different to what a student would expect from a University department. Furthermore, unexpected questions were asked to make students reflect on concepts;
- Funny and bizarre, because speakers told enjoyable anecdotes on how it is working in an unconventional environment;
- Emotional, because the communication of the message to students happened through well-structured videos enriched with music and highlighting the organizations of events for social purposes.

### 2.2 Support tools & teaching workflow

The main supports within the course included slides enriched with videos, links and other tools. When preparing a presentation the first thing to have in mind is that slides are something to use in order to make the message understandable and easy to remember; so slides are successful when they get to the point, highlight what is important and “keep it simple”. Visual explanations are welcome, of course, because, for instance, there is no better way to explain what a car crash test is than by showing it (Figure 3).
A clear organization of the “teaching workflow” was paramount in this case, mainly because of the difficulty in conveying a “brand new” concept for all students. For this reason, a conceptual map (Figure 4) structured around three main concepts was created in order to organize ideas and make the explanation the simplest possible. This framework supported the whole presentation process, in order to leave students a well-structured sequence of information.

The three concepts chosen around which the lecture was organised are the following:

- **Methodology**: the scope is to define a structured method in order to put into practice theoretical concepts acquired within the presentations. The methods presented show different characteristics on the basis of the specific domain in which they act; BIM is an extremely wide concept that gave birth to several acronyms, such as HBIM, InfraBIM or DIM, each of them deepening specific aspects in relation to the field of applications in which they are used;

- **Tools**: tools are another crucial element to explain, because concepts related to BIM methodology are indissoluble from tools used. After having defined and structured main goals and methods, tools are fundamentals in order to develop applications of the methodological approach. The tools were not only presented as single entities but the highlight was on the interoperability among several platforms, in order to make students understand how to collaborate among several software and disciplines;
• **Case studies:** The case studies presented reflected the work done in the past years in the context of the lab; each case study analysed different points of view, in order to go deeper in details with specific domains considering the great amounts of heterogeneous data concerned the built environment.

Within the whole course, the most important concepts have been repeated in different ways, with the aim to strengthen the message and make the audience remember crucial notions, taking care of producing clear, simple and structured support tools.

### 2.3 VAR presentation

The last part of the course included a presentation on VAR and MR technologies; undoubtedly, this part of the course was the most attractive for students. Why? The idea was to make them conscious of real potentialities of these technologies by showing impactful videos on their advanced use to produce customized applications. The lecturers started from presenting backward equipment up to the most innovative ones. Introductive videos aimed at “waking up” the audience in the introduction of the topic by activating their emotions. Support tools were useful also to create discussion around topics; some videos were so unexpected or bizarre that managed to trigger students’ curiosity. Another interesting part of the lesson was related to a direct conversation with students who were asked to look at pictures or videos and understand which type of technologies was shown. This step was important to fix the concepts they were told and develop a critical sense in the receiving of information. To conclude, students were given a demo of some applications developed in the context of the laboratory using VAR or MR; students were surprised that those tools can be used not only to play with videogames, but also to perform serious intents.

This example shows that these technologies can be effective to communicate any kind of message, mainly with youngest generations of students. What is most important is that inspiring students’ creativity using attractive support tools results in having students more focused and interested in the serious contents behind. Furthermore, this approach makes them reflect on how to use tools with different purposes and develop a deeper engagement with disciplines that apparently have nothing in common.

### 3 RESULTS

The course resulted to be successful despite the different backgrounds of students. Students with higher school education (who are currently attending University) showed more engagement in processes, interoperability and methodological concepts, while surveyors were more interested in modelling tools and new professional roles related to BIM disciplines. The students’ heterogeneous character “ended up” in an added value for all participants, because they all learnt by other’s questions and topics of interest.

The last part of the presentation involved a direct interaction with the audience during the presentation itself; at first the whole topic was explained, then students were asked to give answers on the basis of their own interpretation of the topic. This step was fundamental in understanding the level of knowledge acquired by the audience, which resulted to be quite high.

Another key result that showed the arise of interest around the topics presented within the lessons is related to operational activities, in which participants were asked to perform exercises to apply and try out what they listened to. This phase was very successful, because it enhanced the exchange of information and point of views among students. This phase was subdivided into two stages, the first one linked to the theoretical concepts explained which aimed at making students reflect and subsequently learn more intensely, on the other hand the second exercise involved specific operational activities, to be performed in order to deliver a predefined set of documents.

