UNIVERSITY OF PETROȘANI

DOCTORAL SCHOOL

FIELD: ENGINEERING AND MANAGEMENT

DOCTORAL THESIS

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AN EXPLORATORY STUDY REGARDING THE USE OF BLOGS IN A PROJECT MANAGEMENT APPROACH IN TEACHING AND LEARNING FOR THE CASE OF "STUDENTS AT RISK"

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List of Abbreviations/Acronyms

AR- Augmented Reality

CBT – Computer Based Training

CMS - Content Management System

E-portfolio – Electronic Portfolio

G- Gamification

GA- Google Analytics

HMD – Head Mounted Device

ICT – Information and Communication Technology

K-12 - From kindergarten to 12th grade school system

LA – Learning Analytics

LMS – Learning Management System

PBL – Project Based Learning

DT – Development Team (Scrum Process)

PDSA cycle- Plan-Do-Study-Act, is an iterative, four-stage problem-solving model

PM- Project Management

PO – Product Owner (Scrum Process)

SDLC - Software Development Life Cycle

SM – Scrum Master (Scrum Process)

STEM- Science, Technology, Engineering and Mathematics

VR –Virtual Reality

Web 2.0 - Websites that emphasize user-generated content, ease of use and compatibility.

XP - Extreme Programming

Introduction

Research Settings and Justification

There are always challenges in teaching K-12 students Science, Technology, Engineering and Mathematics which is called STEM subjects due to the scientific nature of these disciplines that require strong and higher order thinking along with the ability to connect abstract concepts and relate to them. Additionally, there is a decrease in number of students interested in these disciplines (Hom, 2014). Moreover, the Covid-19 Pandemic had affected education in a drastic way worldwide and had led to an almost total closure of schools, colleges and universities and forced them to convert their educational procedures to on-line. Hence, applying creative methods of instruction in regular school systems has more benefits than ever, especially if on-line elements are used. The advantages are many, and one of them is to keep students motivated and engaged especially students at risk who tend to have low motivations, lower grades, and tendency to drop out from the educational system. K-12 teachers always face challenge to keep all their students motivated and engaged at the same time. By offering more choices to students and by providing more authentic assessments to their students, and by allowing students to take active role in their education, intrinsic motivation of students will improve (Albrecht et al., 2009). A new way of looking at STEM education is to teach these disciplines of Science, Technology, Engineering and Mathematics as one. So, students who are taught these disciplines integrated as a whole one subject will be able to solve real life problems. Furthermore, real life problems are not separate disciplines which are taught in lessons. These problems tend to be complex, and is difficult for discipline-based teaching to solve and define these problems hence the use of Project Based Learning (PBL). Additionally, the effectiveness of STEM integration is manifested once it's organized in a PBL setting and used by the teacher and students in teams for solving specific problem or managing a specific project in a specific time frame. PBL enables students to collaborate with each other, apply their prior knowledge, stay engaged, and it makes them gain different skills throughout the project So, it is necessary for teachers to explore alternative methodologies and built-up methods that reinforce the important skills related to STEM, in order to achieve a high-quality education. These skills will improve the students' involvement in learning, as well as their social and ethical commitment. It will provide critical thinking and problem solving, effective communication, collaboration and team building, creativity and innovation. Not only it will enable them to assess their learning, but also their ability to learn and their learning skills in general. The ability for innovation is based on a set of skills and knowledge which produces creative thinking among students. These skills are not only technical but also include soft skills, that are crucial in boosting innovation. These soft skills include autonomy, communication, proactivity, accountability and problem-solving. They are exhilarated through pedagogical methods such as digital integration,

and learning through collective projects (Ferguson et al, 2017; Zergout et al., 2020). So, by digital integration it's possible to use Web 2.0 based technology like blogs to promote such advantages. Research on the use of blogs in Higher Education, for instance, had suggested that students who blogged, as part of a course requirement, demonstrated an increase in reflection, a heightened feeling of connection, and an increase in course-related knowledge. So, blogging can provide a promising medium for students to engage in reflection as they participate in a PBL. It can actually guide a project by providing a productive place for team members to communicate clearly, to document their work and input other resources, and also brainstorm their ideas. Research also suggests that blogging brings other advantages for students like increasing their motivation to learn and provide them with ICT skills. Blogs also bring to classroom differentiated instruction for diverse students, or it can be used as electronic portfolios for students: using e-portfolio system individually positively influence some subjects, it encourages students using computer or cellphone to reach the information on virtual environments to assess themselves and to monitor their computer skills, and their development. It provides a creative way of organizing, summarizing, and sharing student work and to demonstrate evidence of students' professional growth (Karademir et al., 2016; McBride et al., 2015). Blogs can also be used as a supplementary medium to promote achievement and knowledge acquisition for students as well as an information searching and sharing skills within a learning community. Furthermore, once blogging was used in a PBL STEM environment and was managed effectively, this will maximize the advantages of it. Hence comes the Agile methodology in managing such STEM projects with blogs. Agile is a demanding methodology for organizations in general and educational organizations in particular, because Agile helps teams in projects to manage and adapt quickly to change. Additionally, Agile provides students with workforce ready skills and it gives them better performance in group projects (Hulshult & Woods, 2020). It can be used to manage STEM projects in education combined with blogging.

Personal motivation

In order to deal with students, there must be a mix between attention, affection, patience and dedication. With more than 20 years' experience working with teenage students I had noticed the need to keep these students motivated while they learn engineering and technology subjects. The students at risk need supplementary aid all the time while they study STEM subjects, so that their interests are boosted during learning. Hence, I noticed the value of ICT tools in keeping these students motivated in the way it attracted their attentions. Yet I noticed that there are certain aspects that need to be explored for a successful deployment of such tools. Additionally, I was exposed to the use of Agile project management frameworks, which may be tuned to K-12 STEM education by using Gamification and Learning Analytics. Moreover, there are plenty of challenges that need to be

overcome while pursuing such task. But for sure, the driving force for me throughout this research was always my desire to help and my dedication to anticipate new knowledge for the scientific community.

The aim of the research

The thesis aims to explore one of the ICT tools, namely the blogs along with other elements like Agile methodology in STEM project under formal K-12 educational setting in particular. Yet, there are still many other conditions to be further considered, such as the method of selecting assignments, or the content materials, or the methods of assessing students. Other variables including: the use of Gamification elements when setting up the project, the use of Google Analytics to properly analyze data; may be used with other conditions in order to motivate students to learn and keep them engaged. The making and usability of the designed blog, according to the previous conditions, is also considered to be one of the aims.

The research will explore the use of blogs, Google Analytics, Gamification and PBL in STEM subject along with the use of Augmented Reality.

Perspectives of the research

Some research questions arise from the literature review and from the observations made by the author of the thesis:

> Why do we need to address the issue of students at risk?
>
> How can we motivate these students?
>
> How do we assess that they became motivated?
>
> Are the students prepared for the 21st century skills through ICT tools and Web 2.0 technology?
>
> What should students, teachers, and faculty expect when implementing an ICT tool like an e-portfolio in their program or course?

So, the main Research Question (RQ) is:

RQ: How can ICT tools generally and blogs especially help students-at-risk?

> The premises of the thesis approach are reflected by the author of the thesis through the results obtained in the period preceding the doctoral studies (2013-2014; 2014-2015; 2015-2016; 2016-2017). The research continued during the doctoral studies and focused on introducing Gamification elements and Google Analytics (2017-2018; 2018-2019) together with implementing the Agile methodologies (2018-2019), and for the period affected by the pandemic it was experienced Augmented Reality inclusion in blogs (2019-2020).

In order to answer the Research Question, the following research objectives were set:

O1: Synthesizing the main theoretical and applied approaches that allow the correct substantiation of the students at risk issue based on previous results with reference to the role and importance of ICT tools, blogs especially in increasing students' motivation in teaching and learning.

O2: Integrating Google Analytics and Gamification into blogs in teaching and learning

O3: Identifying the proper project management methodology for implementing the approach that integrates Google Analytics and Gamification into blogs in teaching and learning

O4: Exploring Augmented Reality integration in Blogs in teaching and learning
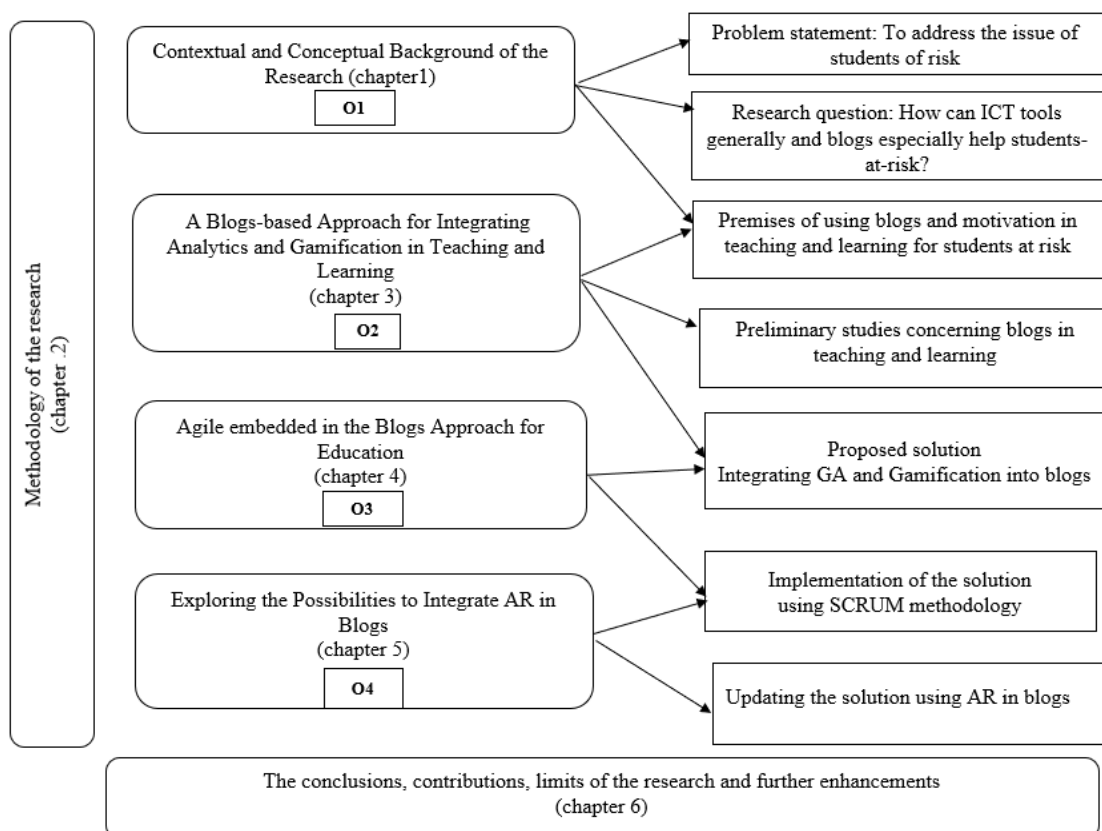
Figure 1-1 The Structure of the Thesis

