Learning Analytics Beyond Learning Management Systems: Proposing a Learner Dashboard which collects, analyzes and reports learner-generated data from social networking sites

by
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21 September 2012

Supervisor: Prof. Hugh C. Davis
2nd Examiner: Dr. Mike Wald

A dissertation submitted in partial fulfillment of the degree of MSc Software Engineering by examination and dissertation
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All my work is dedicated to the most special woman in my life who has supported me all the time!

Without her I would not be who I am today!

To my gorgeous mum, Belgin Ozkul…
ABSTRACT:

For many years, people have sought the ways of understanding learning and the environments in which it occurs. Interpretations about, what makes learning better and what does not, have been done by observing learners’ activities. With the new digital century, learning processes have been shifted to more online basis, which inevitably has increased the number of online activities that can be examined for further and detailed interpretations. As Web 2.0 has added write feature to the read only Web 1.0, digital learners have started to produce huge data trails with online learning activities. With the increasing use of computers, the Internet, and smart mobile devices, data comes from every single action of these learners within web sites, learning management systems (LMSs), social networking sites, mobile applications and so on. Curiosity of what makes learning better lead to the idea of analytics of these learner-produced data so that the numbers can speak for themselves. Learning analytics collects and analyzes learner-generated data and reports them visually. This idea has existed, after LMSs have been started to use to understand how these systems help education. That is why, current use of learning analytics primarily focuses on data coming from LMSs. However, data coming from these systems usually about how many times student logged in, how many times they clicked on a link, attended a discussion forum, or used a wiki, which actually does not show the reality. In other words, these reports do not explain why students perform well and get good marks although they are not using such systems or just used the system to upload an assignment and download a lecture material. Most of the students are not using ‘only’ learning management systems for supporting their education. In fact, learning process for students are not just limited with these systems. In this digital era, students have social media and their own personal methods to support their education. They have Facebook groups in which they discuss course content or past papers or Twitter to share knowledge and so on. What is missing in learning analytics is lack analysis of real world environments in which lifelong learning occurs. This problem must be handled in order to make reasonable predictions about student performances, give them appropriate feedback and make adjustments in curriculum accordingly. This research project proposes a learning analytics framework in which a learner dashboard collects and analyzes not only data from universities’ LMSs but also social networking sites that students use to support their education. As preliminary testing and evaluations indicate that although there are some privacy concerns, the idea of being able to see analytics result of activities have done on Internet and social networking sites made students very excited as they believe that LMSs are repository of lecture materials and learning occurs mostly outside of it.
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ABBREVIATIONS

CMS: Course Management Systems
EDM: Educational Data Mining
ELI: EDUCAUSE Learning Initiative
LA: Learning Analytics
LAK: International Learning Analytics and Knowledge Conference
LMS: Learning Management System
SIS: Student Information System
VLE: Virtual Learning Environments
Chapter 1: Introduction

After project supervisor suggested range of topics for MSc. Project and several investigations done based on these topics; learning analytics (LA) have become an interest, which initiated the idea of doing a project within this concept. Not only supervisor’s suggestion but also range of potential research needs in newly emerging LA field also led to study in this area.

LA is one of the youngest research areas in education domain, which mainly collects and analyzes large sets of learner-generated data to enable making interventions about what makes learning processes better, and what does not. Learners, educators, and administrators are the audiences of this research area who can get benefit from the results of interventions. Within existing research area, this project aimed to address one of the problems to fill the gap exists in the field. Although LA aims to collect and analyze ‘all’ of the learner-generated data, in the literature this data is mainly limited with the LMSs. Even though these kinds of systems provide learner-produced data, they are just indicating a fraction of learning activities limited within the system activities. However learners have their own ways to learn and study, which are definitely not limited with LMSs. Therefore, this research project, aims:

- to identify the current use of LA applications are inadequate to reflect the real learning of the students
- to be able to make more accurate interventions about learning processes with a proposed learner dashboard prototype
- to fill the inadequacy gap within the LA field

The overall research aim for this project is to point out LA applications need to move beyond the LMS data collection and analysis to be able to have an analytics of real learning elements of the user so that more accurate interpretations about learning processes can be made. Within the context of this overall aim, other research objectives are identifying what technologies students are using for supporting their learning, exploring learner ideas about impact of social networking sites on their learning and what they think about the privacy issues might appear with the analytics of social networking data, and formulating a learner dashboard prototype on learners activities beyond LMSs.
Within these objectives, dissertation will start with a literature review, which begins with data explosion and big data concepts that lead the idea of analytics. Then the value of analytics in education will be mentioned and LA concept will be examined deeply: who the stakeholders are, development processes of LA idea, how it works, differences between similar concepts such as educational data mining (EDM), time to adoption horizons and privacy issues regarding what data to analyze beyond LMSs. Literature review chapter will be followed with software development processes chapter in which MSc. Project’s development processes will be explained: feasibility, requirements, design, implementation, testing and evaluation.
Chapter 2: Literature Review

2.1 Data Explosion:

In this digital era, information sink has been filled with massive amount of data every single second. Data comes from everywhere. Every click on a link, every page visited online, every tweet or retweet, every status update on Facebook, every like or a comment, every application downloaded and used increase the amount of data in the sink.

Fast growing number of computer use, social media sites, and smart mobile devices is one of the major factors that have contributed to the data explosion term in 21st century. Although it seems today’s digital era lead to the data explosion term, McIntosh already defined it in late 1970s as “richness and profusion of available data acting as a barrier to its use” (Fergusson, 2012).

2.2 Big Data:

Data explosion term comes from the vast amount of data, which causes an overflow in the sink; that it is called big data. Formally big data refers to the available data, which explodes in terms of quantity and sometimes quality and difficult to be stored and managed with current advancements of database software tools (Diebold, 2000). In other words, what is meant by big data is, a dataset, which has a size beyond the capabilities of a usual database software tool, to be captured, stored, managed and analyzed (McKinsey).

In 2009, old Google executive, current CEO of Yahoo, Marissa Mayer, defined data as three elements: speed -increasing availability of data, scale -increasing power in computing, and sensors -new types of data which is Internet of things (.). As Long and Siemens (2011) mentioned, due to these three elements, it is not feasible to use current data collection, management and analysis techniques for making decisions about learning processes. This is again because, typical database software tools are not sufficient to manage and analyze large datasets (Fergusson, 2011).

Current advancements in database software tools become insufficient because available data size is inevitably big as mentioned. For instance, as IBM announced almost 12 terabytes of tweets created every single day and as McKinsey Global Institute stated 30 billion pieces of content shared by Facebook users each month. And this is the only data
size coming from ‘some’ of the social media sites. Because in this digitized world, everyone create their own huge data trails by browsing, surfing, searching, and communicating; which lead to a growth in the volume of multimedia content. Therefore there is an exponential growth in the amount of big data (McKinsey). In addition to the digital footprints left by many people, there are billions of other reasons such as sensors, cards, and digital records that also contribute to rich and big amounts of data trails (Long and Siemens, 2011).

Due to the limitations of typical database software tools suggest that analytics can be a powerful strategy to make sense of data in order to make improvements in learning processes.

2.3 Analytics:

Data explosion, which is caused by big data and inadequate advancements in database technologies, can actually be a beneficial way to figure out current situation and to think about future improvements for many sectors/domains. Instead of insufficient database software tools, data collection and management can be achieved with analytics technology to reach these benefits.

Many people create data: clients of companies, members of organizations and so on for some purpose or no-purpose. And this data can be used as a map for treasure hunting of meaningful information. “Who knows why people do what they do? The point is they do it, and we can track and measure it. With enough data, the numbers speak for themselves” (Anderson, 2008). That’s why, many sectors such as government, healthcare and industry have started to use data mining and analytics in order to derive valuable information from large data sets and to gain valuable insight about their activities (Siemens and Baker, 2010; Fergusson, 2012).

