

# Data Driven Information Flow in E-Universities: A Process Modeling Analysis

Rasha Ismail and Atik Kulakli

**Abstract**—Advancements in information and communication have a big impact on people's life. The quality of information affects the decisions made by the management. This paper focusses on the analysis of data flow in the of 'Handling a lecture' process at two universities. Based on the process analysis, the demonstration of the activities, roles and data flow enabled the authors to compare the flow of data in the two processes. This analysis aids in evaluating the quality of data and the means of improvements to obtain well-structured data for better analysis and decision making. The impact of improvement will need to be reflected again in the process model, which indicates a triangulation between both techniques and thus each one reinforces the other. Accordingly, such methodology could be generalized and used in other universities that are aiming to make the transition to e-learning.

**Index Terms**—E-University, lesson planning, virtual learning, e-learning, information flow, knowledge sharing, process modeling.

## I. INTRODUCTION

Universities, have long been accepted as major social and cultural institutions that serve developments in various forms as knowledge based organizations [1], [2]. Two common forms of universities are traditional campus base form, or electronic form such as online, distance, virtual and e-learning [3]. With the advancement of technology and communication, information can be easily collected and integrated. Information analytics is based on high quality-integrated information. Students reach those rich content with few clicks to acquire, process and disseminate through social media tools to their friends and peers.

New skills such as computer literacy, knowledge creating, sharing, co-operative working, open source movement, collaborative working have become very important issues for academia. In the speed of information age, new generation students require new forms of learning platforms and communication channels while they already use similar applications in their private life. New forms of educational approaches needs to be more students oriented, collaborative and interactive [4]. In this context, Tapscott and Williams [5] suggest collaborative classrooms, note taking, lecturing, listening may not disappear but live alongside the new and innovative educational processes. Wissema [6] indicates that the new university concept has more industry-style

collaborative framework rather than old classroom school model. Innovation, interaction, collaboration are key elements along with technology-driven initiatives. Similarly Tapscott and Williams [7] concentrates on user-generated media, social networking, crowdsourcing effect and peer production for the new university concept which mass collaboration is a new form of online collectivism. This paper will present a review of the literature with regards to the evolution of e-university including data flow in the of 'Handling a lecture' process at two universities.

## II. LITERATURE REVIEW

In the literature, university and educational forms have been categorized as online learning including distance (online) learning/education, virtual universities, virtual learning environments, e-learning, mobile learning, social networking and Web 2.0 based education. Some other definitions of virtual teaching and learning found as Learning 2.0; university 2.0; pedagogy 2.0; and library 2.0 [8]-[10]. From this point, we prefer to use virtual university as an educational institution to be considered an e-university it needs to delivery every aspect of university online including teaching, processes, structures, working place, staffing, administration, support, aid, assessments, evaluations, and services [11]. These requirements include technology and changing expectations, content creation and distribution, accessibility, face-to-face on campuses, open access sources, ethics, legal and social issues, privacy, learning skills, motivation, curriculum-administrative needs, system management, and communication with peers [10], [12]-[14].

### A. E-University Context

Online learning provides enormous sources to access the content and enrich sharing among peers. It provides revolutionizing access to reach mass population with rich and various content availability which has been designed to complement rather than compete with old school learning. This new shape of education forces educational organizations to adapt themselves and compete in highly demanding educational area. Students are demanding more access to sources while organizations try to prepare more competitive learning packages for them. Mazoue [8] suggest that the emergence of learning sciences, the wikification of knowledge, the unbundling of faculty roles, and the migration of learning online are driving fundamental institutional change toward location-independent alternatives. Therefore, Internet is becoming the dominant infrastructure for knowledge exchange among people and new generations of students [5]. Another element discussed in success of e-university is the appropriate use of

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technology. Some of the universities have experimented e-university concept in the virtual environment with some successes [15], [16].