Structure of the Thesis

The first chapter will introduce blogging in education: its importance, its advantages and the accompanied settings for maximum performance in educational environment. It defines students at risk, students' motivation, the need to prepare students for the 21st century skills through ICT tools and Web2.0 technology, ICT and motivation, definition of blogs, the relationship between blogs and motivation, and how a blog can be used as an e-portfolio. Other factors related to successful deployment of such scheme are discussed, like the effect of teacher efficacy on students' blogs, teacher efficacy and motivation. This chapter contributes to the problem identification through

recognizing the main variables that are related to exploring the use of blogs as ICT tool in education for students at risk.

The second chapter is about the methodology of the research. Using blogs in the context of the research, the strategies of the research, the usage of qualitative and quantitative research and their significance in this context, other research methods will be discussed briefly to show the reason for using such approach. Data collection tools, like observation and interviews, are discussed. Validity of the research is discussed based on the data tools used.

The third chapter introduces a blog-based approach for integrating Analytics and Gamification in teaching and learning in STEM subject. It will be discussed the link between the Web 2.0 technology, Google Analytics and Gamification. The Learning Analytics (LA), its history and perspective, LA techniques and applications, are then used as an experiment integrating Google Analytics into blogs in a STEM subject.

The fourth chapter deals with Agile embedded in the blogs approach for education with discussion of Agile methodologies, Agile in education, and the most appropriate Agile methodologies in educational setting. Then a discussion of an experiment using Agile for the Blogs-based approach in education integrating Analytics and Gamification and using SCRUM framework is included.

The fifth chapter explores the possibilities to integrate Augmented Reality (AR) in blogs. Two simple-to-complex approaches are presented to integrate AR into blogs. The first is an interactive approach that give students tools to practice using AR, while the second approach is tutorial oriented using AR as a mean to present knowledge, both use applications from STEM subjects in electronic engineering.

The final chapter presents and discusses the achievement of the objectives and concludes by providing an overview of the entire thesis and summarizing the major findings and contributions. The chapter also provides recommendations for future studies in terms of enhancing the research by overcoming the limitations.

Research Contribution

This study is significant since it investigates the conditions and the interactions of K-12 students using specific web 2.0 technology like blogs which becomes more important during the Covid-19 pandemic due to the ongoing demand on on-line instruction and learning. The blogs will be used both by teachers and students each with its own functions and characteristics. Students will be working as teams in a project-based learning (PBL) for STEM subject in formal setting and using Agile methodology at the same time. The thesis will also study other variables like teacher efficacy, motivation of students, their learning, and their engagement.

To answer the research question, an interdisciplinary approach was needed to solve the identified problem regarding students at risk. The solution of the research topic was done through an approach that integrates specific aspects of systems engineering represented by ICT tools through project management.

Chapter 1: Contextual and Conceptual Background of the Research

The main objective of this chapter is: *Synthesizing the main theoretical and applied approaches that allows the correct substantiation of the students at risk issue based on previous results with reference to the role and importance of ICT tools, blogs especially, in increasing students' motivation in teaching and learning (O1).*

For achieving this objective, a thorough literature review is carried out and the problem of students at risk is stated right from the beginning together with the students' motivation, pointing out that ICT may be the tool needed to shift student's motivation from extrinsic back to intrinsic.

1.1. Introduction

Schools focus usually on ensuring that all students succeed in life. It enables them to participate effectively in society, yet there are some students who are at risk of dropping out due to many factors. The term "at-risk" is used to describe students who are in danger of not meeting educational goals which includes graduating from high school or acquiring the skills that are needed to become contributing members of society, some of these students show disruptive behavior that interferes with their learning. Their background characteristics may place them close or below the poverty level. Other characteristics may include low grades in tests scores and abundant absences from school. At-risk students may feel that they are overwhelmed by the content covered in high school. These students may have learning disabilities that make it harder for them to read or write. So, how can we motivate these students? But how do we know first that they became motivated? According to Palmer (2007) once they become motivated, they pay attention, they start working on tasks immediately, they begin asking questions, volunteer answers, and they are shown to be happy and eager to learn. Technology may be used to motivate these students (Madrazo, 2011; Barley, 2002), research shows how feeling of autonomy, having extrinsic and intrinsic goal orientation, gaining task value are related to increased motivation among at-risk students (Madrazo, 2011). Information and Communications Technologies (ICT) are widely considered as the lever that would lead to substantial educational and pedagogical outcomes which support students' development on the knowledge and skills required to succeed in the twenty first century. The graduates of secondary school need to have digital literacy requirements (i.e. ICT skills, Critical thinking skills and ethical skills). However, the results obtained about technology initiatives have been mixed. Often, the use of technology into classrooms fails to meet the proposed expectations, as proponents anticipated (Darling-Hammond et al., 2014). If achievement effects of traditional use versus computer-assisted instruction can produce similar

positive or negative effects, then inquiries about the types of highly-effective technology and supporting classroom infrastructures are essential for strategic planning, particularly in regards to the literacy instruction of students at risk populations (McGuinnes, 2015). Web 2.0 applications, like social networking, podcasting, blogs, social bookmarking, media sharing and RSS, contributed to the students' acquirement of the requirements of digital literacy (Jimoyiannis & Angelaina, 2012). Academics, educators, researchers and policymakers have advised that the emerged Web 2.0 applications will have the potential to lead for enhanced learning opportunities including both students and educators and will be able to support lifelong competence development. In a matter of fact, using blogs, as web 2.0 technologies, in the classroom can help increase student learning using student's preferred learning style, increase motivation, align his or her personal interest, and raise engagement. Students' blogs may encourage self-reflection for the student and critical thinking. The fast internet connected publication of a blog for the whole world audience elevates student motivation for writing and learning, as the scientific the literature reveals. Student blogging bridges that gap between home and the classroom, it creates an unlimited learning environment. Using blogs had shown that it allows collaboration which promotes constructive environment. And for low-achieving students blogging can give to that "silent student" a voice by allowing him the opportunity to write on topics of interest (Sawmiller, 2010). Teachers' role is important; it plays a role in motivating their students. Teachers, for instance, who feel they are efficient will spend more time on student learning, supporting the students in reaching their goals and they will reinforce their intrinsic motivation (Bandura, 1977). They also feel a personal achievement, having high expectations, feeling responsible for student learning. They also have strategies for reaching objectives, with positive attitude about teaching and believing that they can influence student motivation in learning (Ashton, 1984).

The anticipated framework will be able to combine two benefits; first, it promotes motivation and engagement by using ICT and blogs specifically, and secondly it will enhance digital literacy requirement for secondary students when they practice ICT skills, self-reflection and critical thinking. Additionally, all these factors will also promote lifelong learning for these students.

1.2.Students at Risk

Why do we need to address the issue of students at risk? The highest performing education systems are those systems that have the combination of equity and quality. They give all their children proportional opportunities for a good quality education. Some students may leave school without completing upper secondary education or without the relevant needed skills, hence they will have fewer life prospects. They will have lower initial and lifetime earnings, more difficulties in adapting to the rapidly changing knowledge-based economies that will emerge in the 21st century, and they

will have higher risks of unemployment. The dropout will also be less likely to take up further learning opportunities and will be less able to participate effectively in the civic and democratic aspects of their modern societies. Those dropouts will also impose high costs on society. Poorly educated citizens may limit economies' capacity to produce, grow and innovate. Schools with high percentage of dropouts may damage social cohesion and mobility, they impose additional costs on public budgets to deal with the consequences of higher spending on public health and will increase social support spending and greater criminality, among other factors. Figure 1-2 shows the percentage of youngsters, males and females, age 25-34 who have completed upper secondary education.

