# Big Data and Teaching Development in Higher Education

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Abstract—Big Data has recently become a common term. Its applications penetrate every field from business and healthcare to education. Many of Big Data techniques are used to enhance the educational process through its different stages starting from the early stage and ending with the evaluation stage. In order to ensure the quality of learning process, keeping communication channels between students and their teachers open is an essential pillar. Big Data provides various techniques to support such channels. This research shows how the results of the course evaluation. which is one of the Big Data application systems, are the basic incentive to develop teaching strategy. The research compares between two different teaching strategies applied in two successive semesters based on the feedback received from the students. An obvious enhancement occurred in the students' performance after changing the teaching method. This indicates the importance of impeding Big Data techniques in teaching process development.

*Index Terms*—big data applications, course evaluation, teaching method, project based learning

## I. INTRODUCTION

The term Big Data has become a common term in all aspects of life. [1] It describes data with large amounts which is very complicated to be handled for further processes. [2] It plays a vital role in various fields such as banking, health care, computing and education in general and teaching in specific, which is the main scope of this research. It helps promoting comprehensive development and making data of different levels in the whole educational process organized.

Big Data can be utilized in education in different ways; it can help in monitoring academic level by using data mining techniques to identify at-risk students and students in need of special assistance. Also it suggests where students should focus their time in order to improve exam performance. [1] In addition, Big Data provides various learning styles through creating learning resources networks and learning navigation networks.

As teaching can be considered an interactive process happens within a context, the success of teaching and learning process depends upon many factors. Big Data applications can support those factors with different techniques. For example, the art of teaching, which is one of the factors affects the success of teaching, depends upon the personal abilities of teachers [3] to select and organize information and use appropriate teaching strategies [4], which helps in delivering the required content to students. [5] Big Data technique can be used to guide learning process. It predicts what technique works for each student and the best way to tailor learning. Also dashboards can help teachers to present and organize their materials in active way. [6]

The social aspect is another factor affecting teaching process. [7] Supporting social relation between teachers and their students is necessary for creating active engagement by learners. [8] This factor is encouraged during the real contact between teachers and their students. Furthermore, it is supported by dashboard applications as well, which is applied in universities. Such applications give the students the chance to discuss and express their ideas with their teachers and their colleagues. This helps achieving a deeper understanding [9] and encourages students to express their thoughts freely. [10]

Considering students thoughts and opinions is another factor affecting teaching success. It is highly important to consider students' feedback and thoughts. Both during the running teaching activity and after finishing the course through teaching evaluation [11], Big Data enriches teaching evaluation systems and gives the students the chance to express their satisfaction about their courses and their recommendations for improvement. [3] This type of evaluation is confidential so the students can freely express their ideas. [12] Course evaluation helps faculty develop their teaching methodologies and fosters professional and personal abilities of the students as well. [13]

Considering all those factors supports learning process and participates in its continuous development [14], which leads to students' future success [15]. The scope of this research is course evaluation technique that is one of Big Data techniques. The research displays a case study of the effect of students' feedback on developing teaching strategies, which enhances students' products and results.

### II. RESEARCH CASE STUDY

Introduction to landscape architecture is one of the major courses for architecture undergraduate students in many universities. This course has variety of intended

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learning skills. Among them are knowledge skills, which aim to recognize the concept of landscape. Communication skills target making the students communicate effectively in oral and written forms. Cognitive skills expand the students' ability to understand and apply landscape principles. Finally, interpersonal skills aim to produce a small landscape design project.

Using effective learning and teaching methods is essential to acquire the required skills and to build knowledge in learner's mind. [16] Moreover, it helps students apply what they learned. [17] Accordingly, the project based learning technique was used in teaching landscape course which considered as an important teaching method besides other teaching methods. It is one of the successful techniques. [18] It helps students acquire information better [19], makes them become more engaged in learning [20], enhances their ability of understanding how and when the acquired knowledge should be applied [21], enables the students to make decisions and finally transform them from following orders to practice self-directed learners. [22]

In spring 2015, the course of landscape architecture was assigned to the author for the first time. She started following the syllabi to cover the required topics. Those topics included introduction to landscape, historical background, elements and principles of landscape and procedures of designing landscape projects. Teaching methodology used for this course depended on delivering group of lectures to cover the mentioned topics. After that, the students were asked to design a small landscape project and apply the various aspects of landscape they learned during the semester. Working in the project went through different stages starting from performing site analysis to creating zoning diagram for the different functions within the project. They were asked to use variety of soft and hardscape elements and distribute them in a creative and attractive form composition by following the various principles of landscape.