Analytics technology works for decision makers of an organization to find out best course of action by evaluating large data sets (EDUCAUSE, 2011). Many sectors ‘including education’ have been using analytics to foresee the future and making decisions based on the data that they have. Such sectors gave up to use their instincts about deciding what needs to be done in the next step because big data is there which is waiting to be analyzed to make the next step crystal clear. As Long and Siemens (2011) illustrated, healthcare is one of the examples in which there is a tendency to shift from clinical practice to evidence-based medicine. Beforehand, treatment decision was made based on the personal
experiences of physicians regarding previous patient cases. With big data collection and analytics clinical practice turned to evidence-based medicine; moreover analytics has been used to predict potential people who will get sick (Long and Siemens, 2011). In short, big data, which has sometimes seen as a barrier due to quantity and quality explosion of the data, has been used within the analytics technology to get benefit from it.

2.3.1 Value of Analytics in Education:

“Data is a critical value layer for governments, corporations, and higher education institutions” (Long and Siemens, 2011). Business leaders and technology companies have fascinated with data and analytics, which provide new insights about individuals and their interactions with technology, organization or other people (Siemens, Gasevic, Haythornthwaite, Dawson, Shum, Ferguson, Duval, Verbert, and Baker, 2011). Growing interest in data and analytics and increase in vendor base also influence the development of analytics in education sector (Siemens, 2012).

Big data and analytics can add value to education by shaping the future of it (Long and Siemens, 2011). Data produced by learners can be used to understand what happens in the learning processes and can be useful to find out what kind of improvements should be done by educators (Long and Siemens, 2011). Additionally, analysis of learner-produced data can provide detailed information about potential problems of students who are under risk of dropping out and who might need additional support (Long and Siemens, 2011). Analytics in education can also positively affects administrators’ institutional decision-making strategies; can create shared understanding between institutions about figuring out which pedagogical approaches to use; can help to specify learners who are at risk of failure; can show to learners themselves about their own progress and learning habits and can help leaders to experiment and understand impact of changing various elements in learning processes.

There is no doubt that analytics add value to education, therefore some higher education organizations have already applied analytics technologies to be able to understand the learning processes better, and this procedure called as learning analytics.
2.3.2 Learning Analytics:

Rapid developments in big data created the term *business intelligence*, which is an intersection of data and insight (Siemens et al., 2011). When this applied to education, LA comes out (Siemens et al., 2011). LA is a relatively new concept in education sector and fastest growing concept in technology enhanced learning research area. Early definition of LA done by George Siemens in 2010 in one of his blog posts which says “Learning analytics is the use of intelligent data, learner-produced data, and analysis models to discover information and social connections, and to predict and advise on learning.” In 1st International Conference on Learning Analytics and Knowledge (LAK11), this definition was refined and learning analytics was described as, “measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs”.

As Director of the EDUCAUSE Learning Initiative Malcolm Brown stated, purpose of LA is, to comprehend the collected and analyzed learner produced data to make appropriate interventions about learning behaviours (Brown, 2011). LA takes the same approach of analytics but with a particular aim of improving learning outcomes (EDUCAUSE, 2011). In LA focus is on the learning processes in which relationships between learners, content, institution and educator are examined (Long and Siemens, 2011). LA aims to provide better evidence and insight about factors affecting learning processes, which provide student success (Siemens et al., 2011).

2.3.2.1 LA Stakeholders:

LA stakeholders are learners, educators, administrators, and funders (Siemens et al., 2011). The information returned from LA can be used by instructors, students and administrators (Brown, 2011). Instructors can learn about student activities and progress, students can get feedback about their own progress, face with their own learning habits and clearly see the impact of activities on their learning progress which increase self-awareness and self-regulations, and administrators can make departmental and institutional level adjustments based on the data collected and analyzed (Brown, 2011; Siemens, 2012). The most common use of LA is to spot learners who appear to fail and to make interventions in order to help those students (EDUCAUSE, 2011). Although identifying at-risk students is a significant contribution, it is only a fraction of LA; analytics can do more to improve education and optimize learning processes significantly (Siemens, 2012).
2.3.2.2 Development of LA Concept:

As Brown (2011) stated, in instructional technology area, LA is the third wave of development. First wave began with LMSs, which was instructor-centric, based on traditional teaching models on Web 1.0, which provided only content for its users; that's why it was also called read only web. Afterwards, Web 2.0 layer was added to LMSs; that is a second wave in which learner-centered content and tools take place; allowing learners themselves to produce data, which is therefore called as read/write web. Now, people have started to question which Web 2.0 tools should be used and in what manner. At this point, LA becomes the third wave, which will "provide information on what works and what does not with respect to teaching and learning" (Brown, 2011).

Fergusson defined three factors that contribute to the development of LA technology. According to her first driving factor is a technical challenge, which has started with the widespread use of virtual learning environments (VLEs), which are also known as course management systems (CMSs). Since these systems produce significant amount of data about student activity and their built-in analytics offer limited or none visual reports; people have started to think how technically possible to extract value from these learner produced large sets of data (Ferguson, 2012). Second factor is an educational challenge. Due to lack visual cues about student satisfaction, engagement or challenge during activities in online learning environments, educators struggled to figure out the quality of learning environments and to evaluate the learning activities. Therefore they have started to think about how possible to optimize opportunities for e-learning which became second driver for LA technology. Third and the last driver is political/economic challenge, which asks the question of how possible to improve learning opportunities and educational outcomes nationally and internationally. Since there is a growing institutional need of being able to measure, demonstrate and improve performance of education in many countries, analytics technology has become an increasing demand. For instance USA government invest billions of dollars to increase the overall educational attainment (Fergusson, 2012). So as a result, these three drivers create three different interest groups in LA technology: educators/learners, educational institutions and governments that shape the development of LA concept (Fergusson, 2012).
Even though LA is a young and developing concept, existing LA implementations demonstrate an important potential for providing vital improvements into teaching and learning (Siemens, 2012).

In short, LA has many invaluable benefits to education such as decreasing attrition by spotting students at risk of failure and generating alerts for them and their educators, ensuring each learner have enough information about their current progress, enhancing learner motivation with timely feedback about their performance and offering advices on activities that has some gaps, providing information to educators about which students need extra help, which teaching practice makes positive impact on learning, offers higher quality curriculum adjustments and learning process design with real-time data and so on (Siemens et al., 2011).

To be able to adopt analytics in educations, there are some areas, which need to be developed such as new tools and techniques, the practitioner experience and analytics researchers (Siemens, 2012).

2.3.2.3 How LA works?

LA technology has powerful techniques that deal with pre-existing, large sets of machine-readable learner produced data, which cannot be handled manually (Fergusson, 2012). Learners leave digital footprints/breadcrumbs while interacting with activities on various computer systems, and these are collected and analyzed by LA (EDUCAUSE, 2011). Therefore, data collection, analysis and making appropriate interpretations are the main elements of LA to optimize learning experience (Brown, 2011; Pardo and Kloos, 2011). LA applications gather data, analyze it, generate reports and enable interventions (EDUCAUSE, 2011).

As Brown (2011) mentioned programming and scripting are some of the methods for data gathering. Data can be obtained from one or more sources, which affects the size of it that can be large to very large amounts. Collected data can be structured such as server logs or unstructured such as forum postings. If data obtained from LMSs, the platform itself easily provide structured data about who did what, when and with whom (Pardo and Kloos, 2011). The type of collected data depends on the institution and application but generally it contains frequency of time used by learners to access online materials or activities (EDUCAUSE, 2011). After data collection, analysis process begins. If data is unstructured, before analysis process some sort of structure given to it (EDUCAUSE, 2011). Data
gathered become more meaningful with well-established web analytics tools (Pardo and Kloos, 2011). At the end of the analysis phase, results are reported and displayed using a combination of mostly visual elements such as graphs, charts, tables and etc. These reports are examined by the audience of the LA application, who can be learners, educators or administrators to make appropriate interventions.