For the full concept of E-universities to be realized, strategies have to be in place that exploits under-utilized capacities of technologies to improve student engagement, motivation, and higher order thinking skills [17], [18]. There have been several technological advances that are set to guide new opportunities for the raise of e-university. Researchers have predicted that Internet of Things (IoT), virtual reality, augmented reality, quantum computing, artificial intelligence, and simulated intelligence are set to transform educational delivery and resurrect the idea of a fully integrated e-university [19] along with some improvements include faster video streaming, virtual reality [20], teaching experiments improvements [21], and augmented reality simulation games in education [22]. There are some considerable advantage in using technology to automate educational teaching. Having new teaching and learning technologies can reduce costs and may increase quality simultaneously. Many high ranked universities such as MIT, Harvard, Stanford, University of Michigan, and University of Pennsylvania are delivering online free courses [23]. Students would be more flexible to choose their preferred courses, at their own pace, accessibility independent of location as well as having better value for money [24], [19].

### *B. Existing Online University Models*

There has been attempts to design and re-model aspects of online learning. The model of Global Network for Higher Learning focuses on knowledge created and shared in teaching and learning processes of a university by suggesting open content and the emerging global meta-university as a model. In this model there are five stages which are course content exchange, course content collaboration, course content co-innovation, knowledge co-creation, and collaborative learning connection [5].

Another example is that of Massive Open Online Courses (MOOCs), which aims to reach millions of learners around the world. MOOC refers to an online course that is free and open for anyone with particular curriculum that content over an internet connection [25]. Example of MOOCs are Coursera, edX (Harvard, MIT) and Udacity [26].

In all these cases, the models represents important pace towards e-university but failed to complement the full process aspects of a physical university in the conventional way. They represent variations that can contribute to the process and specifically the process model for universities moving from physical and virtual. Pre-recorded lessons and content uploading fail to account to the real experience students get from the physical university and ability of instructors to apply different pedagogical approaches to teaching. To truly appreciate the gap, there needs to be a comparison between physical and virtual classroom interactions. There has been several works done with regards to physical university process modelling including automation of key processes. Tapscott and Williams [5] also argue that the new shape of university has to have two important characteristics such as 'collaborative learning' and 'collaborative knowledge production' both traditionally

linked to classroom operations.

### *C. Information Flow in e-Learning and e-Universities*

Online platforms bring rapid changes in information flow even more accessible to everyone with educational tools, online sources, and systems used in the organization. On the other hand, reliability of content is a very important issue today; because there are lots of information and knowledge sharing interactions could be found across all channels and those would not be filtered properly.

Time is limited for the educational process, so that online educational tools encourage scholars to follow better designed in-class activities along with curriculum needs in order to enable successful practices. Besides location boundaries would be eliminated with online platforms to reach greater participants at the same time. Once educators build an active network with learners in same interests can start interacting and sharing immediately. One-to-many or many-to-many form of communication brings flexibility and more effective information flow about peer activities [3].

Blacburn [27] studied on how the technology can play a key role in student learning and educators can adopt innovative technology based approaches. According to findings of online problem-based learning (PBL) resources allows students to interact authentic, complex and realistic problem designed in that environment which enhances student learning outcomes. Educational technology rapidly changes more interactive forms from traditional textbook learning to online resource oriented. [28], [29]. Technology driven educational platforms (e-learning) are increasingly being used by educators who wish to adopt their curricula with innovative teaching-learning. Due to change of traditional one-way communication between faculty and students to more contemporary method of student-centered multiple way of communication enhances learning activities to acquire new form of information flow and knowledge sharing [30], [27]. Student outcomes would be improved by using e-learning technologies in learning initiatives, thinking and problem solving skills and communication among peers [31]. Although those technologies (namely educational software and hardware) costly for any institution to apply but there are considerable benefits of using them in scalability, richer functionality and more features, content availability and capability for content development and sharing proper information in various forms.