TABLE I. ASSESSMENT TOOLS (BADAWI)

Intended Learning Outcomes ILOs	Assessment Tools
Knowledge Skills	Quiz1, Quiz2, Mid-Term, Final Exam Part1
Cognitive Skills	Assignment, Mid-Term, Final Exam Part1
Interpersonal Skills and Responsibility	Project, Final Exam Part2
Communication, IT, and Numerical Skills	Research, Assignment

There was variety of assessment tasks to measure students' performance and their acquisition of the course intended learning outcomes. Those tools included research, quizzes, exams, assignments and designing project. Table I shows the assessment tools related to the intended learning outcomes. During early evaluation tasks, the students showed high performance in quizzes, research, assignments and midterm exam. The majority of students' results ranged from A+ to B+, which indicated that they successfully acquired the required knowledge skills. Fig. 1 shows the results of the students in the different assessment tasks.

In the final evaluation tasks represented in the final exam and final project, the results of the students declined in the parts that required high level of applying knowledge. The final exam was divided into two parts.



Figure 1. Students' results in the early assessment tasks (Badawi)

The first part aimed to measure Knowledge and Cognitive Skills; the results of this part ranged from A+ to A. The second part targeted measuring interpersonal skills represented in producing a small landscape design project; the results in this part showed a clear declination ranging from B+ to D as can be seen in Fig. 2.



Figure 2. Students' results in the two parts of final exam (Badawi)

Regarding the final project, it was divided into two main parts. The first part is a simple application for the acquired knowledge, which represented in site analysis, zoning diagram and Landscape elements details. The second part, which is considered as more advanced level of application, reflects the ability of students to distribute all the elements of the project in an appropriate form composition using 2D and 3D drawings and present their posters in a good way. This part is very important and reflects high level of understanding and ability of application because the form composition is a critical step of design; it directly affects the aesthetics value of the designed space because it is directly perceived by users once they see it. On the other hand, most people are not able to determine whether a design works functionally well or not without spending a period of time there. [23] That is why the ability of students to create and present a well design form is an essential factor for the success of the project.

The students were allowed to use drawing aided programs during all stages of design. The analysis of the project parts results showed high grades in the first part while it shows a declination in grades in part 2A "form composition" and a high level in part 2B "presentation" as can be seen in Fig. 3.



Figure 3. Students' results in the two parts of the final project (Badawi)

Fig. 3 shows samples of students' work in the final project and the final exam. The products of the students didn't reflect what they learned during the semester, such as the variable principles of landscape, the different shapes and types of hard and softscape elements, the colors and texture characteristics and the different styles of gardens. In the final project, the students used simple forms in distributing their elements and a limited numbers and types of landscape and hardscape elements, but they presented their projects in an acceptable level by depending on computer aided design programs. In the final exam, the students chose a very primitive form, which depends on dividing the garden into 4 equal parts regardless the different requirements and functions in the garden; there was no soft and hardscape elements and they couldn't present their design in an acceptable level or even draw plants symbols or hardscape elements. It is worth mentioning that most of the students in the final exam chose to use this form.



Figure 4. a1, 2, 3 Students' products in the final project; Figure 4b1, 2, 3 Students' products in the final exam (Badawi)

The analysis of students' performance reveals many issues. There was a clear gap between the ability of the students to gain the basic knowledge and their ability to apply this acquired knowledge in producing landscape project. The use of computer aided design in the early stages of the project made the students lose many skills of drawing and presenting their work in appropriate level. Observing the products of the students by the instructor indicated the need of developing the course in order to fill the gap between knowledge and practice.