One of the example uses of LA application can be given by ‘The Signals’ project of The Purdue University in which early detection of student-failure aimed (Pardo and Kloos, 2011). In this project, data mined from institutional CMS that students use during learning experiences. Then data is manipulated with some mining algorithms to identify students at risk and afterwards risk levels of students are represented as a traffic light in which red, yellow and green represents risk levels. With these visual representations, instructors make some interventions such as posting traffic light to student’s page, e-mail or text messages or face-to-face meeting about it (Arnold, 2010).

2.3.2.4 Educational Data Mining vs. LA

LA has similar evolutions with some other domains such as educational data mining (EDM) and web analytics (Duval, 2011). Because all of these domains use detailed large data sets to define patterns based on data mining techniques, they all have similar evolutions (Duval, 2011).

Although these communities share many attributes that serve for common goals, each of the community has also its unique attributes (Siemens and Baker, 2010). EDM and LA share the same aim, which is improving education by researching on problems in the system and making proper interventions (Siemens and Baker, 2010). Also, both communities have a common goal of improving quality of the large sets of educational data analysis to have good and valuable research (Siemens and Baker, 2010). However, three factors, mentioned by Fergusson (2012), which drive to LA technology also made split between different technologies that sometimes confused with each other. At that point LA concept split from concepts of EDM and academic analytics.

After Web 2.0, with an increasing number of datasets coming from VLEs, the field of EDM gradually emerged (Fergusson, 2012). In the field of computing, data mining technology applies a range of techniques to databases to be able to explore and show previously unknown but potentially useful data patterns. EDM is a subset of data mining field, which develops methods to discover unique types of data coming from educational
settings and uses those methods to better understand learners and the environments in which they learn (Siemens and Baker, 2012; Fergusson, 2012). Fergusson (2012) gave reference to the most cited EDM paper in literature (Zaiane’s, 2001) which explained EDM’s aim as turning students into effective better learners by focusing on data mining and machine learning techniques so that educators can better evaluate web-based learning environments in which learning processes occur.

EDM focuses on the technical challenge that Fergusson (2012) mentioned; it seeks to answer the following question: how technically possible to extract value from big sets of data produced by learners? On the other hand, LA focuses on the educational challenge and it seeks an answer to the following question: how possible to optimize opportunities for e-learning? And finally academic analytics deals with political/economic challenge in which ‘how possible to improve learning opportunities and educational outcomes nationally and internationally’ question is aimed to be find out. Although there are overlaps between these three groups, they are disambiguated between each other (Fergusson, 2012).

Siemens and Baker (2012) also listed key distinctions between EDM and LA fields. For instance, EDM and LA communities differentiate in their origins, preferred research approaches, techniques and methods.

Siemens and Baker (2012) call for communication and collaboration especially for two communities: EDM and LA. Although there was a competition between these two communities in the past, there still should be a friendly and healthy competition, which leads to different educational practices and research in order to improve learning process and environments in which it occurs (Siemens and Baker, 2010). It is very important to connect some research domain such as LA, EDM, machine learning, psychology of learning, and statistics that will have offer more accurate and strong results at the end with shared distributed knowledge (Siemens, 2012).
2.3.2.5 LA Adoption Horizons:

EDUCAUSE Horizon report 2011 specified time to adoption horizon for LA as far-term horizon, meaning there is four to five years from widespread adoption. However on the following year, EDUCAUSE changed and decreased this adoption time to two to three years. Because there are many factors proving that LA will be in mainstream use by two to three years time (Brown, 2011). As Brown explained, first factor is the idea of LA is compelling; because it helps to spot potential problems of students, identify these students and make interventions to deal with these problems (Brown 2011). Additionally, unlike the traditional course evaluations done by students at the end of the academic year, which demonstrate only student reflection, LA provide information on what students actually did rather than their reflections (Brown, 2011). Second important factor is increasing number of vendors that provide LA technology to schools (Brown, 2011). Currently increasing number of LMS vendors offer built-in analytics tool within their software (EDUCAUSE, 2011). Beforehand, schools needed to build their own system to conduct LA technology. Instead, schools can begin running LA technology by actually buying one from vendors without consuming years to create one or even they can use third-party software, which works with LMSs. However as Brown mentioned, although it seems LA will be in mainstream use in two to three years, it will take more time to make majority of the schools use highly sophisticated forms of LA; however most of them will be using LA in some form.

2.3.2.6 Moving Beyond LMS:

In order to improve teaching and learning, using analytics is the method. However before analytics process data which will be used should be carefully chosen because there is a massive amount of data waiting out there (Long and Siemens, 2011). Like finding a needle in a haystack, valuable data should be used in analytics, which exactly tells what needs to be known about learners (Long and Siemens, 2011).

Starting point for most of the current LA applications is the data coming from LMSs (Pardo and Kloos, 2011). Because LMSs provide data about learners’ engagement and interaction with the activities in the system LMS analytics widely used to capture clues about learner success. How many times learner logged in, how many times clicked on a link, how many times viewed content, downloaded it or attended discussion forum are some of the data from LMSs. Therefore, much of the data used by LA depends on LMS, which provide log-in information about learners, participation rates to forums and time spend in online activities (EDUCAUSE, 2011). However as Long and Siemens stated LMS analytics do not
give other activities of learners, which might be valuable to analyze to recognize effectiveness of learner processes. Because there is a tendency to use applications, which provide more functionality for the learner, rather than what LMS offer, what student interacts with is not limited with the LMS activities (Pardo and Kloos, 2011). For instance, online activities within social media sites, use of mobile devices and library use are other forms of data, which needs to be analyzed to conclude and have better interventions about what affects learning processes (Long and Siemens, 2011).

Even though LMSs offer range of features for students, they choose their own ways of interacting with peers, finding resources, and sharing resources which demonstrate that learning experiences also take part outside of the LMS (Pardo and Kloos, 2011). As a result, in order to make more realistic interventions about student learning and increase effectiveness and accuracy of LA, collected data should be moved beyond LMS (Pardo and Kloos, 2011).

**2.3.2.7 What exactly should be measured?**

In LA applications, people are quite unclear about what data should be mined in order to better understand what makes learning better and how (Duval, 2011). Usually the typical data used in LA are about how much time learners spent, how many times they logged in to the system, how many times they clicked on a mouse to access specific resources, number of finished coursework and so on (Duval, 2011). However as many researchers asked, is this enough to understand learning processes deeply?

Pardo and Kloos (2011) specified this issue as one of the big challenges of LA, which is deciding what factors are truly significant to have more accurate predictions about student learning. As an illustration, in one LA study 22 factors within the LMS used by learners were analyzed; however as statistics indicated only 13 of those factors were found significant which has a positive correlation between student grades (Pardo and Kloos, 2011). In short, although vast amount of data is gathered from different sources, they might not clearly show what makes learning better.

One of the weaknesses of some LA implementations is the data sources because data is gathered mostly from LMSs and Student Information Systems (SIS) (Siemens, 2012). However, this is only a smaller part of the learning process (Siemens, 2012). Learners’ activity outside these systems should be included to have more accurate interpretation and predictions about student progress and learning process. If data coming from mobile
devices, sensors, physical world such as use of library resources and frequency of tutor/mentor meetings is included, complete learner profile can be analyzed (Siemens, 2012). Data coming from multiple resources can increase the accuracy of learner profile and so the interventions (Siemens, 2012).

**2.3.2.8 Privacy: The Ethics of Doing Learning Analytics**

If the way of understanding learning process better is having detailed learner-produced data, there are serious issues come out about privacy (Duval, 2011). Because analytics derives from data, it is an inevitable fact that LA causes outstanding concerns particularly about ethics of using data (Siemens, 2012).