Proportion of youths having attained at least an upper secondary education, 2017
(% of 20-24 year olds)

Note: ranked on the average for all youths aged 20-24. Jordan, Lebanon and Tunisia: not available.
(¹) 2015.
(²) This designation shall not be construed as recognition of a State of Palestine and is without prejudice to the individual positions of the Member States on this issue.
(³) 2016.
Source: Eurostat

eurostat ⬛

Figure 1- 2 Proportions of 20-24 who have completed upper secondary

Across OECD (Organization for Economic Co-operation and Development) countries, about twenty percent of students do not reach the minimum level of skills in order to perform normally in today's societies (which indicates lack of inclusion). Students from a low social economic background are generally twice as likely to be low performers. This implies that personal or social circumstances hinder youngsters to achieve their educational potential (indicating lack of fairness). Lack of inclusion and fairness are the main reasons for school failure, of which dropout is the most visible expression – with an average of twenty percent of secondary students drop out before graduating.

Six predictors can be identified and used for student dropout that when combined can help to effectively identify students who will most likely leave the school system (Figure 1-3).
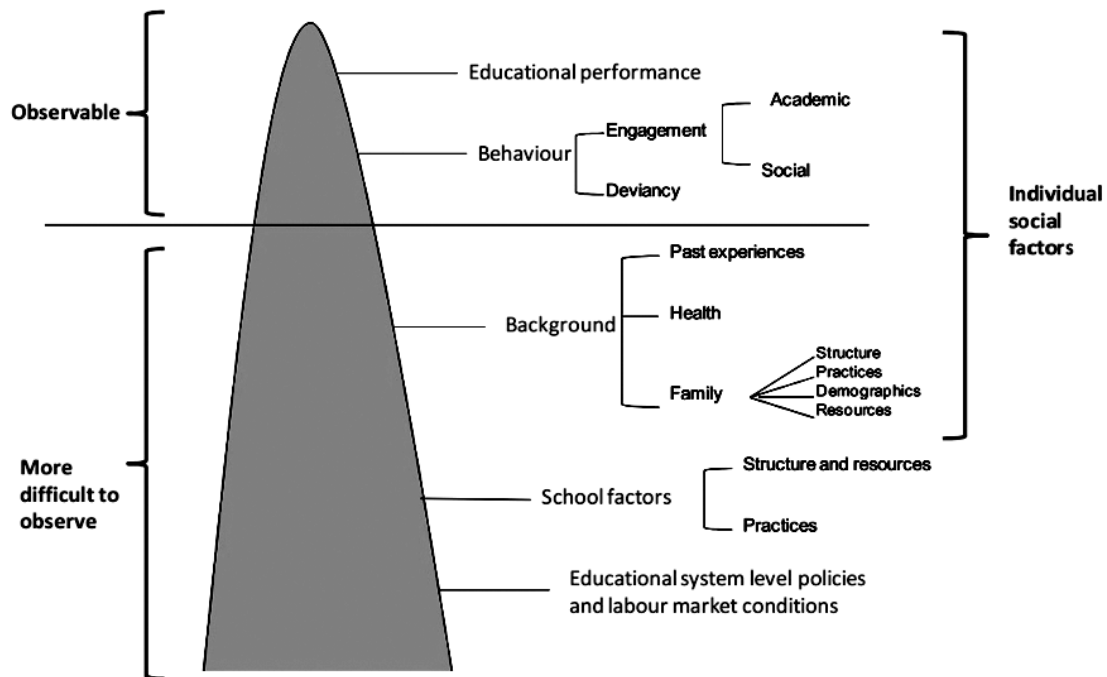
Figure 1- 3 The iceberg of low performance and school failure (OECD, 2012)

• the highest predictor for dropout is the educational performance, because a signal of lower preparation in order to go through the educational system can be considered the students' low grades (Lyche, 2010). Above, in Fig.1.3 the iceberg of low performance and school failure which shows educational results as the tip of the iceberg since there are other factors involved and some of them are difficult to identify.

• Students' behavior also matters for success in school. Students who tend to stay in school are those engaged in academic and social activities, valuing education. In OECD countries, the studies show that 25% of 15-year-old students do not appreciate success in their education. Evidence also shows that students may lose focus from learning when they experience negative emotions. Additional behaviors such as drug or alcohol abuse and juvenile misdeed are also associated with lower performance (Pfeiffer & Cornelissen, 2010).

• The students' background exerts an important influence on their performance. Students from low-educated families with a negative attitude towards education or who do not have the resources to support their children at school are more likely to drop out of school. Previous research has shown that family environments have deteriorated in recent years (Heckman, 2011). The number of children from families earning less than 50% of a country's average income has increased in the last 10 years in most countries, especially in Austria, Germany, Luxembourg and Turkey. This is due to the fact that most children are born into disadvantaged families, most of whom come from minorities or

immigrants (Heckman, 2011). In Figure 1-4 is presented the influence of context on adolescent progress over time (Jessor, 1993) at the intersection between family, school and neighborhood in the global social-economic, political and cultural environment.
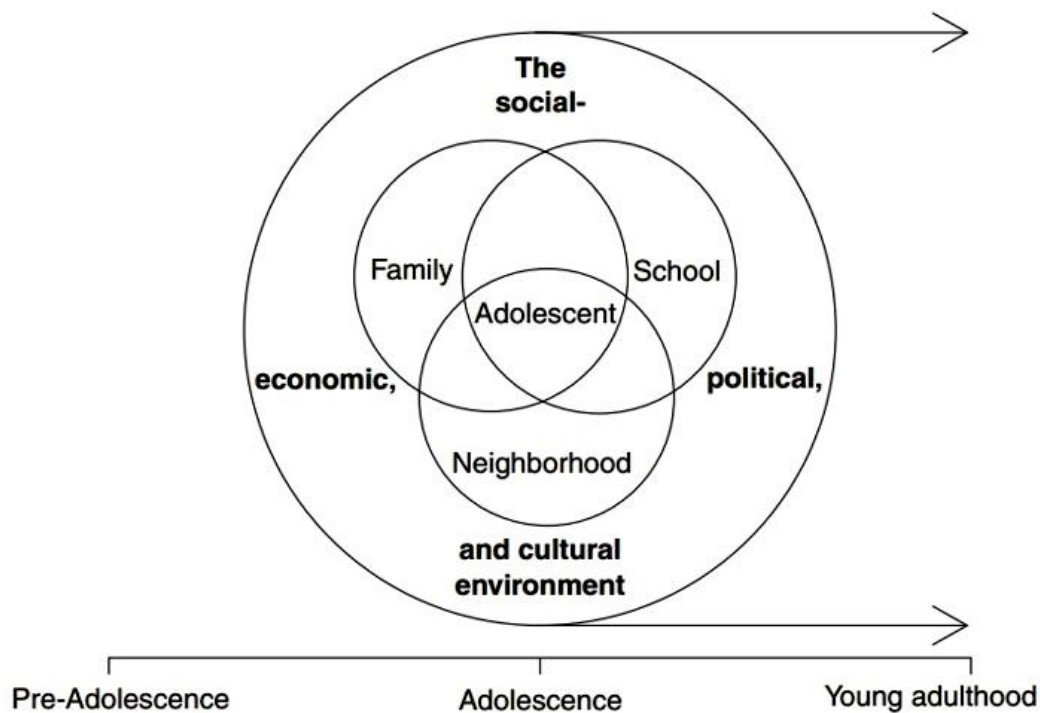
Figure 1- 4 The influence of context on adolescent progress over time (Jessor, 1993)

• Educational structures, resources and practices strongly affect students' learning. The way in which information is transmitted, extracurricular activities, inter-student and student-teacher relationships as well as pedagogical practices all influence students' learning, motivation, commitment and sense of belonging.

• Some educational policies such as early tracking, grade repetition or specific issues such as the lack of sufficient apprenticeship or school violence can all contribute to increased dropout (Bridgeland et al., 2006)

• Labor market conditions may also have an impact on dropout students. For example, some labor markets which can be regional and seasonal like tourism or construction had attraction to students to leave school, and hence become unskilled workforce with poor prospects to success. These types of jobs along with the desire of some secondary students to earn money early, either due to their economic situations or merely for their desire to have money early motivates them to leave school early (European Commission Report, 2011).

The education systems could be designed to encourage these young people to stay in school, or possibly return to school at a later stage in their lives. A study of backgrounds and drop-out factors, based on data collected from 363 regions in 30 developing countries on 130,000 children, showed the

following: the highest incidence of dropping out school, more precisely 72%, is due to family factors, parents' education, occupation and income being the most important; the family structure also has a rather important role, thus, children from single-parent families drop out of school faster than others. In addition, important factors are the educational resources, characterized by the quality of schools and teachers, as well as the level of development of the region. The results of previous research show that the transition from primary to secondary education is a critical point in children's education. There are studies that argue that extending the duration of primary education could be an effective strategy to keep children in school longer (Huisman & Smits, 2015).

One of the important studies about students at risk of dropping out and how to promote their engagement with science subjects was done by Faria et al., 2012. The goal of the study was to promote more understanding to the factors related to school science, and the ones that affect students-at-risk engagement and make them drop out of school science. Also, the need to recognize activities and teaching strategies that are more suitable to such students. Results published had shown the importance of linking science with society by means of practical activities like real life activities that give them meaningful learning. Also, the activities that are student centered, give them autonomy, and mobilization of complicated competencies. These types of activities had helped to facilitate students' engagement with school science (Faria et al., 2012). Additionally, strengthening guidance and counselling for these students and planning targeted measures to prevent or decrease dropout and looking for additional avenues to obtain an upper secondary qualification or incentives in order to complete school. The interventions that have helped students with disabilities or problems to graduate from school include early warning systems, mentoring programs, student engagement, family support, academic enrichment, career-focused curricula, interpersonal skills instruction, emphasis on the transition to high school, and class/ school restructuring initiatives (Wilkins & Bost, 2016).