E-university model has been increasing with e-learning initiatives along with pervasive learning technologies and approaches. E-learning projects as strategic objectives for higher educational institutions have provided enormous benefits them in content creation, managing sources, motivating learners, innovative classroom settings, scenario-based learning and problem solving skills as well as key components of digital age activities supported by web technologies [32]. Available educational technology also enables greater accessibility to information, effective content delivery, personalized learning initiatives, standardization of processes, on-demand content sharing, web-based course homepage system, multimedia integrated learning, [33], [34].

Dee and Leistle [4] studied on knowledge sharing and flow in a large public university in USA. According to

findings, knowledge flow has impact on quality assurance of institutional decision-making, innovative teaching practices, improve organizational performance, active-passive forms of knowledge creation in terms of cross functional team communication and disseminating teaching practices within university departments. The joint production of knowledge enables knowledge transformation across all the units. Strategic planning through organizational practices need collaborative work in order to implement new educational initiatives which supports innovative teaching practices and opportunities for professional development. Wang [35] similarly contributes that knowledge socially constructed with cognitive development [36] and information literacy has critical role for integrated curriculum creation along with planning, assessment, interactivity and information sharing. Participants included departments, librarians, campus support units, information professionals join the processes to support development programs, course content, activities, assignments and assessments in collaborative ways.

**D. Process Modelling**

Process modelling identifies processes in two different ways; an abstract model and a detailed model [37]. The purpose of modelling is to link the process design with the implementation. In the abstract model, an overall picture about the organisation’s processes would be drawn. However, in the detailed model, every process could be investigated independently.

The generated model could then be used to produce a prototype for the flow of work and the flow of information; consequently, improvements could be easily managed [38]. Process modelling can be used to break an organisation’s activity down into small processes made up of actions and interactions. The modelled processes can then be analysed and perhaps improved. New processes can be designed and the old ones altered. With the support of business process management software, processes in a model can be enacted to become real processes in the organisation.

**E. Riva Method**

The Riva method of process modelling is considered a business-oriented rather than software-oriented, in that it focuses on the management of business entities through the actions and interactions of different roles, rather than on a reduction of business to logic [39]. At this stage the paper will focus on the detailed Role Activity Diagramming (RAD) retrieved from a previous research [32] of ‘Handle a lecture’ Process to explore the detailed activities in this process.

Using Ould’s Riva method, the educational Process model is retrieved in this paper to map the traditional educational processes onto the automated/online educational system while focusing on the data flow in each one. The retrieved diagrams is the ‘Handle a Lecture’ process in traditional and virtual universities that explains the detailed activities, roles and flow of data in each process.

At this stage the paper will focus on the difference between the two systems from the perspective of data flow. The RAD is used to explore the activities that are taking place in the same process for the two universities.

Riva technique is one of the techniques that is used to show the details of how organizations run their processes

and activities in a dynamic view and on different detailed architectures. The model also could be used to be generalized on other organizations in the same line of business, which will support the study to map the traditional educational system to the virtual educational system. Perhaps we find some processes are deducted, modified or added in the current model. Changes or improvements that will be applied on a process will also be reflected in the improved model.

**III. METHODOLOGY**

The research aim is to analyze the data flow in both traditional and integrated e-university to design a framework for other universities in the transition to e-learning. This analysis based on the process model retrieved from a previous work [32] so that the information flow would be traced to map the differences and similarities in both systems. The analysis explores the need for process modeling before data flow analysis takes place. For this to be completed the authors agreed the methodology to follow these defined research objectives.

- 1- To conduct a literature review on existing models for e-university.
- 2- To identify gaps in the literature with regards to key process modeling.
- 3- To use the process model that was previously developed for both universities for the purpose of data flow analysis.
- 4- Validate and compare data flow in the two universities from different perspectives.
- 5- Make recommendations for improvements and changes.