Director of the ELI Malcolm Brown (2011) stated that, in the LAK, all presenters and attendees agreed that LA raises privacy related concerns. Because LA mechanisms examine what learners are doing, it might be assumed as invasion of privacy for some people. With the increasing number of powerful tools for LA application concerns about ethics and privacy have been discussed (Fergusson, 2012). Monitoring daily activities of learners can be assumed as invasion of privacy behind the scenes and even called as ‘Digital Big Brother’ (EDUCAUSE, 2011).

Brown mentioned, allowing students opt-out can be an alternative way to deal with privacy concerns. However letting some students to hide their activities might decrease the accuracy of LA because analysis of an incomplete data from the subset of the students in a course cannot give the realistic results. So if the only way is tracking all the student activities, Duval suggested that transparency is a key principle in doing so. In other words, it should be always obvious to the learner that they are being tracked. He also mentioned that there should be a tool like ghostery¹, which enables user to understand they are being tracked on the system (Duval, 2011).

However, there are still questions, which need to be answered and to be carefully worked on, such as ‘Should learners be told that their activities are being tracked?’ ‘How much information should be provided to learners, educators, and administrators?’ ‘Should students have a chance to opt-out?’ and so on (Fergusson, 2012).

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Learners have a right about data ownership; therefore there is a need for learners themselves to control about which data to share (Siemens, 2012). LA applications should be responsible of transparent notification of the scope and clear communication about the role of the system itself (Siemens, 2012). In short, researchers need to find out the ways for balancing learner privacy and value of data collection.

**2.4 Developing a Learner Dashboard:**

In the learning process, for learners, educators and administrators, it is very beneficial to have a visual representation of learner-produced data, which shows relations, and compares it with other learners’ data (Duval, 2011); because the activities has been done and its affect on learning can be interpreted by the intended audience clearly.

These visual representations are collected within one place, which is called *dashboard*. Dashboards are sense-making component of LA applications in which data analysis is represented as bars, charts, and diagrams to the intended audience in order to assist them when making decisions on teaching and learning (Siemens et al., 2011).

In this project, *learner dashboard* was developed in which weekly activities of the learners visually represented to them with charts. Once students authorize the software, it tracks student activities not only in LMSs but also in social networking sites. Since real and life-long learning does not occur only in LMSs, software demonstrates social networking activities as well. In addition to the analysis representation of learner-generated data, data can also be mined to provide recommendations about resources or activities of the learner to students (Duval, 2011). For that reason, software makes suggestion to the learner about what can be done more to improve their activities and available new resources that student might miss.

Next chapter will explain software development processes of the MSc. Project including feasibility study, requirements elicitation and analysis, design, implementation, testing and evaluation respectively.
Chapter 3: Software Development Processes:

3.1 Feasibility Study:

As for all new systems, by considering overall objectives of the research, software development process should start with a feasibility study in order to find out whether it is feasible to continue with developing this software or not (Somerville, 2004). Therefore before starting this project, necessary feasibility studies were done and some changes were proposed and applied both in the scope and the schedule to be able to continue with the project.

As this was a small MSc. project, there was no funding; therefore all the available free software preferred to be used to increase feasibility. It was much more feasible to implement the system with an open source technology, therefore implementation strategies were done accordingly which will be explained deeply on Implementation part. But in summary, system could be implemented by first using streaming APIs\(^1\) of the social networking sites in order to collect learner-produced data from these platforms, then database software tools to store collected data and finally charting components\(^3\) to visually represent the data analysis to the learner. Furthermore, this software could easily be integrated with the current systems, which are already in place, without requiring any cost or technical difficulty. Learner Dashboard can be used as part of any universities’ student information systems (SISs).

One of the feasibility study elements is doing a tangible or intangible cost-benefit analysis (Gilbert and Gale, 2007). For this MSc. Project intangible cost-benefit analysis was done based on the time/schedule and quality of the software. Without any budget, open source software used for development, which made the quality inevitably average. However within the given schedule this quality result was quite reasonable.

As a result, requirements and constraints specified based on the feasibility study results, which will be explained in detail in the next requirements elicitation and analysis part.

\(^1\) https://dev.twitter.com/docs/streaming-apis
\(^2\) https://blog.facebook.com/blog.php?post=57822962130
\(^3\) http://archive.msdn.microsoft.com/mschart
3.2 Requirements Elicitation and Analysis:

After feasibility study it was obvious that this project can be done within the given time period, if constraints can be arranged accordingly.

Aim of this project is to show what makes learning processes better to the learners themselves by providing analytics results of their activities within the range of platforms, so that they can make deductive reasoning and figure out which of these platforms help their learning progress more.

Audience is the learners of higher education institutes who are mainly digital learners who use Wikipedia to gain overview about any topic, YouTube to watch videos about it, Google Scholar to search articles published on these topics, Facebook to chat with friends about it, Twitter to follow academics or others who tweet about this topic and so on. Most of these are mainly what university level students do during their learning processes, in addition to LMSs or other web sites provided by the university. Therefore project began with a very big scope in which every single action of the learner aimed to be tracked and visually represented into their dashboards. As it can be seen from the early prototype created in June -see appendix A, each social networking site that students have currently used, every Internet activity done by students throughout the day related with education such as use of search engines, online encyclopedias and existing university web sites that students have an access, planned to be analyzed. This general overview about user profile was basically decided based on the personal experiences and observation of other peers. However, more professional overview was gained after project supervisor’s survey result published in 2009 was examined. 919 students who were studying at variety of departments in the University of Southampton was the survey participants in which it was aimed to understand how students support their studies with the help of technology and e-learning. According to survey results, web sites, which are visited more than twice daily were Google (566 responds), Facebook (422 responds) and university provided sites such as online portals or CMSs (555 responds altogether). This was actually proving the correctness of the overall idea about what students are using for their learning.

Based on personal experiences and survey results, constraints were shaped. However there were some limitations about the implementation, which changed the scope in a great extent so did constraints as well. For instance, with the available current technologies, only analytics of a specific page searched on Wikipedia can be done, such as this much user from these countries looked at this page without any specific user information, which is same
with Google Search as well. Therefore learner’s web activity analysis part was omitted from the project.

Afterwards, the objective mainly became social networking analytics in addition to LMSs; but the point was deciding which social networking sites should be used in the project. Idea is having analytics of social networking sites specified by students themselves who has given access to the system; however for the project demonstration there was no point to analyze whole social networking sites especially within a limited project implementation time. Therefore two social networking sites, which are widely used across the globe, were chosen. Of course Facebook was the one, which has nearly 908 million\(^4\) users and another one was Twitter, which is listed as the second social networking site in terms of the number of registered users that is 500 million\(^5\). After regarding these facts and several meetings with project supervisor, scope and constraints defined as described.

Before designing the software learner scenario was written to describe final user and system requirements. This scenario shows how user interacts with the system and what the user expects from the system with the flow of events.

### 3.2.1 Learner Scenario:

Duygu is a student who has an access to a dashboard of analytics that shows her progress weekly for each module that she enrolled in and provide her an automatic feedback about her progress every week like all students at her university. Her dashboard is available online to view anytime from anywhere and she also gets a weekly summary of what has changed via e-mail.

For every single module, dashboard is aggregating her activities on some sites provided by University itself such as ECS Intranet Site or Blackboard LMS as well as some of the social web tools ‘she has given access to’, because she does a lot of her learning using external tools such as Twitter, and Facebook. Duygu has authorized the system to reach and analyze her activities on such external sites by accepting terms and conditions.