Low performing disadvantaged schools usually lack the ability to improve by itself, as school leaders along with teachers and within school environment. Hence, classrooms and neighborhoods many times fail to offer a quality learning experience for these disadvantaged students. In Table 1-1 solutions are presented (recommendations) for improvement of low performing schools that have students at risk.

Table 1-1 : Improvement of low performing disadvantaged schools hosting students at risk (OECD, 2012)

Recommendation	Description of the low performing causes	Solution
Enhance school leadership	• Leaders-principals are selected in an un-appropriate method • They are mostly unprepared to exercise their functions • They lack the support that they need to succeed in their work	• Enhance school leadership preparation programs • Coaching, supporting, mentoring and networking • Provide suitable conditions to work, continuous support and incentives
Strengthen school environment for learning	Low performing disadvantaged schools are at difficult environments for learning needing specific policies	• Priority for the enhancement of positive teacher-student and student-student relationships • Encourage the use of information systems for school analysis and diagnosis • Organize alternative methods of learning • Smaller schools, smaller classes
Improve quality of teachers	Disadvantaged schools usually lack quality teachers	• Provide targeted teacher education • Provide mentoring programs • Develop supportive working condition
Providing effective classroom learning strategies.	Lack of specific educational practices that would be able to make a difference for students at risk.	• Enhance learning in classrooms • Use diagnostic tools, formative and summative assessments • To make sure that schools follow the curriculum and encourage a culture of higher expectations.
Make a priority to link schools with parents and the community in large.	Parents of students at risk usually tend to be less involved in their children's schooling	• Prioritize the links with parents and communities • The need to enhance communication strategies • Work with communities to enhance learning in schools

1.3. Students' Motivation

Motivation is one of the significant factors in students' lives; it affects their classroom behavior, their engagement, and their future success. Motivated behavior is defined by Santrock (2009) as being, "energized, directed and sustained". Student behavior is influenced by two major kinds of motivation–which can be named, autonomous and controlled. The most influential factors on students' motivation are family or mainly social factors (Butler, 2015), school and peer interaction factors, and teachers including teaching styles. Teachers have a particularly significant impact on students' motivation through their relationships with students (Wilson & Ryan, 2013), or through punishment and reinforcement techniques (Wery & Thomson, 2013), or through strategies of teaching (Morgan, 2013)

or teaching styles. Tuan (2012) concluded that students perceived their teachers as the most influential factor in motivating them for to learn, and for this reason, students need their teachers to encourage them by applying different motivating techniques like problem-solving and inquiry-based instructions (Chen & Chou, 2015). Albrecht et al. (2009) describe a program for increasing students' intrinsic motivation in an effort to increase academic achievement. The case study was secondary students in a middle to upper-middle class. These students were noticed to be disengaged from learning due to lack of motivation. Hence, there was negative classroom behavior, and there were obstacles that hinder their academic progress. There were many indications of low motivation among secondary students as well as other poor behaviors. Additionally, there is documentation of this problem that includes academic and other records of student behavior. The problem was defined by experts supported by scientific literature led to the development of the following three interventions:

1- Providing autonomy to these students,

2- Providing the support to create goal setting,

3- Developing positive teacher feedback.

So, the following treatment was suggested:

1- Offering more choices to the students,

2- Providing authentic types of assessments,

3- Allowing students to take a more active role in their own education.

This suggested that the above treatment will improve intrinsic motivation of secondary school students which directly affects learning behavior and learning achievement of students (Tokan et al, 2019). It will also introduce a new mentality of learning to these students as opposed to the extrinsic rewards that were used before. Lengyel (2010) supported such results where the study found that direct reading instruction and student choice proved to be both motivating to students as well as a positive influence on reading comprehension. The above results were also supported by Gnambs & Hanfsting (2016) where the research showed that adolescents typically exhibit a marked decline in academic intrinsic motivation throughout their school education. Following self-determination theory, it is assumed that traditional school environments insufficiently fulfill three basic psychological needs of young students during maturation, which includes the needs for autonomy, competence and relatedness. As a result, insufficient need for satisfaction might be the reason for the decline in intrinsic academic motivation during adolescence. On the other hand, the Self-Regulation of Motivation (SRM) is a mental process which directs students' efforts as well as their persistence to perform required tasks. This mentioned process regulates student's behavior through strategies that are influenced by motivational beliefs. This allows students to motivate themselves and guides their behavior (Paulino et al., 2016). It was shown that self-efficacy is also important in promoting

student´s motivation for learning. Other scientific evidence supports the theory SRM for learning especially for youngsters.

As for low-achieving students previous research done in regular education setting supported the idea that achievement among lower performing students is connected to the students 'perception of self-autonomy and feelings of competence (Madrazo, 2011). As Deci, et al. (1992) studied 450 students from non-mainstream (self-governed) classrooms who had handicapping codes of either learning disabled or emotionally handicapped, they examined the effect on motivation of limiting students' autonomy and sense of competence. Findings concluded that students with learning disabilities need tasks that increase feelings of competence. Students identified in the research as emotionally handicapped are less likely to experience frustrations academically whereas they are more likely to experience negative feedback based on self-regulation; they desired a greater sense of autonomy.

1.4. Preparing students for the 21st century skills through ICT and Web2.0 technology

In secondary school, students used to spend a big portion of their educational occupied with "old" literacies of paper, pencil, and print books (Larson et al., 2010). Meanwhile, in real life, these students are more immersed in other technologies in their cellphones and computers internet gaming, social media, blogs, internet sites and communication programs that require new literacies. The wide gap between what they typically learn in schools and what they actually use in real life situations is a major problem for schools today. This is reflected by the decline in school's pertinence to students' futures. So, the gap between what and how schools teach and how students are learning is increasing. Yet, its usual that the gap exists between the old and new generation on using ICT, but students of today should not be kept behind. Positive attitudes for students towards Internet and Communication Technologies ICT are positively linked to teachers' levels of experience with ICT. This is a necessary condition for the application of ICT in the classroom (Eyvind & Knut-Andreas, 2017). The new required literacies (Figure 1-5) are as Davidson & Stone (2009) mentioned, that new skills must be acquired by all the student before high school graduation. These are vital for their life in the 21st century. These new skills include: (1) creativity and innovation; (2) teamwork, communication, and critical thinking; (3) adaptability and agility; (4) interactivity and information analysis; and (5) initiative and self-direction. The skills drift away from routine as in Figure 1-5, anticipating since 1998 the need for developing new ICT skills (Levy & Murnane, 2004).
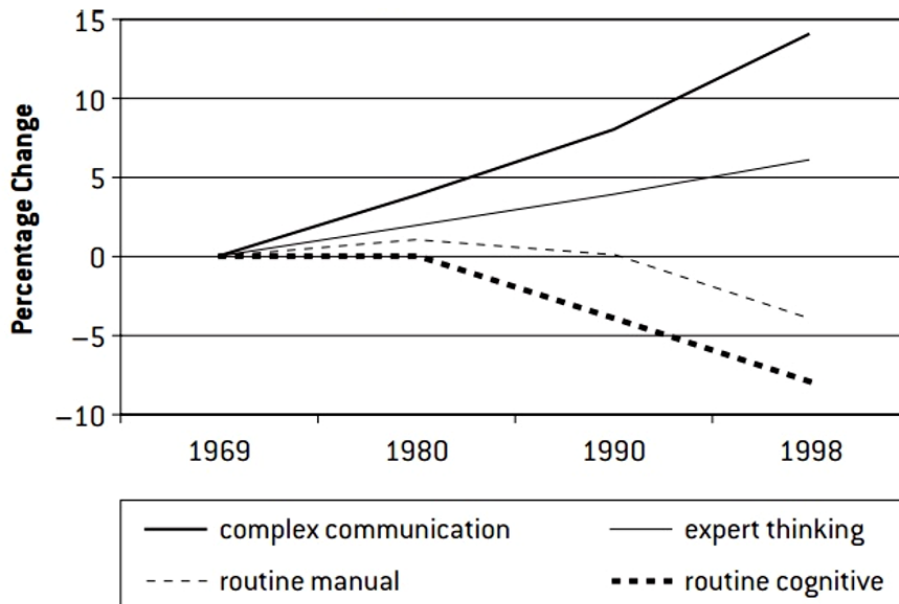
Figure 1-5 New Skills for 21st Century (Levy & Murnane, 2004)

So, complex communication and expert thinking both require the use of the ICT. As UNESCO Policy Brief (2011)[1] put it (Figure 1-6): ICT user skills are the skills that should be learned by all citizens of the so-called knowledge society in order to able for:

• Selection and application of most ICT systems and devices in an effective manner;

• Utilization of commonly used software in their lives;

• Usage of specialized tools for work;

• Flexible adaptation to changes in hardware and software.
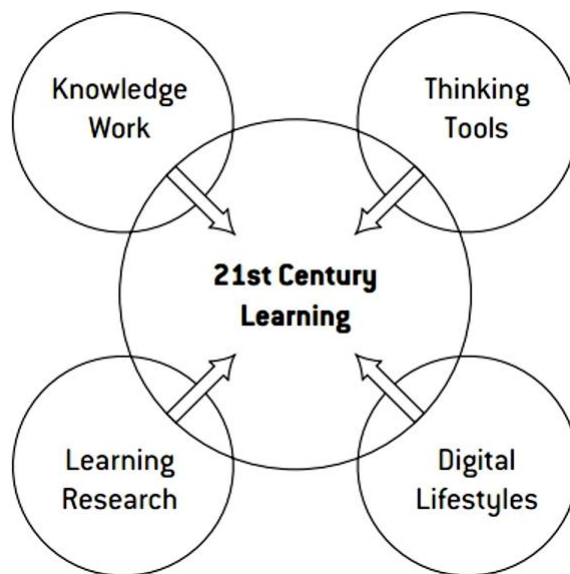
Figure 1-6 21st Century Learning Convergence (Trilling & Fadel, 2009)