Of course, observing and analyzing the students' performance during the semester by their instructor is important for teaching development [24], as it benefits students and instructors as well. [25] However, getting feedback from students about their courses is an essential factor in teaching development. [26] Students are the direct observers of the teaching process [13], and their recommendations help faculties in strengthening their teaching strategies and refine their courses to provide students with better learning experiences. [3] Especially with open-ended comments in the evaluation, which provide ideas about the needed changes. Students requested to reconsider some of the course tactics; this doesn't mean that they are dissatisfied but just to improve the outcome of the course. [27]

After receiving the feedback of the students about their course, the responses of the students were very good and satisfying for the author. However, one comment attracted her attention and stimulated different ideas. One of the main intended learning outcomes is to succeed in designing a small landscape project. Since one student mentioned that she came out learning the basics but not really knowing how to design, a change in teaching strategy needs to be applied. Fig. 5 shows the students' comments received for their course evaluation.



Figure 5. Students' comments about the landscape course (Badawi)

In Fall 2015 the same course was assigned again to the author; with a chance to develop teaching strategy in order to focus more on teaching students how to design not only to know the basics of landscape. The development done in the course targeted enhancing students' skills in drawing and distributing landscape elements, then raise the ability of the students to create a good form composition for the different landscape elements. Those targeted aspects represented the shortcoming appeared in the students' work in the previous semester. The methodology used in teaching the course in Fall 2015 encompassed modifications in the course content without affecting the required covered topics. This represented in adding new lectures illustrating how to transform the simple zoning diagram

into a creative form composition. These lectures explained the variable forms that can be used, the characteristics of each form and the basics of drawing the different forms. Other lectures aimed to enhance the ability of the students to draw and present the different elements of landscape properly.

A change in lectures order was done. Instead of starting with the historical background and the different styles of landscape, the course started with explaining the different elements of landscape "plants- water featureshardscape elements- landform". Each element was explained in a separate lecture. The lecture was divided into two parts, the first part is dedicated for the variable characteristics of the element, and the second part is dedicated for how to use this element in design. Instead of leaving the applied part to the end of the semester, a simple assignment was used in concurrent to each lecture. The assignment aimed to give the students the chance to apply what they learned in each lecture. It was about designing a small garden. After explaining each landscape element, the students started using this element in designing their garden following the principles that should exist in using this element. The assignment targeted also training the students on how to draw and present their work manually in order to be ready for the final exam.



Figure 6. a, b, c. Students' performance in the initial test, final submission of the assignment and final project masterplan (Badawi)

In order to guarantee the validation of comparing the students work in the second semester with the previous semester, a simple test was used before starting this assignment. The students were asked to design the garden before learning the different information about landscape elements. The aim of this task was first, to know the level of the students and their skills in drawing and designing. What is more, the instructor wanted to know whether there were some students with exceptional abilities and would affect the results of this semester. However, the results were negative as can be seen in Fig. 6a. The second target of this assignment was to monitor the progress of the students' performance after each lecture to know the effectiveness of the new teaching method. Fig. 6b shows the development of the students' performance at the final submission of the assignment.

After finishing this assignment, another group of lectures was delivered to the students in order to prepare them for the final project including the site analysis, developing the program, creating bubble diagram and lastly creating a suitable form composition. The students started working in their final project but this time they practiced before and gained a new knowledge, which wasn't offered before. They were not allowed to use computer aided design in the early stages of the project. Fig. 6c indicates the final project masterplan, which indicates the different form compositions used by the students and indicates also the progress achieved through the semester due to the change in teaching method to meet the students' needs.



Figure 7. Students' results in the two parts of final project (Badawi)



Figure 8. Students' products in the final exam (Badawi)

Fig. 7 shows the analysis of the project parts results that tell the high grades in both project parts, pat1 P1 "The application of the acquired knowledge" and part P 2B "Presentation". Besides, it indicates a raise in part P 2A"Form composition" grades compared to Spring 2015 semester.

Fig. 8 shows some samples of students' work in the final exam; which presents the obvious enhancement in the form composition and presentation.