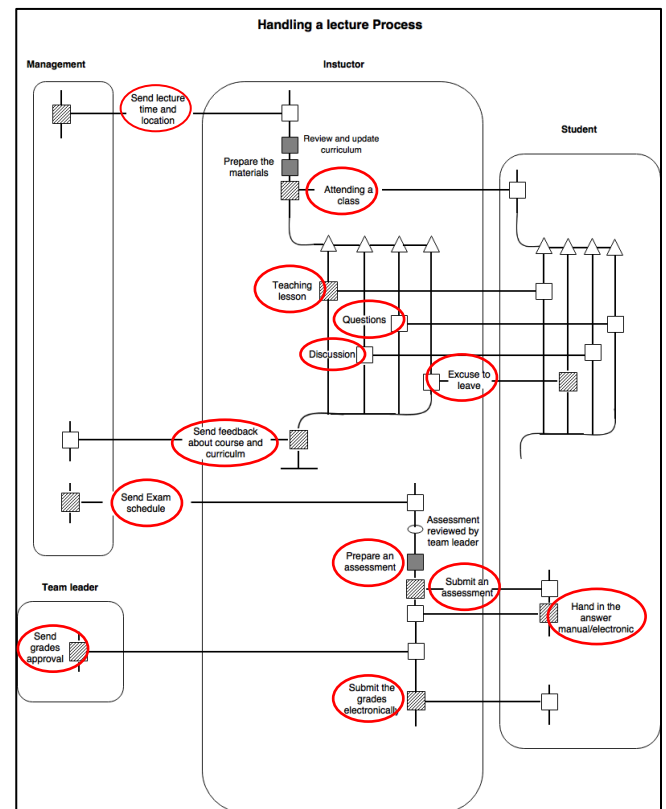


Fig. 1. Handling a lecture at the traditional system.

IV. RESEARCH FINDINGS

Comparing data flow in the two processes (manual and virtual) was made easy by using Role Activity Diagramming (RAD), the two models explain in details data interaction between roles and the activities from and to which they are passing. Fig. 1 and Fig. 2 are retrieved from a previous work [32] that was prepared to analyze the process for the manual and the virtual systems in details. Words in the circles refer to pieces of data that flow between roles and activities.

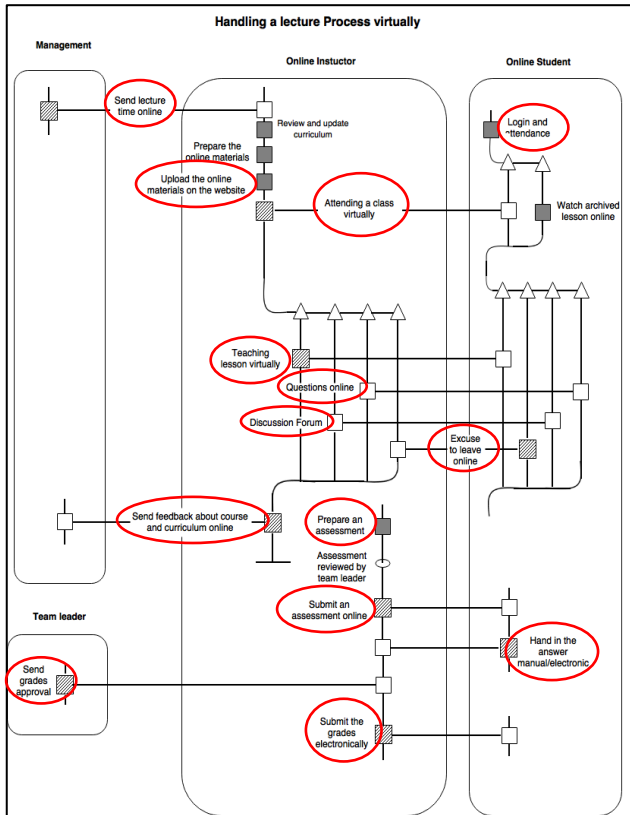


Fig. 2. Handling a lecture at the virtual system.