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[1] http://unesdoc.unesco.org/images/0021/002144/214485e.pdf

The digital literacy requirement has to do with the ability of the person to manage, access, integrate, evaluate and use as an individual or as part of a team the current ICT along with the ability to adapt to new technologies and use it at work or at home in an effective manner. Yet this type of literacy is as important as traditional literacies that have to do with reading, writing, dealing with day-to-day mathematics and interacting socially in an acceptable manner. As Crockett (2016) puts: "No pupil in the history of education is like today's modern learner. He or She is a complex, energetic, and tech-savvy individual"[2]. So, schools need to be prepared to utilize ICT in their education because, according to OECD Report (2015), ICT is a major component of economic growth in all OECD countries. Given that young people today need to be skilled in using these technologies as students, job-seekers or workers, consumers and responsible citizens, all who have no access to or experience in using ICT will mostly have it increasingly difficult to participate fully in economic, social and civic life. However, basic ICT skills may not add value unless they are paired with cognitive skills and other skills, such as creativity, communication skills, teamwork and perseverance. Every school needs sufficient ICT resources to help students both to learn how to use and benefit from these technologies and to acquire new knowledge and skills, and in other subjects, through using them. ICT can also help teachers and school administrators to work more efficiently and effectively. A distribution of resources across and within education systems has long been an important issue for both equity and improvement in education. Given the rapid advances in technology, and the central role ICT plays in all aspects of life, education policy makers need to consider ways to ensure that ICT resources and students' access to those resources are provided to them equitably within all educational systems.

1.5. ICT and Motivation

Computers are widely considered innovative in classrooms, raising expectations of increased cognitive learning outcomes or motivation with effects on learning in deep (Conradty & Bogner, 2016). As it is well accepted the importance of intrinsic motivation to keep students learn and develop the willingness to keep learning, yet due to the nature structure of schools and their reliance on exams for summative assessment more extrinsic motivation is used. But experts believe that ICT may be the tool needed to shift student's motivation form extrinsic and back to intrinsic. (Lawlor et al, 2016). Lawler made a research about how effective technology in promoting intrinsic motivation. Workshops were established in schools to connect learning with technology. Data was collected from hundreds of secondary schools. And the results reveal that regular student as well as students at risk who participated in these workshops had signaled an increase in their intrinsic motivation to learn (Gan, 1999). Malaysian at-risk students were trained in using internet and computers for search

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[2] https://globaldigitalcitizen.org/21st-century-skills-every-student-needs

activities. These activities were structured to include, positive interdependence, individual accountability and interaction. The results of the study found an improvement in motivation, learning attitudes, self-confidence, and academic achievement. However, Madrazo (2010) pointed out that student motivation will be high if the technology applied was used in a creative way like video editing, IPod self-pacing, and web 2.0-project collaboration. It is not enough, therefore, to simply place work on a laptop, teachers must think of different ways to shift their deep-rooted preferences for worksheets, lecture, and assessment to include in their plan's alternative approaches to learning through meaningful creation, in social media, and in project driven curriculum. But for successful integration of ICT, the curriculum should be designed based on the students' learning preferences or prior knowledge, which is manifested as in Sun & Lee (2016). This study tried to find out the best teaching strategy for best motivation and achievement, but it differentiated between students with initial high motivation before conduction the study and students with lower motivation. The results were consistent with initial projection that the use concept maps on tablet PCs improved the student motivation but only for students with initial high motivation. Yet there was significant importance to the instruction design, student's relevant knowledge, and the integration of easy and fun to use technology. Gan (1999) research showed that Malaysian at-risk students trained in information-technology skills were made to lead cooperative-learning groups engaged in computer-search activities. Activities were planned to include student responsibility, positive interrelationship and interaction, group processing and collaborative skills. The following were improved: motivation, self-confidence, learning attitudes, and achievement. These results are also supported by BECTA (British Educational Communications and Technology Agency) documents (2009) where researchers have pointed to well-designed use of technology benefiting, for example:

• Improved learner effectiveness or performance gains;

• Enhanced learner efficiency;

• Greater learner engagement, motivation or satisfaction;

• More positive attitudes to learning.

1.6. Blogs what are they?

Blogs is one of the types of digital composing. Scientific literature establishes connection between digital composing and many positive attitudes like iterative writing. So, it provides students with new avenues to express themselves easily, to send and receive feedback along with scaffolding. Students may not necessarily engage all these advanced methods or revising activities and reflective composing (Hashemi, 2016). In fact, it is a vital tool to share and discuss information in real-world problem-solving (Thohir et al., 2020). Additionally, Sim and Hew (2010) have defined blogs as "personal web pages, or internet-based pages" which have mainly four features: "updates that are

displayed in a reverse chronological order, hyperlinked post pages, individual ownership, and archival of all posts". On the other hand, Edublogs.org defined a blog as (a blend of the term "web log ") which is a type of website. Blogs are usually maintained by an individual or set of known individuals with regular entries of commentary, list of descriptions of events, or other material such as graphics or video. Entries are usually displayed in reverse chronological order (figure 1-7.) Additionally, blogs usually are interactive based Web 2.0 technology which allows visitors to leave comments and even send messages to each other. So, this interactivity is what differentiates them from other static regular websites.
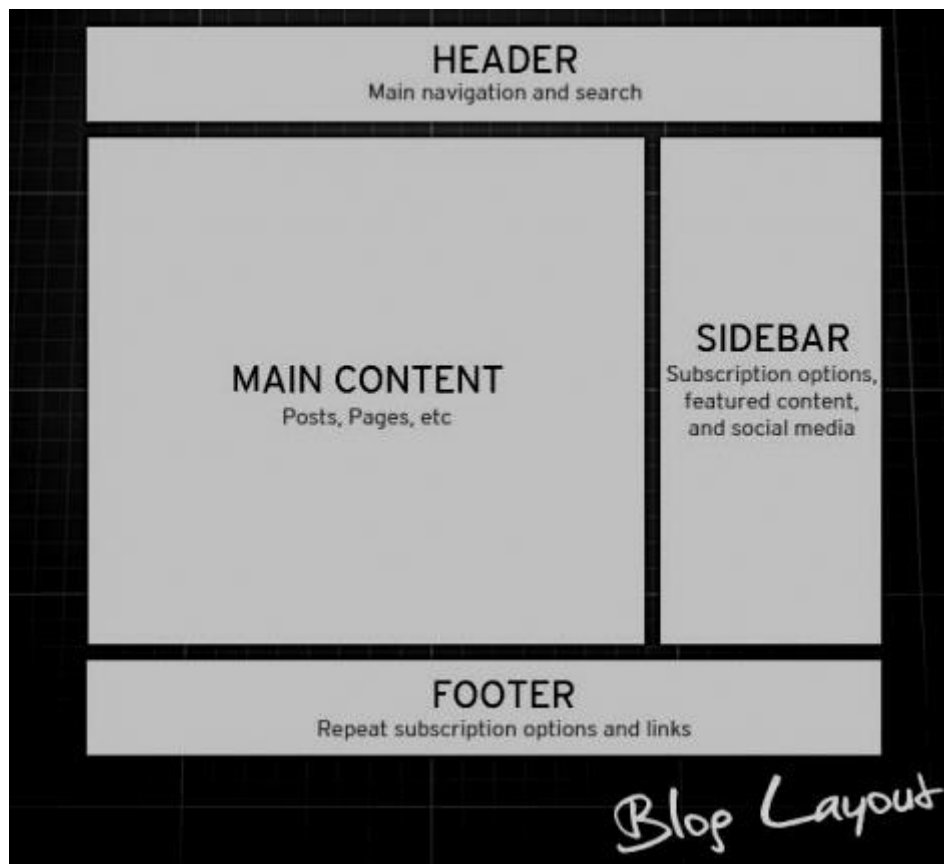
Figure 1-7 Anatomy of A Blog

(Source: http://edublogs.org/files/2010/09/WhatIsABlog.pdf)

Blogs are used to gather information related to a particular topic; they can be used as course management tools, as personal journals to record information on life events or other events; or they can be used as communication and interaction tools, or even as an assessment tool. Blogs can also be seen as internet-based diaries or e-portfolios that facilitate interactive computer-mediated communication through media types such as regular text, static or animated photo, audio and video (Agarwal et al., 2012). So, blog assignment might improve students' composition and other outcomes (Hembrough, 2019). Hence, a blog is a publishing tool which enable user to show the world

immediately his/her thought and ideas expressed in multimedia format. So, blogs are internet electronic diaries composed to target audience (Li, 2005). So, there are seven main reasons for blogging: enhancing writing, self-documentation, organized information, self-expression, passing time, medium appeal, and socialization (Li, 2005). In a blog created for educational purposes students and teachers can use blogs for different reasons, like learning journal, or for recording personal everyday life, or as knowledge web log, or for communication with others, or for expressing emotions and feelings, or as an assessment tool or task management tool (Sim & Hew, 2010). As Bener and Yeldiz (2019) showed that Blogs had significance for their potential contribution to improve the professional development of trained teachers and the integration of technology into a class-based teacher training course. So blogging is beneficial for both teachers and students where blogs can be divided into two main types: Teacher's blog and student's blogs. Teacher's blog is where teacher insert his own version of the curriculum gradually, dynamically and puts assignments for students throughout the semester. The gradual insertion of the curriculum is important for the sake of the pedagogic learning for students and in order for them to grasp the educational material slowly and gradually. The dynamic nature of blogs enables the teacher to instantly change the educational material given to students according to his/her own judgment and based on the current learning level of students, hence, the teacher has the ability to modify the curriculum instantly which was never before available with curriculum that is based on books or printed materials which require enormous time to print or modify. In fact, in some experimental assignments the modification may be within the current educational session and based on the formative assessment obtained from students. Whereas students blog is the student collection of his own work that could be answers to specific assignment or it could be his or her own work within specific period of time. The work inserted in the student blog could be accumulative which enables the student to consider as his/her own accomplishment help him/her reflect on his/her work and hence deepen his/her own learning.