The final exam results show a clear increase in both parts of the exam, that targets to measure Knowledge and Cognitive Skills, and Interpersonal Skills, which aims to produce a small landscape design project as can be shown in Fig. 9.



Figure 9. Students' results in the two parts of final exam (Badawi)





Figure 10. Comparison between final exam results in both semesters (Badawi)

The comparison indicates an enhancement in the students' performance due to the development made in teaching method.

After receiving students' evaluation to the course, the evaluation indicated full satisfaction of the students about their course. The percentage was 100%! The only comment received was about the contradiction between the time of issuing the landscape project and the architectural design project. Despite this contradiction the students' products were better than the previous semester.



Figure 11. Students' satisfaction and comments about the landscape course (Badawi)

As can be seen, the satisfaction of the students about the course was 100% and the only received comment was about the timing of the project and the conflict between the landscape project and other projects; it was not about the gained knowledge of the course!

#### III. CONCLUSION

Teaching and learning should be a continuous development process. There are many opportunities to

benefit from Big Data variable techniques such as data mining, data analytics, and web dashboards to achieve this goal. Educational institutions must understand the value of a data-driven approach to education because having such systems enhance performance and guide decision-making.

The research case study focuses on Course evaluation technique and its effect on teaching development. Teaching evaluation helps students express their opinions and helps faculty develop their teaching methodologies and courses. Course evaluation systems give systematic feedback in real-time using big data techniques, which help students, teachers and administrators use that material and results to improve academic performance.

In some cases, the problem of teaching evaluation is not just organizing and processing data, which can be solved by big data techniques. The problem sometimes is that the results of evaluation are rejected by teachers because they doubt their qualifications. On the contrary the instructors must figure out the best way to enrich with the necessary knowledge. Taking everything into account, the Teaching evaluation should be considered as a tool of development instead of a tool of judgment.

Another problem related to teaching evaluation is that in some cases the evaluation is prejudice; it may reflect the personal opinion of some exasperated students. Personal issues could negatively affect the results.

Even if the problems of organizing and processing data have been handled by big data techniques, parts of course evaluation should be handled subjectively.

#### REFERENCES

- [1] B. Gaffney and D. Dobbs. (February 2014). What is Big Data? The Healthcare Information and Management Systems Society (HIMSS). [Online]. Available: file:///C:/Users/sbadawi/Downloads/What%20is%20Big%20Data\_ HIMSS%20Data%20and%20Analytics%20Task%20Force\_July% 202014.pdf
- [2] K. Sravanthi and T. Subba Reddy, "Applications of Big data in Various Fields," *International Journal of Computer Science and Information Technologies*, vol. 6, pp. 4629-4632, May 2015.
- [3] S. Raza, S. Naqvi, and A. Lodhi, "Assessing need for teaching development of faculty at universities of Pakistan: A students' Perspective," *Bulletin of Education and Research*, vol. 33, no. 2 pp. 49-62, December 2011.
- [4] G. Paul and D. Drew, What They Didn't Teach You in Graduate School: 299 Helpful Hints for Success in Your Academic Career, 1<sup>st</sup> ed. Stylus, Sterling, Virginia, 2008.
- [5] D. Orr, M. Appleton, and M. Wallin, "Information literacy and flexible delivery: Creating a conceptual framework and model," *Journal of Academic Librarianships*, vol. 27, no. 6, pp. 457-463. November 2001.
- [6] B R Prakash, M. Hanumanthappa, and V. Kavitha, "Big Data in Educational Data Mining and Learning Analytics," *International Journal of Innovative Research in Computer and Communication Engineering*, vol. 2, no. 12, pp. 7515-7520, December 2014.
- [7] C. Armstrong, "Implementing education for sustainable development: the potential use of time-honored pedagogical practice from the progressive era of education," *Journal of Sustainability Education*, vol. 2, March 2011.
- [8] G. Gibbs and M. Coffey, "The Impact of Training of University Teachers on their Teaching Skills, their Approaches to Teaching and the Approaches to Learning of their Students," *Active Learning in Higher Education*, vol. 5, no. 1, pp. 87-100, 2004.
- [9] D. Phillips, "The good the bad and the ugly: the many faces of constructivism," *Educational Researcher*, vol. 24, no. 7, pp. 5-12, October 1995.

