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Violeta Nushi, Arta Basha-Jakupi: VKLUČEVANJE “INFORMACIJSKEGA MODELIRANJA ZGRADB” (BIM) V TRAJNOSTNO ARHITEKTURO IN GRADBENIŠTVO: ŠTUDIJA PRIMERA NA UNIVERZIV PRIŠTINI CASE STUDY IN PRISTINA UNIVERSITY

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IZVLEČEK

Glede na poglobljeni in primerjalni pregled člankov, objavljenih za uporabljene vrste programske opreme za “Informacijsko modeliranje zgradb” (BIM), študija omogoča širši razumevanje in kritičen razmislek o vključevanju in sintezi razvoja BIM v izobraževalni sistem na Kosovu z namenom podajanja smernic akademskim raziskovalcem, študentom in strokovnim delavcem. Ker je učinkovitost BIM široko sprejeta v svetovni industriji “Arhitekture, Inženiringa, Konstruiranja” (AEC), je potrebno vzpostaviti sinergijo med izobraženimi BIM kadri in tistimi, ki se v praksi ukvarjajo z aplikacijo BIM programske opreme na Kosovu. To vodi k iskanju intenzivnejših in primernejših pristopov ter orodij z namenom vzpostavljanja integralnih rešitev preko izobraževalnega sistema; zlasti z namenom, da bi ponudili znanje svetovne prakse BIM v izobraževalne programme, ki so usmerjeni v trajnostni razvoj ter AEC, učne načrte in / ali tečaje.

Večina Tehničnih fakultet Univerz na Kosovu predpostavlja preživetje BIM-a kot strategija poučevanja in načrtuje premagovanje ovir za integracijo BIM-a v kurikulum. Z izvedenim vprašalnikom za študente smo raziskali trenutno stanje integracije BIM na programih visokošolskega izobraževanja “Sustainable Architecture and Construction” (SAC). Na podlagi pridobljenih odgovorov smo ugotovili, da jepriporočljivo povečanje znanja ocenjevalca za evalvacijo vključitve BIM v učne načrte ter novi trajnostni didaktični koncepti in zavedanje, kar bo spodbudilo uporabo in prenos znanja v BIM v programe SAC, kar bi omogočilo diplomantom pridobitev znanj o BIM programski opremi pred vključitvijo v profesionalno kariero.

KLJUČNE BESEDE

“Informacijsko modeliranje zgradb” (BIM), izobraževalni proces, učni načrt, vprašalnik.

ABSTRACT

After a comparative review of articles published for used types of «Building Information Modelling» (BIM) software, this study provides a broader understanding and critical reflection on the integration and synthesis of BIM developments into the Kosovo education system by providing essential guidance to academic researchers, students, and practitioners. As the effectiveness of BIM has been widely accepted in the worldwide «Architecture, Engineering, Construction» (AEC) industry, there is an urgent need to establish a synergy between BIM-educated and practitioners in Kosovo likewise. This leads to finding more intensive and suitable approaches and tools for an integrated solution through the education system, particularly to offer worldwide BIM practices into sustainable AEC education programs, curricula and/or courses.

Virtually, most of the Technical Faculties within the universities of Kosovo pretermitted the viability of BIM in teaching strategy and plan to overcome the barriers to integrating BIM into the curriculum. Through questionnaires, students surveyed the current state of BIM integration in higher education curricula of Sustainable Architecture and Construction (SAC) programs. Their answers revealed the recommendation to increase the appraiser’s knowledge of BIM in curricula, followed by new sustainable didactical concepts and awareness, which will energize the commencement of BIM into SAC programs and establish graduates equipped with the necessary knowledge and skills for BIM software.

KEY-WORDS

“Building Information Modeling” (BIM), education process, curricula, questionnaire.

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EDITORIAL
ČLANEK
ARTICLE

RAZPRAVA
DISCUSSION
RECENZIJA
REVIEW
PROJEKT
PROJECT
DELAVNICA
WORKSHOP
NATEČAJ
COMPETITION
PREDSTAVITEV
PRESENTATION
DIPLOMA
MASTER THESIS

1. INTRODUCTION

Despite an extensive number of studies regarding the methods for integration of Building Information Modeling (BIM) in the process of education for Architecture, Engineering, and Construction (AEC), a lack of consensus remains among researchers and practitioners regarding the applications of BIM in context of education in Kosovo (Nushi & Jakupi, 2017).