1.7. Blogs and Motivation

Lin et al. (2007) examined an electronic portfolio design based on blog services and program called blog folio. Research results showed that many students expressed the feature of easy to use and their willingness to maintain their portfolios in their personal blogs. Portfolios using Web 2.0 technology can be maintained much easier and updated much faster. It can include multimedia files like graphs and audio/video clips. It's also much easier for teachers to view blog folios to many students and provide feedback to all of them. Teacher can subscribe to RSS reader in order to get immediately updates about new additions in students' portfolios. It was also confirmed in literature that collaborative learning has positive impact on students learning, so viewing peers' portfolios and inserting their comments within can be considered as one type of collaborative learning where

students have a model to reflect upon and learn from. Building a portfolio with personal style in simple steps will improve students' motivation and while maintaining their portfolios. So, blogs can be used as an additional source of information to promote achievement and knowledge acquirement for students. It can also be used for researching, and sharing information in a knowledge society (Tekinarslan, 2010). The results are also supported by the research conducted by Hume (2012) where there was an extensive research done on the effect of blogging on student learning. The study examined the use of blogs as the main source of learning and reflection. Students were able to move from single loop learning to double loop learning with reflection. Hence, there was an improvement in learning and reflection for students, and an increase in student satisfaction. There was also improvement in both individual and over all class learning. "Reflection is an important human activity in which people recapture their experience, think about it again, mull over & evaluate it. It is this working with experience that is important in learning" (Boud at al., 1985). As Tate & Sills (2004) put it: "We learn through critical reflection by putting ourselves into the experience & the exploration of personal & theoretical knowledge in order to understand it & view it in different ways".

Not to mention the advantage that blogs bring to classroom in terms of promoting "differentiated instruction for diverse students" in order to promote individual learning which had a lengthy research by Colombo & Colombo (2007). In that research they discussed how the instructional impact of science teachers can be extended by the use of blogs. This allows teachers to "differentiate their instruction for students with diverse needs". It is easy for teachers to establish class blogs that contain multimedia along with text on any subject. The s discussed how to use blogs to improve differentiated instruction for wide range of different types of students.

1.8. A Blog as an E-portfolio

Regular paper portfolios have been used for decades to assess student work for performance and employment. Despite the growing number of institutions using the e-portfolio, educators do not agree on a common definition for it. Jenson & Treuer (2014) define the e-portfolio as a tool for documenting and managing one's own learning over a lifetime or a time-period in ways that foster deep and continuous learning. The advantage of electronic portfolios is its ability to incorporate multimedia and hyperlinked text along with ease of use, ease of posting, and ease of modification. It promotes the use of 21st century skills. All levels of education must try to integrate 21st century teaching strategies to meet the needs of these different learners (Jenkins et al., 2011) such as the computer use. Using e-portfolio system positively had influenced some subjects. It encourages students to use computers, to reach wide range of information on virtual environments, to assess themselves and to monitor their progress in computer skill, and their development in general (Karademir et al., 2016). "E-portfolios provide a creative way of organizing, summarizing, and

sharing student intellectual artifacts, and demonstrating evidence of students' professional knowledge-based growth" (McBride et al., 2015). Educators and evaluators can use these easily accessible portfolios to assess student performance while the portfolios themselves permit rapid and immediate inclusion, reconfiguration, and organization of portfolio data by the owner of the blog. Electronic portfolios are also useful to measure and assess student learnings. In fact, E-portfolio adds value in students' learning deeply and keep them motivated and engaged. It also acts as a medium to involve parents, promote students' self-esteem. It is acknowledged not only as "a valuable assessment tool but also a challenge for the school community in general" (Theodosiadou & Konstantinidis, 2015). As there are many blogs hosting sits that user can choose from, user should recognize his needs and requirements in order to choose the best suited provider (Papp, 2014). It should be noted, though, that the use of blogs as portfolios in schools had enabled students to be authors of their work and were able to reflect upon their work (Karlin, 2016). In Blaustein and Lou (2014) an extensive review went underway for the scientific literature published between 2004-2013 which explored the effect of blogs as e-portfolios on students' performance, their self-regulation, their engagement, and their motivation. The results showed:

      1-E-portfolios were related to self-regulation and motivation

      2-They have many benefits on learning, academic achievement and motivation

      3- E-portfolios when used need to be student-centered, offer user control in some kind, and require full user commitment and planning. The e-portfolio then can be used as a digital storytelling instead of the PowerPoint e-folio (Ferguson, 2017). It also can be used as an innovative way of improving language skills through the PC or through mobile app technology in EFL (English as a Foreign Language) settings. Hence a project was designed based on the targeted purposeful and meaningful mobile learning and collaboration in order to maximize language production and in order to integrate all language skills–reading, writing, speaking, listening and translation, with student's active engagement in planning, thinking, discussing, and interacting through a series of tasks via the social media WECHAT platform. E-portfolio was used as a mean of supervision and assessment. The results showed that students made significant progress in producing language (Sun, 2017). There are also similar results from Awada and Gutie´rrez-Colon (2019) where they showed that the use of cooperative learning instruction through the use of blogs in culturally mixed groups had improved the intercultural communication competence and it had decreased intercultural communication apprehension among language students. In addition, blogs can be used for pre-service teachers as in Savage (2016) where the research attempted to examine the usage of blog as e-portfolios for pre-service teachers and the effect of these blogs on their self-reflection during the learning process. The results had affirmed the importance of blogs as e-portfolios and the elevated steps of self-reflection for these pre-service teachers (Savage, 2016). But what should administrators, students, teachers, and

faculty expect when implementing e-portfolios in their program or course? Instructional orchestration, pedagogical goals, stable infrastructures, curricular integration, procedures for portfolio development, as well as feedback and flexible assessment processes differ across institutions, programs and courses (Panke, 2014). For instance, Ching et al (2016) shows the importance of discipline-specific framework in order to guide students' reflection of learning. When e-portfolios are used as summative assessments for degree programs, although students must demonstrate their knowledge in the field as evidence of learning and achieving the results expected by the study program. For the evaluation of students in the field of educational technology (ET), pedagogy and content knowledge elements (TPACK) through e-portfolio, using instructions based on the TPACK framework, the results showed that students demonstrated their skills related to technological pedagogical knowledge accumulated and had positive reactions to the opportunity to write the reflection work. This demonstrated the importance of creating a discipline-specific framework for guiding students in their reflection on learning (Ching et al, 2016).

Possible Disadvantages:

There is careful consideration in implementing e-portfolio as the misuse of it may hinder education, as Chau & Cheng (2010) put it: "Although in theory e-portfolios are believed to yield benefits for learning, in practice e-portfolio use may often lead to confusion and frustration". E-portfolio not only has traditional problems, such as reliability and validity, but it also brings certain technological problems, such as poor computer skills students have, and technical concerns for adopting e-portfolio (Chau & Cheng, 2008)

Programs and platforms:

There are many programs and platforms that can be used to create an e-Portfolio, Mahara is an open-source e-portfolio web application that allows users to keep a portfolio online by creating, uploading and linking content. This way learners can provide each other feedback on their portfolios and collaborate in groups on common projects using forums and creating group portfolios. Mahara was being used from primary school to university, as lifelong portfolio beyond and also in career services (Hoeppner, 2011).

Another program for creating e-portfolio is integrated an e-portfolio application on Facebook, which is the most used social application on the internet. In Baris & Tosun (2013) the research examined how students reacted on using e-portfolios to post their homework assignments. In fact, students had shown their original work and were serious in posting the best they have by developing their own skills. They had positive attitudes in using this technology and low-grade anxiety. So, the overall reaction had enhanced student's viewpoints and achievements. (Baris & Tosun, 2013).

A tablet device was used by Morimota & Suzuki (2015) since most current e-portfolio programs are not designed for K-12 education. Therefore, they proposed an e-portfolio framework for collecting and using K-12 student learning records with a tablet device and developed an e-portfolio system based on this initiative. Evaluation from a free-description-type questionnaire particularly had demonstrated that using their system enabled students to continue their learning with future prospects, they were able to reflect on their learning, and to enhance their motivation of learning (Morimota & Suzuki, 2015).

1.9. Teacher efficacy and Students Blogs

Self-efficacy, also referred as personal efficacy, is confidence in one's own ability to achieve intended and planned results (Ormrod, 2006) and it's related to effective learning (Table 1-2.).

Table 1-2   How to deliver the effective learning process (Dumont et al, 2010)

Learner-centered	The environment should be focused on learning as the principal activity, not as an alternative to the critical role of instructors and other learning professionals but dependent on them.
Structured and well-designed	To be "learner-centered" means it requires careful design and high levels of professionalism. This leaves room for inquiry and autonomous learning.
Personalized	The learning environment need to be sensitive to individual and group differences in background, to prior knowledge, to motivation and abilities, and needs to offer tailored and detailed feedback.
Inclusive	It needs to take into consideration individual and group differences, including the weakest learners, and it needs to define an educational agenda that excludes no-one.
Social	Learning will be effective when it takes place in group settings, when learners collaborate between each other as an explicit part of the learning environment and when there is a connection to the outside community.