For her MSc. Project and Dissertation module, Duygu has a public Twitter account, which was created specifically for that module so that she won’t let dashboard to analyze her personal tweets. Duygu is using Twitter to follow people who are doing research particularly

on her area, to retweet some of those that she finds useful for her project, and to tweet about her personal findings with a specific hash tag which is her MSc. Module code and university name e.g. #comp6029 #soton. Duygu is also using Facebook for this module. In fact, she liked a ‘page’ of this module on Facebook so that she attends discussions about writing dissertation by commenting posts, likes hints about writing in English shared by her peers and she shares some useful information in that page as well. That is why she let dashboard to analyze her activities only in that Facebook page.

Every week she receives feedback based on her activities within these sites from the dashboard itself and sometimes from the module lecturer as well. She sees what she did during the week, such as how many times she tweeted and retweeted, how many times she visited a wiki page on ECS Intranet Page and so on. Based on these, system presents her some suggestions about how to become more effective strategic learner for instance by suggesting new people to follow such as George Siemens or Simon Buckingham Shum who are specifically tweeting about Learning Analytics. She can also see comparison of herself with her classmates via pie charts; such as 15% of the students enrolled that module are using Twitter; average tweeting for the week is 5% and you are below the average etc. In addition to specific feedback, she receives general feedback from the system such as ‘75% of your classmates are using Mendeley to save time in finding and organizing research articles and papers; which can also help you’. Or she might receive some warnings or small strategies from the lecturer especially when she falls behind the others such as ‘your activity progress is not enough to catch up the planned project schedule’.

This learner scenario was used as a summary of requirements elicitation and analysis so that project was completed within this scope. Next part will show this scenario as a use-case diagram, which indicates possible learner behaviour within the system.
3.2.2 Use Case Diagram:

Drawing a use-case diagram represent requirement elicitation as scenario based technique in which type of interactions between actors and the system specified (Somerville, 2004). Here is the use-case diagram of learner dashboard, which shows what learners can do within the system.

Figure 1. Use-Case Diagram: Learner
3.3 Design:

After requirements elicitation and analysis, based on the written scenario and use-case diagram, user-interface design and database design decisions were done which will be explained separately in the next sections.

3.3.1 User Interface Design:

System designed for university level students who are taking different modules and awaiting analytics results of learning activities for each module both in the university sites and social networking sites. Before implementation, user interface plan was done with the second prototype as it can be seen in Appendix B.

For the user-interface design, Jakob Nielsen’s heuristics were considered and user-interface created by obeying ten usability heuristics of Nielsen (Nielsen, 2005). In order to make user-interface more friendly, clear and aesthetic colors, fonts, and background chosen accordingly in a harmony as it can be seen from the Figure 2. Consistency was a key element in the system so that each system module would become much more clearer to the user. That is why in both of the columns consistency was considered; in which left side represents social networking analytics and right represents university’s LMS analytics.

As it is said, in order to develop such a system, first of all an effective user-interface is required, which represents analytics result visually with a good quality to the learner. There are plenty of charting types to choose for such as pyramid, spider, bubble, funnel, renko, kagi, column, pie, doughnut, line, stacked column and so on. In this system, to show the analytics results, line, column and stacked column chart types were chosen which are the most convenient and widely used charting types for users. As it is seen from the Figure 2 and 3 in the next page, for Twitter Analytics, line chart was used which shows daily tweets and retweets of the user; for Facebook Analytics, column chart was used which demonstrates daily likes, comments and shares of the user in a Facebook module page and finally for university’s LMS, ECS Intranet analytics, stacked column was used to represent how many times user visited different parts of the LMS. Furthermore, pie and doughnut charts were used to indicate activity comparison of the user with classmates as shown in Figure 4.
Figure 2 Learner Dashboard GUI 1

Figure 3 Learner Dashboard GUI 2
3.3.2 Database Design:

Another design element of the system was the database in which data coming from social networking sites and university’s LMS is stored and managed. System has five database tables, which are student, module, Twitter, Facebook and Intranet.

Module table has four attributes: module code, which is a primary key, module name, module leader and module tag, which is a pre-defined hash tag for the module to be used in tweets. An example module table tuple is: COMP6003, Enterprise Web Development, Andy Gravell, #comp6003soton.

Student table has six attributes which are student id that is a primary key, student name, surname, image, which is used to show in the system page, e-mail to send analytics results via e-mail and programme that students enrolled in. For instance, one student table tuple can be as follows: 25137115, Duygu, Simsek, image, ds4g11@ecs.soton.ac.uk, MSc. Software Engineering.
Tweet table’s attributes are *tweet id*, which is an auto-increment primary key, *tweet text*, *student id* as a foreign key to show who tweeted this text, *screen name* which is the account name of the student in case student might have more than one Twitter account for different modules, *date*, and *tweet tag*. An example tuple of the tweet table can be as follows: 1, tweet text, 25137115, duygusimsekMSc, 06/01/2012, #comp6029soton.

Facebook table consists both *student id* and *module code* as a primary key, *date*, and *number* of likes, shares and comments as attributes. Similarly intranet table’s attributes are both *student id* and *module code* as a primary key, *date*, *number* of visits to intranet system, module page, wiki section, and resources part.

After user-interface and database design decisions were made, implementation phase began in which what technology to use for achieving these design decision were made that will be explained deeply in the next part.

### 3.4 Implementation:

After extensive review of technologies were made for data analysis such as Google Analytics tools and social networking sites’ streaming APIs, regarding the limited project time, just to show the idea, mock data had been used as agreed with project supervisor. One of the project aims is to prototype a learner dashboard idea; thus mock data is an easy way to work with. Therefore, none of the analytics technologies actually used.

Then, which web-programming language should be used for implementation was decided based on personal experiences and a meeting done with Dr. Andy Gravell, who gives Enterprise Web Development module in the University of Southampton. Knowing both PHP and ASP .NET’s advantages and disadvantages as also discussed in lectures with Dr. Gravell made the selection clearer. Instead of PHP, which has no choice of programming languages and can be mainly used for the hobbyist or small business due to its deficiencies, ASP .NET was the web-programming language used for the implementation, which has good choice of programming languages, excellent support for modularity and wealth of libraries and frameworks. Also, because it is easy to create graphical user interfaces (GUI) professionally, efficient to play with mock data within its database and create visual representations with additional libraries that can be downloaded.
Regarding these decisions, firstly, database tables created and filled with mock data in the SQL server of ASP .NET. After an extensive search about what charting technology to use, Microsoft Chart Controls for .NET Framework\(^6\) downloaded and used for visualization which would undoubtedly work more efficient for an ASP .NET, instead of other possibilities.

After implementation phase, software was tested and evaluated which will be explained in the next part in detail.

### 3.5 Testing:

Testing is one of the most important steps in software development lifecycle, which stands as a mirror showing that what is good, what should have been done more to get closer the perfectness or at least more closer to the point. Even though it is the final step, it has a major impact on the system so that as a developer you become aware of faults, make them correct and gain new insights about future developments. This software was tested with a range of test cases and tested by five different users to evaluate interface, usability and the idea.

#### 3.5.1 Test Cases:

Validation testing was done by expecting system performs correctly with a given set of test cases, which reflect what actually is expected from the system (Somerville, 2004). Therefore, this software was tested by twelve test cases -see Appendix C to N, considering every possible action can be triggered. Aim of these test cases was to discover any faults/defects or any unexpected/undesirable behaviours that system might has. That is why for every button, menu item and combo box element in the system, test cases prepared carefully; in which test case description, pre-conditions of the system, steps and expected system response for each step and pass or fail result took place with post-conditions at the end. The entire test cases successfully completed without finding any defects or errors and system behaved as expected.

As a result, no errors found but as Sommerville mentioned testing does not show that system is free of bugs or will behave like this every time (Somerville, 2004). Therefore it needs actual users and several attempts to figure out system behavior in a great extent, which was done in usability tests with five different users that will be explained in the next part.