Education related to architectural and construction sustainability and sustainable education in other technical fields must be updated and follow the current trends of sustainable social and economic development. In this sense, it is essential to see the needs of an increased population, followed by the increased clamor for a better lifestyle. Thus, the demand for natural resources, such as sunlight, atmosphere, water, land (including all minerals), and vegetation, has an oblique report with the Architectural, Engineering, and Construction (AEC) industry demands.

A tendency to meet such demands and their reports are also appearing in the capital of Kosovo, Pristina, due to rapid expansion and growth, in 1910 with 18,000 habitats to nearly more than 550,000 residents recently (Nushi *et al.*, 2011). Particularly the social-political changes within the last two decades have influenced the demands for the achievement of architecture and sustainable construction. Thus, the nexus between the AEC industry and political power habitats, areas-contexts, and costs are not proportional developed.

Furthermore, misuse of sustainable building assessment in Kosovo by environmental and building state management or/and other institutions during the entire life-cycle of buildings creates an effect that, regardless of some comparable alternatives of buildings assessment management methods, so in default of appropriate BIM system. In this regard, sustainable development in KS needs a holistic approach and integrated establishment. In this direction, learning methods in higher education of architecture and construction should follow changes as though worldwide contemporary education systems.

Thus, according to Liu *et al.* (2015), the knowledge or skill acquired by instruction or study of architecture and construction requires today also the activity or process of studying, practicing, and being taught for the achievements in BIM or/and other digital tools. Therefore, today, "it is crucial for universities to introduce BIM as a promising tool since it generally helps to create opportunities for advanced collaboration and project coordination in a triangle, client: designer: builder; and develop building design documentation and construction processes".

To satisfy the building technology demands for the AEC industry with BIM, many educative institutions worldwide have integrated BIM into their academic programs AEC (Pikas *et al.*, 2013). Identifying and solving social, environmental, cultural, and economic problems must be supported. From the educative and academic point of view, the quality of life of habitats, education needs, unemployment, environmental degradation, and increased needs for natural resources makes necessary transformations to long-term planning, learning, and justifying decisions in the AEC industry. In this context, the educational system in Kosovo can be exploited in developing and bringing a sustainable AEC industry, e.g., through the educational process of using BIM tool implementation into new concepts for design and construction issues.

A research questionnaire measures the BIM tool in education processes. The overview of the questionnaire outcome leads to the conclusion that the design of a sustainable built environment curriculum concerning the current and future needs of the Kosovo AEC industry and BIM implementation is pending. Thus, its quantitative and qualitative data provide an exploratory look at the views of a group of 30 students. Their interest is to foresee, plan and actively promote implementing BIM skills into SAC high education processes.

2. LITERATURE REVIEW AND CONTEXTUAL COMPARISON

According to Hoang & Bedrick (2015), BIM curriculum structures in educational programs are categorized into focuses of (1) real-world experiences, (2) class lectures, (3) keynote speakers, and (4) workshops, gained in different education/training manner, illuminated or taught by professional associations, universities or commercial companies. Recruitment for BIM-specific roles directly from education also varies. In many cases, there are no – suitably qualified and/or skilled candidates available to be considered as having relevant experience. In Kosovo, the education systems do not produce skilled BIM candidates that are needed by the AEC industry now. Skills training is not the sole concern of the AEC industry itself. Still, it should be approached at, e.g., secondary and higher education levels to develop and promote the training, learning, and research aspects of BIM knowledge.

The authors (Abbas *et al.* in Ghosh *et al.* 2013) have identified the need to incorporate BIM into university teaching to equip engineering graduates with an adequate understanding of BIM concepts, and they identified engineers' BIM skills as a means to help achieve successful uptake of BIM within the AEC industry. According to Ghosh *et al.* (2013), BIM can be merged into university education in four different methods, as follows: (1) by introducing a BIM elective

Table 1. Typical BIM courses offered in CM programs in US universities, according to Abbas et al. (2016).