The following table summarizes the differences and similarities between both processes:

TABLE I: COMPARING DATA FLOW FOR MANUAL AND VIRTUAL SYSTEMS

Points of comparison	Manual	Virtual
Number of data transfer	12	14
State of data	Written, oral, and online/digital.	All online/digital.
Location of data	Paper, system (database) or not stored	On the system (database)
Location of storage	Different locations.	Centralized location.
Data sharing electronically	It is possible if data stored in the database	All data in the database could be shared according to permissions.
Technology used and systems	Moderate.	Advanced.
Security system	On assessments and grades, for both physical and online data.	On all information.
Data quality (input)	Depends on the system user.	High quality, all electronic and complete data exists.
Data quality	Depends on the	High quality all

(output)	input data.	electronic and complete data exists.
Data integration	Partly integrate.	Totally integrate.
Data analytics	No accurate analysis because of poor data quality.	Accurate analysis because of good data quality.

Refer to Table I, it was found that the number of data flow in both processes is nearly the same. However, the structure of data differs as the mean of data usage is different. Therefore, data in the manual system can be in different states, however, in the virtual system it is all online or digital. When data needs to be stored, in the manual system there is more than one location; some data might be stored in physical files manually, some in the database otherwise not stored at all, unlike the virtual system, as all data moves electronically in digital format so all data is stored in a centralized database/s. because not all the data is stored in the database, so data in the manual system is not totally shared, only the data stored in the database, while in the virtual system data could be shared following the permissions and business rules assigned by the management. Most interactions in the traditional lecture take place physically while also the level of technology used is limited to share the schedule of lectures, take attendance, record the students' grades and publish them online to the students. Data entered in traditional lecture requires human intervention at each action to store the data in the system, however, in the virtual system the user interaction with the system yields data entry to the system. For instance, student's attendance is recorded in the systems when the student logs onto the system to attend a lecture. As a result data stored in the virtual system is more cohesive and of higher quality than in the traditional system, which impacts data analysis and decision making.

V. DISCUSSION AND ANALYSIS

Riva model made the process clear to understand and analyze the data flow. Ould's model provides analysis of the activities [40], data and interactions between roles within a process. As a result of this analysis, one can track the flow of data and analyze activities where improvements can take place. Poor data could be discovered and treated by automating some activities. The model shows that information that exists online can be accessed at anytime from anywhere, lectures are stored on the system, and students are also able to revisit in an e-learning format the lecture/lesson at later stage. Text analytics assists in answering questions, or inquiring about a specific topic. It is evident from this analysis that nearly all the data in both systems (traditional and online) is the same, they mainly differ in accessibility, integrity, accuracy and availability. While data is the same in both systems, more data was found in the virtual database than in the traditional database. The analysis also shows that there is no evidence that the system can verify if the student who logs onto the system is the legitimate student, however, at this stage this might not be of great importance. More technological devices exist now a days to verify the identification of a student that is considered critical in the exam process.

Analyzing data flow using Ould's model demonstrates the

triangulation between process modeling and data flow analysis. Without process analysis one can hardly figure the flow of data within a process, the model also provides a clear view of electronic and manual data entering and coming out of the system. Every change that happens in the flow of data due to changes in the flow of work will need process modeling to represent the latest changes. Therefore, both techniques are reinforcing each other, the transition to e-learning could be generalized to other universities based on the proved analysis.

## VI. CONCLUSION AND FURTHER RESEARCH

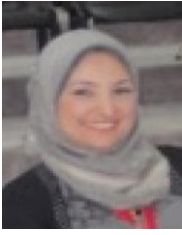
The aim of this paper is to look at the data flow in the 'Handle a lecture' process. Evidently this analysis shows that process modeling is a precedent step to data flow analysis. This analysis might imply improvements in data flow to take place that will also enforce a change in the model to take place. This triangulation between the two methods is crucial to generalize the same method for other processes or colleges that are making the transition to e-learning. The next investigation is for the 'Handle an exam' process. This investigation will provide further understanding for the needed security systems for the data transferred online. Will exams be secure if implemented online? What will be the key identification method for students? Which data is valued as confidential?

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Dr. Rasha Ismail was awarded certificates for attending conferences and presenting papers there, she was also awarded a certificate of appreciation as a reviewer from IBIMA, in addition to certificates of appreciation from AUM for her efforts at work.



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