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\(^6\) [http://archive.msdn.microsoft.com/mschart](http://archive.msdn.microsoft.com/mschart)
3.5.2 Usability Test:

As the guru of Web page usability and the king of usability, Jakob Nielsen, stated that the best results can be achieved from usability tests with no more than five users (Nielsen, 2000). With five users, maximum cost-benefit ratio will be achieved without depending on what kind of system is tested (Nielsen, 2012).

Based on this approach, system was tested in terms of its usability with five international post-graduate students, who are doing masters in the University of Southampton since 2011. Three of them were studying MSc. Software Engineering, one of them was studying MSc. Web Technology and the other test user was studying MSc. Human Resource Management. They all got their undergraduate degrees in different countries including China, Vietnam, Greece and Iran. Two of the test users were female and the rest was male, whose ages vary between 24 and 30.

Users were carefully chosen, considering that they have no prior idea about this project and how the system works, which would have affected the results. On usability test day, after project description was briefly given, one by one users tried the software with my presence around five to ten minutes. When software had been started, two of the test users reflected their first impression as “Nice, perfect, I liked the consistency!” and “Wow, amazing, I like it, seems friendly!” whereas other test users stayed silent and seemed like they are trying to figure out what all these are.

All of the users tested each menu item, button and dropdown element in the system, which were all working properly. However, most of the test users missed that there is a dropdown list at the top-right in which modules can be changed; they found it with my directions and when specifically asked ‘please change module page’. Additionally, some test users had a tendency to skip ‘compare my activity’ button, which indicates that it is not clearly placed; some of them required my assistance to be aware of it.

MSc. Web Technology test user professionally examined the system, mainly its interface with his background knowledge about usability as he took a module about it last term. Overall, he found the software nice with all the parts. However, he had some complaints about the user interface, as he found it a bit unreadable and wished for bigger diagrams. Additionally, he stated that buttons could be much bigger or with a different colour at least because it is hard to recognize that which is button, which is text. When it is asked what you would like to change or add to this software, he advised that help button should be
placed next to diagrams so that user can have an explanation about what they mean and show and how they work. He also would like to change the idea of having two different menus as single menu at the top, which he claimed would be more convenient as most of the web users get used to this kind of menus more.

One of the MSc. Software Engineering users found the overall appearance consistent and loved this feature; because he mentioned that, if user understands one part, they will be able to understand the rest easily. He was very good at following every single menu item, drop-down list element and buttons without any difficulty to figuring out them. When he clicked on ‘compare my activity’ button and then changed the course page from the drop-down list, he expected to stay in the comparison page for changed module instead of going back to home page again. Furthermore, he complaint that it is hard to figure out which colors represent what in the diagrams; he mentioned that user expects to see small colored squares saying blue represents number of likes, green represents number of shares and so on. When same question asked to him, he wanted to add a new feature to suggestions part. As he mentioned, he would have added a history of suggestions with a specific date showing the overall suggestions of the system in one place, instead of having current week’s suggestion only.

Other MSc. Software Engineering user had some difficulties about understanding what graphs meant to him. During the usability test, he kept saying:

“I don’t understand what this graph shows to me about my learning. How can I understand social networking sites’ impact on my learning on my own? System itself should explain it to me.”

In short, he expected to see a written explanation of charts’ meanings and their relation to his learning progress. He also wanted to add a “prediction feature” to the system so that system can demonstrate what kind of graph he will possibly have next week.

Last MSc. Software Engineering user found the user interface very friendly, clear and easy to understand. She advised to make suggestion area much bigger for gaining attention. She also wanted to have a text area in which users can write their own learning and study experiences belong to that week and share these notes on social networking sites to make it visible to friends.
3.6 Evaluation:

At the end of usability tests, five more questions about the software asked to each user in order to gain insight about what they think about it and the idea of learning analytics which track their activities not only CMS based but also social networking based.

Although they were separately interviewed and they did not know each other well, they gave same answers, as if they agreed before. First, all of the participants agreed that this software is very useful especially with the idea of having visual summary of activity tracks and especially with its ‘compare me’ feature. They all believed that such system would be very useful to actually see how much time they allocated on CMSs or on social networking sites for studying. Additionally, they all agreed that being able to compare themselves with everyone else in the class would strongly increase their motivation because seeing others joining activities more than they did would motivate them to engage with activities more. Here are couple reflections from test users:

“This system would be really useful because we always spend time on social networking sites, but we cannot actually recognize how much time we spent for study or just for fun on these sites.”

“LinkedIn has a statistical feature which shows my weekly activities and when I see low results there, I become really unhappy and try to be more active to increase it for the following week. So I believe that it will be the same for this software too.”

“This software, especially suggestion part, is really useful; because if I miss any announcement or note, it can warn me. Besides, I would ask myself that why I did not attend wiki activity whereas so many people visited wiki page this week, did I miss something important? I mean if there is an activity that I’m not part of it, I would interested more.”

In order to understand their reaction to having such a software, it is asked to each user that ‘would they use the software although university makes it optional’, they all were so enthusiastic about the idea and everyone said yes without thinking for a second.

“Yes of course, of course! It is easy to use and automatically compares me with everyone else comparison between others! Loved this idea.”
“Of course I would, especially if university does such system; because I trust the university, so I would use it all the time!”

“Yeah, of course; because I think it is useful and it is combined with social networking!”

“Yes, sure! I can control my activities so my understanding about my own learning might improve.”

“Yes, I hope everybody use it! It is like a checkpoint for your study life. It will encourage me to study more and I’m sure it will encourage everyone else!”

Then to get their ideas about privacy issues, it was asked to each user that ‘would they allow the system to track their activities on social networking sites, if they knew that it would be private and used by right people’. They actually hesitated to say strong ‘yes’ answer except two of them. They put a condition besides their yeses.

“Yes, only if I’m sure that no one get any announcement about my activities on Facebook like Duygu visited COMP6003 page. I have to control with some kind of privacy settings! I have to be sure that it is only seen by right people.”

“No I would not allow for activities on Facebook, but for Twitter of course!”

“If lecturers would see it, I would not be happy to be tracked because I would definitely fail!”

In short, all of the participants liked the idea of being tracked by the software, having visual representations of the analytics results and being compared with everyone else anonymously; because they believe that being able to see how much time they passed on activities, and how much time others passed on activities would definitely encourage them to engage with activities more and help them to realize how they use platforms for their learning activities so that they can understand which affects their learning progress more.

In the next chapter, test users’ overall idea about the CMSs, social networking sites’ affect on learning and privacy issues will be discussed based on the structured interview answers of five test users.
Chapter 4: Discussion

During usability test day, five test users also attended a structured interview – see Appendix O, which has three parts and seventeen questions altogether. With this interview, it is aimed to somehow understand whether hypothesis ‘learning analytics should not be limited with LMSs; because social networking has also an impact on learning progress’ correct or not. Additionally, although privacy concerns whether the idea of being tracked and having visual reports in a learner dashboard is what learners would like to have or not was aimed to understand with the interview.

First part of the interview was about CMSs and what makes their learning better. According results, two of the users haven’t heard about CMSs concept even though they use it and three of the respondents have just started using it in the University of Southampton since September 2011. All of the participants agreed that CMSs have a positive impact on learning progress, although all of them think that based on their experiences, CMSs are like repositories of lecture materials like a directory. They added that the only reason of using CMSs is just reachability of lecture materials, downloading them and uploading assignments. In some extent, this proves that mostly CMSs’ impact on learning, especially blended ones, does not move beyond material reachability and ability to upload an assignment.