Course names	Institutions	Credit Hours	Description/Purpose of course
Construction Information system	Auburn University	3	To explore, create and implement BIM that exists in mobile and/or cloud application forms.
CNMG 2318, BIM	The University of Arkansas at Little	3	To focus on utilizing basic functions of BIM for residential and commercial construction and examine geometry, spatial relationships, geographic information, quantities and properties of building components. To ease quantity takes off by virtual models of buildings.
MCM-602, Construction Information Modeling	Philadelphia University	3	Integrated practice and BIM are given comprehensive coverage, about the application of the software to the actualization of the built form.
CM 414, Virtual Construction	University of Washington	3	To examine the use of BIM for managing the construction process and facilitating collaboration among project participants.
CE 570, BIM Collaborative CM	University of Southern California	3	To provide some hands-on experience with advanced BIM solution and to provide some knowledge about how to work in BIM teams and learn to different aspects of BIM-based scheduling, estimating and collaborative modeling.
ECIV 309, BIM in Construction	Montana State University	2	To develop working knowledge of BIM and its software applications and to understand BIM role in AEC industry.
CGT 46000, BIM for commercial construction	Purdue University	3	Study of commercial job site planning and coordination. Trade coordination, visualization, and communication are also emphasized.

or organizing a workshop, (2) by introducing an advanced BIM-focused degree program, (3) restructuring the existing curriculum to include BIM, and (4) integrating BIM into the existing constructions management (CM). This way could build and develop incorporating BIM at the SAC-developed curriculum at Pristina University.

Researchers (Gier, 2007) have concluded that BIM is a helpful teaching tool for construction estimation and quantity take-off skills and highly contributes to design comprehension skills and understanding of construction materials, methods, and processes. However, this education is inclined towards using particular BIM software packages with little consideration for BIM management topics or the procedures for working in a collaborative environment (NATSPEC, 2015). The findings of the studies (Wu & Issa, 2013; Liu & Hatipkarasulu, 2014) from the members of Associated Schools of Construction (ASC) in the US indicates that 54% of the programs had dedicated and fully developed BIM classes in their curriculum. Abbas et al. (2016) found the following BIM education status in the US, i.e., BIM courses in Construction Engineering and Management programs (CE&M), as shown in Table 1.

The research study (Hoang and Bedrick, 2015) also "highlighted that some countries have already prepared to deal with the integration while others have yet to start this integration process into AEC programs". However, in Kosovo, studies on the status of BIM implementation in universities and in the AEC industry are not

very common. The BIM skilled and educated members are lacking in formal and informal settings. Universities across Kosovo are facing a serious lack of focus on overall construction engineering and management skills and education. It believed that 60-70% of Architectural Engineers and Civil Engineering graduates join construction firms and rest to the other domains such as design and consulting firms. Therefore, there is a need to introduce and teach BIM into education process at the university level in order to prepare skilled students to apply BIM on projects when they join AEC industry, enterprise or elsewhere in SAC framework issues.

2.1 Objectives

The aim of this research is that through the conducted to questionnaire students to survey the current state of BIM integration in higher education curricula of Sustainable Architecture and Construction (SAC) programs at the University of Pristina. Based upon their answers, this research tent to outcome with the recommendation to increase the appraiser's knowledge of BIM in curricula, followed up by new sustainable didactical concepts and awareness, which will energize the commencement of BIM into SAC programs and establish graduates, equipped with the necessary knowledge and skills for BIM software before they get promoted in professional calling during their performance into AEC industry.

The following research questions to achieve this aim are: what are

students' knowledge and understanding of a range of terms and concepts related to BIM tools? Why do they raise the need for BIM skills? What practical needs are stated by the students for BIM to be used in the SAC field? Where do the students look for BIM education/training? Are they sufficiently aware of BIM education/training benefits? Do they understand the future processes of BIM?

The findings and arguments of this research will have a pedagogical impact since the recommendation to implement BIM into the curriculum for design, building construction, and urban planning will potentially increase AEC industry performance in Kosovo. Moreover, particularly concerning the current and future needs of the AEC industry in Kosovo, it will influence educators and professional bodies seeking to respond to the fast-technological, thus legitimizing for systematically embedding of long-term design and construction curricula.