Bandura (1977) introduced the concept of self-efficacy beliefs as a "self-assessment of a person's abilities to attain a desired level of performance in a given endeavor". He assumed that that one's belief system affects his motivation, and his persistence to keep moving on against the forthcoming challenges. Several researchers had applied the emanated theory across many fields including the student-teacher relationship (Albion, 2001). According to Schacter & Thum (2004) and Eide et al. (2004) both researchers and policy makers argue the important role of the teacher in the

student achievement, having the greatest effect on their performance (Schacter & Thum, 2004; Eide et al., 2004). Research literature has shown a connection to efficacy and student achievement through its influence on teachers' performance (Prelli, 2016). Developing a high level of efficacy can be a challenging task to teachers who work with low-achieving students (Wang et al., 2017), so "adequate self-efficacy is useful for motivating individuals to engage in continued improvement" (Elstad & Christophersen, 2017). Many of the drop out students' who participated in the Bridgeland et al. (2006) focus-group study doubted that their teachers were interested in school or student learning, and felt that they were more concerned with completing their workday than in teaching class. Empirical research has in fact demonstrated that teachers' expectations do indeed affect both grades and students' likelihood of dropping out of school (Kaufman, Bradbury, & Owings, 1992). It is also claimed that when a student perceives the attitude of his teachers as being caring and fair, that the curriculum as being relevant and interesting, and the learning process as being suited to his needs, then the ground is laid for a significant healthy relationship between the teacher and student, and for a shattering of the alienation that marks dropouts and disengaged students (Cohen-Navot et al., 2001). In fact, teachers who are effective are essential for disadvantaged schools as well as for the low-achieving student:

(1) These types of teachers have positive impact on student performance as documented in scientific literature. Not only this, but they are capable of bridging the differences between advantaged and disadvantaged students.

(2) They have the ability to help low performing student to enhance his academic performance. "Research has also indicated that a perception of connectedness to teachers and student peers in school is associated with multiple indicators of academic motivation and engagement, especially emotional engagement" (Wang and Holcombe, 2010).

So, disadvantaged students and students in general will have fewer disciplinary problems and will learn more when they believe that their teachers are here for them in order to succeed in their academic life. When students feel appreciated by their teachers and are not afraid of being compared to their peers, they are more likely to have a positive connection with their school, to use cognitive strategies that will contribute to their academic success, giving them confidence in their ability to learn. "Specific school measures may include the use of positive feedback, formative assessment and reinforcement" (Harrop & Swinson, 2007), which also means individualized attention (Levin, 2008), which is very important for students who have no other support.

1.10. Teacher Efficacy and Motivation

The scientific literature asserts that "classroom teaching and learning practices are the most critical factor in the achievement and engagement of students" (Black, 2007). According to Williams & Williams (2011) there are five key ingredients which impact student motivation:

Teacher, student, method, content and the environment. Hence teachers should be well trained, dedicated, inspirational as well as be able to control education. While students need to value education and they should have the interest and the ability to learn. The instructional material needs to be pertinent and relevant to students. It must be clear, and accurate. The method needs to be inventive, inspirational, and far from making students bored. The school environment needs also to be safe and accessible to all students. Hence, the more of the above conditions are met regularly the more the motivation will rise.

How teachers can enhance students learning:

1 - Goal Setting: Research literature indicates that teacher's ability of goal-setting is an effective way to enhance academic engagement. However, teachers ultimately feel unprepared to include goal-setting instruction into academic content in order to support active student engagement (Rowe at al., 2017).

2- Defining Rules: Teachers need to define rules in order to clarify their expectations. This will facilitate student's engagement through their feeling of competent. Also, the belief of students that their teachers are here to support their learning will also make them more engaged in learning through the sense of belonging that was generated (Thijs & Verkuyen, 2009). So, when teachers define clear objectives, communicate expectations, give guidelines and monitoring work development, respect students' rhythm all are important issues in order to create secure environments, where students can develop a perception of belonging and interpersonal meaningful relationships, which also mean a sense of competence that will affect their engagement (Thijs & Verkuyen, 2009).

Collective Teacher Efficacy:

Professor John Hattie ranked collective teacher efficacy as the most important factor affecting student achievement (Donohoo, 2016), it has its own conditions as shown in Table 1-3. where collective teacher efficacy refers to the collective self-perception that teachers have that they can positively affect the academic lives of their students (Tschannen-Moran & Barr, 2004).

Table 1-3   Three Conditions that enable collective teacher efficacy to grow and flourish (Donohoo, 2016)

Three Conditions that enable collective teacher efficacy to grow and flourish	
Advanced teacher influence	• Extent of teachers' leadership in a school matter. • Teachers provide greater autonomy and influence over important decisions.
Goal consensus	• Clear sets of goals. • Consensus occurs between teachers. • Overall commitment to achieve these goals.
Responsiveness of leadership	• They help teachers to carry out their duties effectively. • They show responsive, concern and respect for their staff. • School leaders protect teachers from issues and influences that distract them from their teaching time or focus. • Responsiveness of leadership requires awareness of situations.

Research literature in education and psychology also contribute to an understanding of how educators create contexts for school learning that encourages intrinsic motivation and increase academic achievement. Teacher motivation is influenced by many factors like curricular, relational, and logistical factors. Findings in Daniels (2016) reveal that the master schedule, organization of time and the condition of the physical environment play a major role in whether and how teachers are motivated. Also, according to Abazaoğlu & Aztekin (2016) in research conducted in Singapore, Japan, Finland and Turkey, the morale and motivation of teachers play a significant role in the results obtained by students in the field of science and mathematics. This is in line with the study conducted by Korur (2001) in Turkey, where he studied the implications of the quality of science teachers on the attitude, motivation and results obtained by students. The study showed that the biggest influences were related to the pedagogical training of teachers, the preparation of lessons as well as the motivation of teachers.

1.11. Conclusion

Blogs are educational tools that help students, especially students at risk, learn better. Students at risk are students who are in danger of not meeting educational goals such as graduating from high school or acquiring the skills needed to become contributing members of society. The studied research shows how feelings of autonomy, goal orientation and task value are all related to improve in motivation among students at-risk and also students in general. Yet ICT are considered a big factor in making positive changes in educational and pedagogical outcomes. This will support students' acquirement of the knowledge and skills needed to succeed in the knowledge based 21st

century society. The graduates of secondary school must have these skills for the digital literacy requirements (i.e. ICT skills, critical thinking skills, and ethical skills). Web 2.0 applications such as blogs will enable students to acquire their digital literacy. There are two main types of blogs in school environment: class blog and student blog, each has its own setting. Using class blog in the classroom can help improve students' learning using each student's preferred learning style, their engagement and their personal interest. Using student blog has many advantages such as it encourages self-reflection for the student and critical thinking. When using student blog, the students' iterative writing will be enhanced as their abilities to express themselves, to get feedback, and this will enable scaffolding. Generally, teachers can motivate their students through their relationships either with students or through their selection of instructional methods. Their selection of assignments in class blog, their follow up, and their feedback for student's blogs lead to successful deployment of blogs in formal education.

This chapter addresses the importance of blogs in formal education. It clearly differentiates between class blog and student blog. It also addresses the conditions recommended for its best deployment for students at risk.

Chapter 2: Research Methodology

The objective of this chapter is to present the path through which the research is conducted by designing the methodology of the research approach based on different types of research techniques. So, the chapter presents the path from the problem statement to the solutions obtained by describing how the research outcomes will be reached in line with meeting the proposed objectives.

2.1. Introduction

The thesis is an exploratory study regarding the use of ICT tools like blogs in a project management approach in teaching and learning for the case of students at risk.

This type of research enables the researcher to build a base for exploring his ideas, choosing the adequate research design and identifying the variables of the analysis. Also, the results of research can help other researchers enabling to know if it's worth pursuing.

The author of the thesis started from the idea that the introduction of blogs can be useful to reduce the dropout rate of the students, raising the level of their motivation to learn and further explores the introduction of the elements like Gamification, Google Analytics and Augmented Reality for the students at risk case.