When it is asked to participants about what contributes their learning progress in a great extent, all of the participants gave the highest score to the Internet, as it has become an indispensable part of their lives. Finally, they defined what makes their learning better in three words as follows:

“Internet, Social Networking Sites, Classmates”

“Subject, Teachers, Environment”

“Materials, Environment, and my Mood”

As it can be understood from these answers that environment and online platforms are key assets in learning; therefore having analytics of the learning activities and the environments in which it occurs can open the doors of having better understanding of what makes learning better and what does not.
Second part was about impact of social networking sites on education. All of the participants are using more than one social networking sites including Facebook of course, Twitter, LinkedIn, Pinterest, Foursquare, Instagram and Google+. All of the users are using Facebook whereas three of the respondents are using Twitter.

They all agreed that the main reasons of using social networking sites are keeping in touch with friends, sharing feelings, showing their life to others and learning more about friends’ life whether they get married or graduated and so on.

When it is asked to participants about whether they believe social networking sites can also be used for education purposes or not they all said yes without a doubt.

“Yes, I believe it can be used. For instance we have Software Engineering group on Facebook, remember? Some of the discussions are really helpful there. We talk about coursework, share solutions... It provides good communication with classmates, fun and study at the same time!”

“Yes only if it is organized with groups of people like our group, MSc. Software Engineering on Facebook.”

“Yeah, I strongly believe in that. Now not only students but also all the people are there: lecturers, researchers and so many people. And it is better to learn something while looking a photo of someone else, much more enjoyable!”

“Of course it can be! When web introduced, it changed the way we live our lives and at the moment web has reached to a point of social networking age! So now, social networking get the responsibility of changing life and it would include education as well.”

All of the respondents said that they are already using social networking sites for education purposes such as three of the software engineering students are using Facebook group. They all believed that social networking has a positive impact on learning and many advantages. All participants agreed on social networking already attracted so many people’s attention and many people are using these sites, almost every single person. People are already there, so learning can be done collaboratively because social networking sites transfer knowledge faster, cheaper and easier. Furthermore, they claimed that because of
the number of people in these sites, they could have more up to date knowledge. These answers clearly indicate that students are using social networking sites for education purposes and they believed that it helps and shapes their learning processes.

Finally, participants’ ideas about privacy issues were asked. They all have privacy concerns, except one who believes that people are just exaggerating this issue and privacy settings can be used to handle any problems might pop up. Others mentioned that they sometimes overthink before sharing something or even give up to share those because of privacy concerns. One participant said, although there are privacy settings they are sometimes too complicated for simple users so privacy is a legitimate problem. Other participant said that the idea of others might be able to see private discussions, hacking accounts and illegally use photos make her to scare about using those sites. However they all use it anyway.

As a result, there is no doubt to say that, research project’s hypothesis on CMSs and social networking sites mostly supported and proved with these results. Unlike usability test, having discussion about these questions with more than five people might give a better and accurate result and affect the validity of the results; however it shows the general idea of what learners think about CMSs and social networking sites’ effect on learning in a great extent.

### 4.1 Future Work

Because of the time limitations of the project, software was developed as a learner dashboard proposal, which works only with a mock data, which was designed just to show the idea and get learner reflections about it. So researchers can continue to develop a real working system with a real data that can be actually tested with a group of students for a whole academic term. Additionally, privacy issues and ethical considerations of LA can be researched deeply, which is one the future challenges of LA applications that must be handled to create such learner dashboards.
Chapter 5: Conclusion

With Web 2.0, which added write feature to read only web 1.0, multimedia content has been gradually increased every single second, due to users who browse, search, surf, share and communicate on the Web. These online users have produced vast amount of data trails, which is also called as big data that creates an explosion in terms of quantity and quality of the data. Data explosion acts as a barrier to use of these data sets. Inadequacy of current database software tools lead to this barrier because they are not sufficient to store and manage huge data sets. However, because user-generated data is valuable to find out current issues within online sites, activities and can affect future decisions based on that, the idea of analytics was born. As everything else, learning activities have turned more online basis in which students actively engage with e-activities. Therefore, students have left digital footprints of their learning activities that can be collected and analyzed to make interpretations on what makes learning processes better, what does not. At that point, for educators, administrators and learners, the idea of LA came out, which collects, analyzes and reports the learner-produced data within a dashboard system in order to better understand learning and the environments in which it occurs.

After LMSs have started to use, because educators wonder whether they are effective or not, LA concept have been used to assess student activities within LMSs. Therefore, current LA applications are restricted with LMS data which is not enough for accurate and proper interpretations on learning processes; because students are using such systems just to download a course material and upload an assignment and they are using many other platforms to support their education such as Social Networking Sites.

Considering these issues, this project aimed to move beyond LMSs and proposed a learner dashboard, which collects, analyzes and reports data from social-networking sites as well. When structured interview was done with five users, who also tested the dashboard in terms of its usability, research hypothesis was proved that students use LMSs as a repository of lecture materials and they use social networking sites for education purposes as well, although they have privacy concerns. As testing and evaluation of this learner dashboard show that students ready to accept being tracked via software which let them to see their activities and excited about the idea of being compared with everyone else in the class that encourages them to be more active.
In conclusion, students are ready, platforms are ready, and data is there, waiting to be analyzed; if the point is better understanding of learning and the environments in which it occurs, there is nothing to wait to implement such a dashboard except continuing with the research on learner needs, privacy issues, analytics technologies, and implementation techniques.
5.1 Self Reflection on Project Management & Planning

As it can be seen from the Figure 5, project time planning was reasonable and that is why everything went well during the project. With the changes from the scope some parts were omitted and this affected actual completion dates in some extent. However mostly project time was passed as expected. I am very happy with my progress for this MSc. Project, as I achieved what I planned, reviewed literature extensively, implemented my prototype design and tested and evaluated with my peers. For all of these reasons, I feel happy with my contribution to the field.
REFERENCES:


APPENDIX

Appendix A: Design Prototype 1

Appendix B: Design Prototype 2
Social Board

Twitter
Facebook

Number of:
- Likes
- Shares
- Comments

Suggestions:
- New discussion topic has started.

Uni Board

Internet - Blackboard?

Number of:
- Internet
- Module
- Resource
- Download
- Wiki
- Assignment
- Post Paper
- Post Paper

Suggestions:
- Post papers are available online.
- This week’s notes are posted.

Warning:
- Coursework submission due in [date].
# Appendix C: Test Case 1

Test Case Number: 1  
Test Case Name: Change COMP6003 Module  
Test Case Description: Test that the system changes COMP6003 module to COMP6029 when COMP6029 selected from drop-down list.  
Test Date: 14/09/2012

## Pre-Conditions:
- User views COMP6003 module, which is selected from the drop-down list.  
- Module label is Enterprise Web Development as written under drop-down list.

## Step | Action | Expected System Response | Pass/Fail |
<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click the drop-down list</td>
<td>The system displays all list items to select one.</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>Choose COMP6029 module from the list.</td>
<td>The system displays home page of COMP6029 module.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

## Post-Conditions:
- 1. The new module changed to COMP6029 in drop-down list  
Appendix D: Test Case 2

Test Case Number: 2
Test Case Name: Change COMP6029 Module
Test Case Description: Test that the system changes COMP6029 module to COMP6003 when COMP6003 selected from drop-down list.
Test Date: 14/09/2012

Pre-Conditions:
User views COMP6029 module, which is selected from the drop-down list.
Module label is MSc. Project and Dissertation as written under drop-down list.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click the drop-down list.</td>
<td>The system displays all list items to select one.</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>Choose COMP6003 module from the list.</td>
<td>The system displays home page of COMP6003 module.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Post-Conditions:
1. The new module changed to COMP6003 in drop-down list
2. Module label changed to Enterprise Web Development.
Appendix E: Test Case 3

Test Case Number: 3
Test Case Name: Change Twitter Menu Item
Test Case Description: Test that the system changes its behavior when different menu items selected.
Test Date: 14/09/2012