3. RESEARCH METHODOLOGY

The research was done by distributing the questionnaire to 30 architecture students at the University of Pristina. They have been told that the trend of the questionnaire is to get information on whether or not to use BIM for the needs of the AEC industry. The analysis and evaluation of the 30 responses collected were presented as summarized in the tables and graphs shown below. Prior it was done the basic introduction and the definitions of BIM practice to architectural students; to the field of design, engineering and construction; and to the potential users of BIM for the sustainable development of the AEC industry; in the type of guidelines, programs or syllabuses, making an effective and efficient questionnaire.

The questionnaire consists of the basic subsection, such as 1) Personal Information, 2) University Information, 3) Evaluation of the current state of BIM integration in the SAC curriculum, and 4) the barriers to integrating BIM into the SAC curriculum, actually consist 12 questions and nine sub-question, such as: what are their main sources of information on BIM practices? Is there any connection between students' knowledge and the needs of the AEC industry for sustainable development? What ideas, people, or events have influenced the most in developing their interest in the skills they would gain with BIM? In general, they are encouraged to comment on and/or clarify sources of educational strategies or new curricula and programs that would make it easier for them to engage in sustainable design, engineering, and construction in Kosovo.

4. ANALYSIS AND DISCUSSION

The respondents – students were asked about the sources of information they collected about BIM. The majority of respondents, 57%

What sources have been your main information about BIM?

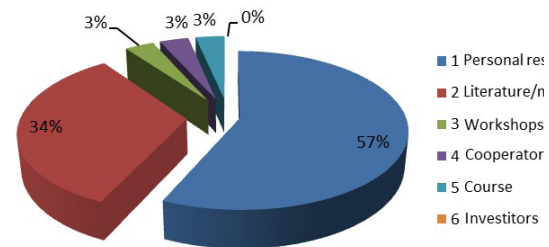


Figure 1: The sources for BIM information.

How much of BIM levels incorporated into curricula or projects?

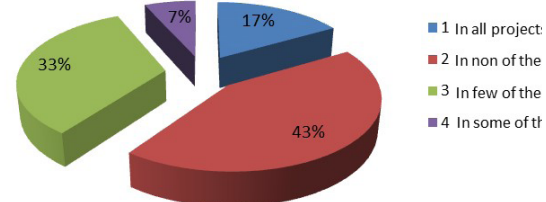


Figure 2: The BIM levels incorporated into curriculum or projects during studies.

(17 respondents), had collected it from personal research; 34% (10 respondents) had collected the information from literature and/or media; whereas the remaining three respondents collected from workshops, cooperators, and courses. Unfortunately, none of the respondents had a chance to collect information about BIM from any investors during their on-job training, as shown in Figure 1.

The respondents answered how much BIM levels are incorporated in projects, as shown in fig. 2. It is seen that majority of them, 43% (13 respondents), did not have or not used BIM in their projects during their studies or elsewhere; 33% (10 respondents) incorporated BIM

If you have taken additional professional education about BIM, how much have you applied during studies?

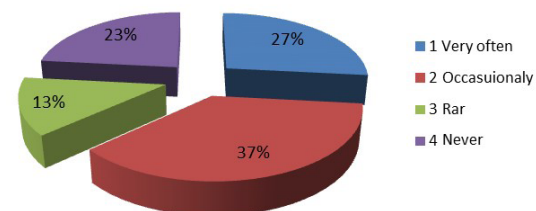


Figure 3: The respondents' usage of BIM professional education.

If BIM is included in your project, is this incorporated more into individual building or public or are those invested privately or by government?

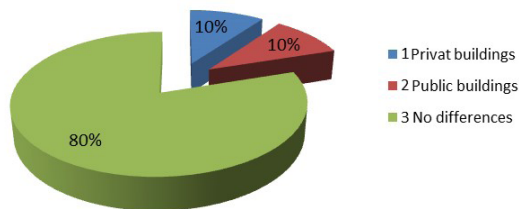


Figure 4: The usage of BIM in building categories.

into a few of their projects; whereas 17% (5 respondents) had the experience of using BIM application both in professional and amateur settings (source: authors Nushi. V. and Jakupi, A.B.)