This experience was paramount in order to test the PBL method as an approach to enhance different knowledges coming from heterogeneous backgrounds, to make students work together and develop problem-solving techniques.

### 3.1 First exercise

The first exercise involved a brief state of the art related to one of the topics presented that each student liked most; the exercise was announced before starting the lesson by telling students they would have asked to hand in an assignment after a short literature review.
The amusing aspect of this phase was the fact that there were almost no overlapping topics; the students chose on their own different aspects of the BIM methodology to deepen for their exercise. This fact was interpreted as another sign of the heterogeneity of the audience. After having carried out research on those topics, students were asked to prepare one slide to discuss in front of the class, explaining also the reason for their choice (Figure 5).

Again, this presentation support tool has proved to be very effective because, firstly, the idea of applying theoretical concepts into practice forced students to remain focused during the whole lesson. Furthermore, the fact of reviewing and reflecting on some topics previously presented strengthened their knowledge on those concepts, because there is no better way of understanding than doing.

The main aim of the first exercise was to make students reflect on what they listened to, in order to really fix those concepts and make them interact among each other on the issues they were less interested in, but maybe just because of a lack in understanding the topic itself.

### 3.2 Second exercise

The second exercise was developed after more specialized presentations, in which specific information on technical tools and commands of software involved in the BIM process was given. In this phase students were asked to analyse the construction works going on in that moment in the school where they were having the course, study the drawings and documents and think on how that project could have been developed through BIM methodology. The idea behind this exercise was to use a real case study, close to them in terms of knowledge (of course it was their school!) and elaborate information on that, by studying an alternative to traditional approach design, performed within the project of the school.

Students were given specific requirements: the Client and the objectives of the exercise with the definition of all tasks to be submitted. Furthermore, students received a document including the exercise information requirements they were asked to satisfy. They were given an extremely short Exchange of Information Requirements (EIR) to which they had to answer with an equally short BIM Execution Plan (BEP), in which they had to report all information required.

Other required information are the following:

- the setting of the template within the digital parametric software;
the model of the context and topography;

• the model of the construction phases of part of the refurbishment project;

• the definition of a file naming for the data classification;

• an openBIM interoperability test, during which students were asked to export and validate the model using the IFC (Industry Foundation Class) format.

Students had to work in groups, in which they had to assume specific roles, so a further request was to understand who was the responsible for each requirement, on the basis of what lecturers explained during classes.

In the end, students had to present their work in front of the other groups; their performance was evaluated with points in a scale of 1 to 3 for four categories. The categories evaluated were: presentation, documents submitted, PBL and the fulfilment of the contents handed in. Specific results for each group are collected in Figure 6, which reports qualitative rating established by lecturers; in general groups who submitted all, or almost, documents required did not handed in complete contents, while those who submitted less produced higher-quality and more extensive contents. The teamwork was a crucial point, because they had to define roles and responsibilities since the beginning of the exercise. The performance highlighted different characteristics for each group, depending on the speaking skills of students; the group who had the best performance organized the structure of the speech before presenting, while the others did not have enough time to focus on this aspect.

To conclude, the small amount of time for this course, only 32 hours in 4 days, was one the negative aspects of the experience, because, mainly for the second exercise, it would have been better to focus more on the results obtained. For instance, the feedback from students reported that not enough time was spent to check the mistakes together with students, who would have liked to understand when and how they could have saved time during the workflow in order to be more efficient and productive.

4 CONCLUSIONS

To conclude, the experience given within this text highlights the relevance of the type of methods and support tools used in conveying a message to a specific target audience. It is not just a question of preparing and creating relevant contents, other aspects must also be taken into account. Adapting ways of communicating with the audience trying to inspire young participants even using non-conventional materials seems an efficient channel to stimulate their curiosity and establish a connection with their interests. The results showed the course was successful despite the criticalities that emerged, for instance the lack of time. At first, students found difficulties in working in teams,
probably because of the habit to work on assignments on their own; anyway, Figure 6 shows encouraging results in terms of PBL, that can be improved by experiencing more this kind of method.

To summarize, the introduction of BIM-oriented learning courses is getting more desirable day by day, to bridge the gap among universities and the work environment. For this reason, it is without doubt advantageous for majors to be reviewed in order to schedule new and interesting course catalogues, attractive for young generations of students. One of the reasons of the gap between University and work environment is this gap of update on teaching methods and disciplines.

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