- [10] S. Kasowitz, A. Pasqualon, and Michael. (2002). Information Literacy Instruction in Higher Education: Trends and Issues. ERIC Digest. [Online]. Available: http://surface.syr.edu/cgi/viewcontent.cgi?article=1032&context=s ul
- [11] D. Fink, "Improving the evaluation of college teaching: Supporting OU faculty in developing 21st century learners," Program for Instructional Innovation, University of Oklahoma, 2006.
- [12] Q. Dai, Y. Chen, and G. Ruhau, "Relationship between big data and teaching evaluation," in *Proc. 3rd International Conference* on Education and Social Development, 2017, pp. 402-107.
- [13] S. Raza, Z. Majid, and A. Zia, "Perceptions of pakistani university students about roles of academics engaged in imparting development skills: Implications for faculty development," *Bulletin of Education and Research*, vol. 32, no. 2, pp. 75-91, December 2010.
- [14] P. Clayton and S. Ash, "Reflection as a key component in faculty development," On the Horizon, vol. 13, no. 3, pp. 161-169, February 2005.
- [15] J. Popham and J. M. M. Ryan, "Determining a high-stakes test's instructional sensitivity," presented at the annual meeting of the National Council on Educational Measurement, Vancouver, B.C., Canada, April 12-16, 2012.
- [16] H. Fry, S. Ketteridge, and S. Marshall, A Handbook for Teaching and Learning in Higher Education, Enhancing Academic Practice, 3rd ed., Routledge, London, 2009.
- [17] C. Howlett, J. Ferreira, and J. Blomfield, "Teaching sustainable development in higher education Building critical, reflective thinkers through an interdisciplinary approach," *International Journal of Sustainability in Higher Education*, vol. 17, no. 3, pp. 305–321, 2016.
- [18] G. Leder, "Constructivism: theory for practice? The case of mathematics," *Higher Education Research and Development*, vol. 12, no. 1, pp. 5-20. 1993.
- [19] J. Wals, "Between knowing what is right and knowing that is it wrong to tell others what is right: On relativism, uncertainty and democracy in environmental and sustainability education," *Environmental Education Research*, vol. 16, no. 1, pp. 143-151, 2010.
- [20] J. Thomas, "Project-based learning: Overview," Novato, CA: Buck Institute for Education, Science and education, 1998.

- [21] J. Bransford, A. Brown, and R. Cocking, *How People Learn: Brain, Mind, Experience, and School Washington*, DC: National Academy Press, 2000.
- [22] Intel® Teach to the Future. Project-based classroom: Bridging the gap between education and technology. Training materials for regional and master trainers. (2003). [Online]. available: http://www.schoolnet.org.za/conference/2011/Fiona\_Beal/Handou t-ProjectBasedLearning.pdf
- [23] N. Booth and J. Hiss, *Residential Landscape Architecture: Design Process for the Private Residence*, 6<sup>th</sup> ed. Education, Inc., publishing as Prentice Hall, Upper Saddle River New Jersey and Columbus, Ohio, 2012.
- [24] S. Ali, "Faculty development program for universities of Pakistan: The need to develop a model," Unpublished Doctoral thesis, University of the Punjab. Pakistan: Lahore, 2008.
- [25] D. Camblin and A. Steger, "Rethinking faculty development," *Higher Education*, vol. 39, no. 1, pp. 1-18, 2000.
- [26] R. Coe, C. Aloisi, S. Higgins, and L. Major. (2014). What makes great teaching? Review of the underpinning research. [Online]. Available: https://www.suttontrust.com/wpcontent/uploads/2014/10/What-Makes-Great-Teaching-REPORT.pdf
- [27] SRI International, Silicon Valley Challenge 2000, Year 4 Report. San Jose, CA: Joint Venture, Silicon Valley Network, 2000.



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