During this research, it was essential to define whether respondents' taken additional professional education about BIM has been appli-

Table 2: Summary of Responses - types of considerations at BIM strategies.

Land use		Land impact		Energy and water		Selection of materials		Well-being		Respondents
4	12%	3	9%	2	6%	0	0%	0	0%	Best practice
6	18%	4	12%	3	9%	3	9%	7	21%	Improved practice
20	60%	23	79%	25	85%	27	91%	23	79%	There are no measures about codes/standards includes

ed during their studies. The majority, 37% (11 respondents), have applied occasionally gathered education about BIM; whereas 27% (8 respondents) used it very often; hence almost the same, 23% (7 respondents) never used or/knew to apply BIM during their studies.

Furthermore, fig. 4 is shown the relation of respondents' answers about if BIM is included in their projects, and if so is it incorporated

Table 3: The factors could hamper BIM integration into respondents' professional work.

1		2		3		4		5		6		7		8		9		Respo.
11	33%	9	27%	10	30%	13	39%	11	33%	8	24%	10	30%	8	24%	13	39%	small obstacles
15	45%	16	48%	15	45%	11	33%	14	42%	22	66%	19	67%	20	60%	11	33%	big obstacles
4	12%	5	15%	5	15%	6	18%	5	15%	0	0%	1	3%	2	6%	6	18%	none of the obstacles

more into individual buildings or public, or are those invested privately or by the government?

The response to multiple-choice questions, as shown in tab. 2, reflects the strategy that contributes to integrating codes into BIM programs for AEC. For example, or reflect the answer to what extent the following considerations in BIM strategies expedite processes in the AEC industry, 80% answered the energy and water; for material selection, 90% of respondents; etc.

To what extent are the following factors that could be hampering the recognition of your profession or the incorporation of BIM strategies for sustainable construction in your professional work, questions such as (1) Lack of education; (2) Lack of expression of student interest; (3) Lack of teamwork; (4) Lack of understanding of recognition; (5) Sustainable construction is expensive; (6) Sustainable design support; (7) Lack of „green“ materials; (8) Legal problems that offer material guarantees or non-standardized methods, (9) not safe from getting information about AEC, the respondent's answers are as shown in the tab. 3.

The questionnaire consisted of a final part of multiple choice questions about the strategy that should be used to integrate BIM into the AEC program; which revealed the preference for teaching standalone BIM courses and/or incorporating BIM topics/contents into conventional AEC courses; or/and organizing BIM workshops in AEC program; restructuring the existing AEC curriculum to include BIM; or/and to student learn BIM skills by themselves. Also, in response to the question on the current status of BIM education within the AEC curricula in their universities, 67% believed that it was at a very low level. Furthermore, 57 % considered a high level that BIM could improve the AEC industry soon.

5. CONCLUSIONS

The literature review's research was initiated to articulate the issues related to the concept of the most efficient integration path of BIM in the AEC industry through educational programs at the University of Pristina and vice versa. Furthermore, e research questionnaire me-

thod was used to collect data and evidence from students to uncover new information or better understand a hypothetical question: Why BIM at education programs and their curricula? Consequently, the integrated inclusion of the developed BIM curriculum in education programs would encourage all political actors and decision-makers of Kosovo who are concerned with the requirements and implementation of practices in the AEC industry of Kosovo. The literature review also brought to light the theoretical models of the BIM framework concerning the design of the questionnaire, which notes the importance of the implementation of BIM within the curricula. This opens the door to the country's sustainable social, environmental, and economic development and a more comprehensive country.

6. RECOMMENDATIONS

The University of Pristina should develop and build students' capacities and young skilled BIM people for their future SAC field career choices. The future graduates of the AEC will face easily increased levels of social and environmental needs for SAC conscience and thinking; in such a foundation, students of architecture within the University of Pristina should be better placed to stimulate their professional studies within a broader context and assisted by specific technologies, such as BIM skills building industry experience and future planning and designing, meanwhile fulfilling the needs of building AEC industry in Kosovo.