Pre-Conditions:
Twitter menu item is currently selected showing twitter analytics data.
Twitter menu item’s backcolour is light blue and forecolour is white and it is underlined.
Facebook menu item’s backcolour is white and forecolour is black.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Over mouse to the Facebook menu item.</td>
<td>Facebook menu item’s backcolour changed to dark blue.</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>Click on Facebook menu item.</td>
<td>The system displays Facebook analytics data.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

Post-Conditions:
1. Facebook menu item’s backcolour is light blue and forecolour is white and it is underlined.
2. Twitter menu item’s backcolour is white and forecolour is black.
Appendix F: Test Case 4

Test Case Number: 4
Test Case Name: Change Facebook Menu Item
Test Case Description: Test that the system changes its behavior when different menu items selected.
Test Date: 14/09/2012

Pre-Conditions:
- Facebook menu item is currently selected showing Facebook analytics data.
  - Facebook menu item’s backcolour is light blue and forecolour is white and it is underlined.
  - Twitter menu item’s backcolour is white and forecolour is black.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Over mouse to the Twitter menu item.</td>
<td>Twitter menu item’s backcolour changed to dark blue.</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>Click on Twitter menu item.</td>
<td>The system displays Twitter analytics data.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

Post-Conditions:
1. Twitter menu item’s backcolour is light blue and forecolour is white and it is underlined.
2. Facebook menu item’s backcolour is white and forecolour is black.
Appendix G: Test Case 5

Test Case Number: 5
Test Case Name: See Last Week Twitter
Test Case Description: Test that the system changes current week’s twitter analytics data with last week.
Test Date: 14/09/2012

Pre-Conditions:
Twitter menu item is currently selected showing current twitter analytics data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on See Last Week button.</td>
<td>Line chart changes with last week's data.</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Check post-conditions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post-Conditions:
1. Go Back button appeared instead of see last week button.
2. Chart’s title changed to “Last Week’s Twitter Activity”
3. Dates on x axis changed to previous week.
Appendix H: Test Case 6

Test Case Number: 6  
Test Case Name: Go Back Current Twitter Analytics  
Test Case Description: Test that the system goes back current week’s twitter analytics data properly.  
Test Date: 14/09/2012

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on Go Back button.</td>
<td>Line chart changes with current week’s data.</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check post-conditions</td>
<td></td>
</tr>
</tbody>
</table>

Post-Conditions:  
1. See last week button reappeared.  
2. Chart’s title changed to “Number of daily tweets and retweets”  
3. Dates on x axis changed to current week.
Appendix I: Test Case 7

Test Case Number: 7
Test Case Name: See Last Week Facebook
Test Case Description: Test that the system changes current week’s facebook analytics data with last week.
Test Date: 14/09/2012

Pre-Conditions:
Facebook menu item is currently selected showing current Facebook analytics data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on See Last Week button.</td>
<td>Column chart changes with last week’s data.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

Post-Conditions:
1. Go Back button appeared instead of see last week button.
2. Chart’s title changed to “Last Week’s Facebook Activity”
3. Dates on x axis changed to previous week.
Appendix J: Test Case 8

Test Case Number: 8
Test Case Name: Go Back Current Facebook Analytics
Test Case Description: Test that the system goes back current week’s Facebook analytics data properly.
Test Date: 14/09/2012

Pre-Conditions:
Facebook menu item is currently selected showing last week’s Facebook analytics data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on Go Back button.</td>
<td>Column chart changes with current week’s data.</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Check post-conditions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post-Conditions:
1. See last week button reappeared.
2. Chart’s title changed to “Number of daily likes, shares and comments”
3. Dates on x axis changed to current week.
Appendix K: Test Case 9

Test Case Number: 9
Test Case Name: See Last Week Intranet
Test Case Description: Test that the system changes current week’s Intranet analytics data with last week.
Test Date: 14/09/2012

Pre-Conditions:
Intranet menu item is currently selected showing current Intranet analytics data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on See Last Week button.</td>
<td>Stacked column chart changes with last week’s data.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Post-Conditions:
1. Go Back button appeared instead of see last week button.
2. Chart’s title changed to “Last Week’s Intranet Activity”
3. Dates on x axis changed to previous week.
**Appendix L: Test Case 10**

Test Case Number: 10  
Test Case Name: Go Back Current Intranet Analytics  
Test Case Description: Test that the system goes back current week’s Intranet analytics data properly.  
Test Date: 14/09/2012

**Pre-Conditions:**  
Intranet menu item is currently selected showing last week’s Intranet analytics data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on Go Back button.</td>
<td>Stacked column chart changes with current week’s data.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

**Post-Conditions:**  
1. See last week button reappeared.  
2. Chart’s title changed to “Number of daily activities within Intranet System”  
3. Dates on x axis changed to current week.
Appendix M: Test Case 11

Test Case Number: 11
Test Case Name: Compare my Activity
Test Case Description: Test that the system shows comparison page when compare my activity button clicked.
Test Date: 14/09/2012

Pre-Conditions:

User is currently viewing home page.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on Compare my Activity button.</td>
<td>Comparison page will be loaded.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

Post-Conditions:

1. Go Back button appeared instead of Compare my Activity button.
Appendix N: Test Case 12

Test Case Number: 12
Test Case Name: Go Back to Home Page
Test Case Description: Test that the system goes back to home page from comparison page.
Test Date: 14/09/2012

Pre-Conditions:
    User is currently viewing comparison page.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Expected System Response</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click on Go Back button.</td>
<td>Home page will be loaded.</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Check post-conditions

Post-Conditions:
    1. Compare my activity button reappeared.
Appendix O: Structured Interview

Thank you for agreeing to this meeting and allocating your time.

This interview forms part of my dissertation research into Learning Analytics, which is a relatively young concept in education domain. It basically aims to collect and analyze learner-generated data and represents the analysis results visually such as in bars and charts to enable making interpretations about learning processes, what makes it better what does not.

The purpose of this interview is to obtain your views on a number of aspects related to my research.

Part 1: How do you Learn? What makes learning better?

QS1) Have you ever used any Course Management Systems in your lectures (e.g. Moodle, Blackboard etc.)? If yes, for what purposes?
QS2) Do you think CMSs have an impact on learning progress? If so, how?
QS3) Please rate the contribution of the following, on your learning progress from 1 (not at all) to 5 (a lot).

Course Management Systems (e.g. Blackboard, Moodle)
The Internet (e.g. Wikipedia, Google, YouTube)
Social Networking Sites
Digital Libraries (e.g. IEEE/ACM libraries, Google Scholar)
Use of Library Resources

QS4) In three words, what makes your learning better?
Part 2: Overview about an Impact of Social Networking Sites

QS5) Are you a member of any social networking sites? If yes, how many and what are they?

*If you answered only 1 to QS5 skip this question*

QS6) Which social networking sites you visited more often?

QS7) For what purpose are you using social networking sites? (E.g. to stay connected with friends, learn what’s happening in the world etc.)

QS8) Do you believe that online social networking can be used for education purposes? (E.g. to communicate with your classmates about lectures, to increase what you’ve learned etc.)

QS9) Have you ever used social networking sites for education purposes? (E.g. discussing a course material, share lecture content etc.)

QS10) What advantages do you think social networking sites can have on education?

QS11) Do you have any privacy concerns about social networking sites like Facebook? Do you think, this is actually a legitimate problem or just an exaggeration?

**NOW TIME FOR USABILITY TEST!**

Part 3: Learning Analytics Idea

QS12) What would you say about this software in three words?

QS13) If you have this kind of software, which tracks your activities and reflects the results to you, how would you feel? Would you find it useful or useless?

QS14) If you have this software last semester, how would your understanding about your own progress change or would nothing change?

QS15) If university makes this software optional, would you use it? If yes, why?

QS16) Would you let/allow the system to track your activities on FaceBook and Twitter, if you knew that it would be private and used by right people?

QS17) If you have a chance to add or change any part of this software, what would you add/change?