Consequently, it is a necessary measure to create a higher education strategy that can handle the integration of BIM in the curriculum of AEC to increase the teaching capacities for BIM and the competencies that the students will acquire as a result. Consequently, in addition to teaching methodologies for BIM, workshops, training, and conferences should also be organized and developed to exchange knowledge between SAC students and teachers with international BIM practices. In addition, the current content of the curriculum in SAC needs reviewing. Therefore it is imperative that the university, herewith the faculty, develops comprehensive courses on BIM, construct and implement additional policies and strategies in favor of the integration of BIM in the programs of SAC, always based on the current national and international needs of the AEC industry.

REFERENCES

- Abbas, A., Din, Z. U., and Farooqui, R. (2016). Integration of BIM in construction management education: an overview of Pakistani Engineering universities. *Procedia Engineering*, 145 (2016) 151 – 157, <https://doi.org/10.1016/j.proeng.2016.04.034>
- Gier, Dennis. M. (2007). Does learning building information modeling improve the plan reading skills of construction management students? Proceedings of the 43rd Annual Conference by Associated Schools of Construction (pp. 12-14). Northern Arizona University, Flagstaff, Arizona, USA. <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.488.8962&rep=rep1&type=pdf>

- Ghosh, A., Parrish, K., Chasey, A. D. (2013). From BIM to collaboration: A proposed integrated construction curriculum. Paper presented at 2013 ASEE Annual Conference & Exposition, Atlanta, Georgia. <https://doi.org/10.18260/1-2--19632>
- Graham, T.E., Shofoluwe, M.A., Pyle, R.B. (2015). Industry-Academic BIM alliance: a pragmatic approach to enhance students' BIM knowledge. Proceedings of 9th BIM Academic Symposium & Job Task Analysis Review, Washington, DC (pp. 191-198). <http://coremng.dcp.ufl.edu/website/cacim/2015bimeducation/2015AiCProceedings.pdf>
- Hoang, H., Bedrick, J. (2015). BIM Education in Asean: the demand for BIM practitioners. In: Raymond Issa, R. (ed.), Proceedings of 9th BIM Academic Symposium & Job Task Analysis Review, Washington, DC (pp. 191-198). <http://coremng.dcp.ufl.edu/website/cacim/2015bimeducation/2015AiCProceedings.pdf>
- Liu, R., Hatipkarasulu, Y. (2014). Introducing Building Information Modeling Course into a Newly Developed Construction Program with Various Student Backgrounds. Paper presented at 2014 ASEE Annual Conference & Exposition, Indianapolis, Indiana. Accessed on 15th of August 2017: <https://peer.asee.org/20698>
- NATSPEC (2015) BIM education – global – 2015 update report. NATSPEC Construction Information. Accessed on 22th of July 2017: https://buildingsmart.no/sites/buildingsmart.no/files/bim_education_-_global_-_2015_update_report_v2.0.pdf
- Nushi, V., Jakupi, A. (2017). The integration of BIM in education: a literature review and comparative context. *Global Journal of Engineering Education*, 19 (3), 273-278.
- Nushi, V., Bejtullahu, F. (2011). Role of Codes for Sustainability Assessment of Construction. In: Bragança, L., Koukkari, H., Blok, R., Gervásio, H., Veljkovic, M., Borg, R. P., Landolfo, R., Ungureanu, V., Schaur, C. (eds.). Proceedings of the International Conferences Sustainably of Construction towards a Better Build Environment, Final Conference of the COST Action C25, Innsbruck, Austria (pp.174-182). Accessed on 23th of July 2017: http://www.civil.uminho.pt/lftc/c25_proceedings_final_conference_2011.pdf
- Sacks, R., Pikas, E. (2013). Building information modeling education for construction engineering and management. I: Industry requirements, state of the art, and gap analysis. *Journal of Construction Engineering and Management*, 139(11), 04013016. DOI: 10.1061/(ASCE)CO.1943-7862.0000759
- Wu, W., Issa, R. R. (2013). BIM education and recruiting: Survey-based comparative analysis of issues, perceptions, and collaboration opportunities. *Journal of professional issues in engineering education and practice*, 140(2), 04013014. [https://doi.org/10.1061/\(ASCE\)EI.1943-5541.0000186](https://doi.org/10.1061/(ASCE)EI.1943-5541.0000186)