2.2. The Research Design

The research overall design is presented in Table 2-1

Table 2-1 Research design

Aim of the research	To explore the use of class blog in a K-12 classroom	
Solution	The use of blogs, Google Analytics, Gamification and PBL in STEM subject along with Augmented Reality	
Objectives	**Research strategies / methods / tools**	**Results**
O1: Synthesizing the main theoretical and applied approaches that allows the correct substantiation of the students at risk issue based on previous results with reference to the role and importance of ICT tools, blogs especially in increasing students' motivation in teaching and learning	Literature research On-line research Data Analysis	Identifying the premises of using blogs and the importance of motivation in teaching and learning for students at risk

O2: Integrating Google Analytics and Gamification into blogs in teaching and learning.	On-line research Data Analysis Comparative analyze (Blogger-Drupal) Inductive reasoning Qualitative methods based on: -Interviews (presented in Appendices 3-3 and 3-4; 4-5 and 4-6) -Case study research Quantitative methods based on Google Analytics. Comparative analysis (with/without Gamification)	Blogging tool selection Google Blogger. Framework for Gamification (G) and Google Analytics (GA) using teacher and students' blogs. Students' perceptions and outcomes in using the class's blog without G-elements and using the class's blog version with G-elements. Approach that integrates Triple Loop for learning and PDSA cycle
O3: Identifying the proper project management approach for implementing the approach that integrates GA and Gamification into blogs in teaching and learning	Literature research On-line research Observation Qualitative methods based on interview Appendices 4-5 and 4-6)	SCRUM implementation for the Blogs-based Approach in Education Integrating Analytics and Gamification
O4: Exploring Augmented Reality (AR) Integration in Blogs in teaching and learning	Literature research On-line research Observation (Appendix 5-1 and Appendix 5-2) Interviews	AR based Blogs Approach AR based e-Portfolio AR Engine Based Blog

Using blogs in the context of the research

The blogging tool selection was made by a comparison between Google Blogger and DRUPAL

A blog is defined by the National Centre for Technology in Education[3] as a very simple webpage where the entries (or posts) are organized in reverse chronological order which means the newest post will be up first and so forth. There are also possible educational uses from a teacher's point of view, a teacher blog can become a class notice board, or an archive of links and documents or as a collaboration or discussion tool with his/her students. On the other hand, the blog can also be used by the students as a learning reflection tool since blogs can encourage students to write and also to read on a topic they wish to comment on. Bloggers on the internet continually search, filter and post ideas and information which engage higher order thinking skills like self-reflection. As blogs are open to the world through internet in the same way as websites, it is possible to allow comments from the readers and to get feedback about the posts. Hence, students can use this feedback in order to improve their work. Additionally,

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[3] https://www.pdsttechnologyineducation.ie/en/Technology/Advice-Sheets/Blogs.pdf

there is evidence that blogs can provide space for bloggers in order to communicate, externalize their reasoning, reflect, and organize their thoughts into structured, coherent posts (De Andrés Martínez, 2012; Xie, et al., 2008). Many blog sites like Google Blogger also make it very easy to embed video, audio. It is also possible to attach word processing documents, spreadsheets and pdf files into a blog. Now the advantages using blogs are striking, for example, according to bluelist.co[4] the statistics for 2019 reveal that the companies who blog, receive 97% more links to their website. Blogs also have 94% more views when using images in posts. By 2020, US bloggers have reached about 31 million readers. 95.9% of bloggers use social networks to promote blog posts. Also, 57% of marketers have gained customers through blogging. Yet when it comes to options there are many blog sites to choose from: According to Schaferhoff (2020) the best blogging sites include Google Blogger, WordPress, Wix.com, Joomla.com, Medium.com, Ghost.org, Squarespace.com, Weebly.com, and Tumbl.com. Out of all these ten blog sites Google Blogger stands out to be the free simplest to use, and language friendly (for Arabic and Hebrew languages in this research), and because of its simplicity Google Blogger can be used as a blogging tool for young students, as young as first graders (Cappali, 2015) like post for blended learning in a first-grade classroom. So, no wonder that Google Blogger is the second most popular in Israel in blog category[5]. And when it comes to simplicity it takes just a minute or less to start a blog through Blogger. Blogger can offer a nice selection of colorful themes and templates to choose from. Customizing the layout of the blog is as easy as dragging and dropping elements into place. The user can add additional authors to his/her blogs. And there are mobile apps for Blogger so the user can post to his/her blog via email. Once the user has a Gmail account, he/she already have a Blogger account. He/she just needs to sign into his/her Gmail account and in the top menu he/she selects Blogger from the "more" drop-down menu.

Google Blogger is very popular for that reason many well-known universities made user manuals for their students to use it like the manual made by University of San Francisco about using blogger[6]. Also, the University of Minnesota made similar guide for the students to use Google blogger[7]. Also, Western Illinois University made a paper about eTools: Google Blogger as an Online Discussion Tool[8]. University of Michigan made instructional materials about google blogs [9]. Also, Princeton Public Library made similar manual as an introduction to blogging with Google Blogger [10]. The IEEE (Institute of Electrical and Electronic Engineers) made similar paper about online discussion-based learning on Google Blogger for Introductory Programming Course for first year engineering

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[4] https://bluelist.co/blog/blogging-statistics/
[5] https://trends.builtwith.com/cms/Blogger
[6] https://myusf.usfca.edu/sites/default/files/cit-createBlog.pdf
[7] https://it.umn.edu/using-google-blogger
[8] https://www.natcom.org/sites/default/files/pages/eTools_Google_Blogger_May2016.pdf
[9] https://lsa.umich.edu/sweetland/instructors/teaching-resources/using-blogs-in-the-classroom.html
[10] https://princetonlibrary.org/event/introduction-blogging-google-blogger-1/

students[11]. In 1999, Jennifer Wagner, a well-known educational consultant hosted her first online project and as of March 2013, over one million students have participated! Jennifer advocates the use of Google Blogger for students[12]. And for that reason, many manuals and instructional materials were made to encourage using Google Blogger in schools and classrooms like the Complete Guide to Using Blogger in School by Richard Byrne[13] or like the manual made about "Should We Be Using Blogger in The Classroom for Student Writing Projects?" [14], or like: Google Blogger in Classroom: Let Me Count the Ways"[15], and "Google blogger for the classroom"[16]. Additionally, Jamie Fithian mentioned Google's Blogger as a great option among other blogging applications for students like Weebly, wix, WordPress, KidBlog, EduBlog, and SeeSaw[17]. Hence, Google Blogger can be used as an effective instructional strategy (Moore, 2014). It is a type of integration of cloud technologies in digitally networked classrooms and learning communities (Gurung, 2016). In Table 2-2 a comparative analysis between Drupal which is a popular application of a Content Management System (CMS) and Google Blogger is presented.

Table 2-2   A comparative analyze between Drupal and Google Blogger in the context of the research

	Drupal	**Google Blogger**
(1)	Drupal is a free and open-source CMS based on nodes and modules for multiple users with built in multi-level security permission[18].	Blogger is a simple online blog site service mostly for one user created and maintained by Google[19].
(2)	Even though Drupal is free but it requires either deployment, customization, installation and maintenance, training and or registration to website service[20]	Blogger is de-centralized platform that has full support to many languages, it anticipates for individualized learning which is one of 21st century learning aspects[21].
(3)	Drupal does not support Arabic and Hebrew Fully.	Google Blogger fully support Hebrew and Arabic languages, including menus, interface, and text orientation since Arabic and Hebrew languages are typed from right to left.
(4)	Drupal can be laid out on personal servers or network servers and the user can oversee the data and own it physically	Blogger is website log made by Google, its free for all users and any one can create a blog, but eventually its owned by Google and the company is responsible to keep the web log up all the time

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[11] https://www.semanticscholar.org/paper/Online-Discussion-Based-Learning-on-Google-Blogger-Majumder/9ea615826e1bcab7b61dc94f985b6760c1719ee0
[12] http://blog.cue.org/to-blog-or-not-to-blog-part-2-about-plns/
[13] http://FreeTech4Teachers.com
[14] https://www.teachercast.net/tep42-learn-set-students-great-writers-using-blogger/
[15] https://msdrasby.com/2016/03/21/google-blogger-in-classroom-let-me-count-the-ways/
[16] https://www.smore.com/m0gdk-blogging-for-the-classroom
[17] https://www.talltechteacher.com/home/tech-tip-tuesday-website-builders-blogging-platforms
[18] https://www.drupal.org/
[19] https://www.bloggingbasics101.com/how-do-i-start-a-blog/
[20] http://www.drupal.com
[21] https://www.lifewire.com/what-is-google-blogger-1616420

(5)	Drupal is an open-source software, so the user can easily extend it to add new features[22].	Blogger is a fine-tuned program service with very limited tools allowing the user to perform specific tasks on his/her website. The things the user can do on his/her blog are limited, and there is no way the user can extend them to meet a need
(6)	There are hundreds of plugins allowing the user to modify the default feature set such as adding a store to website, creating portfolio.	Limited Plug ins for blogger.
(7)	For any business is the best long-term solution for any business owner.	Blogger is less business friendly.
(8)	There are more themes in Drupal that are custom made which allow the user to create professional websites	Blogger only provides a limited set of templates to use. The user can modify the colors and layout of these templates through the built-in tools, but the user cannot create his/her own layouts or make modifications. There are on the web some non-official templates for blogger available, but those templates are mostly very in quality
(9)	The user can move his/her site anywhere he/she wants. Also, the SEO content on Drupal is more advanced than in blogger.	Moving the user site from Blogger to a different platform is a thorough task. There is a risk that the user will lose his SEO (search engine rankings), subscribers and followers, during the transfer. Even though blogger may allow the user to export his/her content, the data will stay on Google's servers for a very long time.
(10)	In Drupal, because it is self-hosted solution, the user is responsible for security and backups. It can be self-managed or it can be through the webhosting company.	In Blogger the user has the added advantage of Google's efficient secure platform. The user doesn't need to worry about managing server's resources, or securing his/her blog, or creating backups.
(11)	Drupal has support system which depend if the system is self-hosted or hosted by a commercial company. There is online documentation, community forums, and many others forms of communication where the user can get help from.	There is limited support available for users in Blogger[23]. The users have a very basic documentation and there is also user's forum. In terms of support, the user in Blogger has limited choices since its hosted by Google.
(12)	Drupal may have more opportunity to survive because it doesn't depend on a single company decision.	Blogger has not been updated for a long time but Google has made significant upgrades to Blogger since 2016. The main upgrade that really important is the default SSL security. Any newly created Blog is automatically using a URL starting with HTTPS[24].
(13)	Drupal is hard to maintain or use because it's mostly for large institutions like universities or like the White House (i.e. whitejouse.gov).	Blogger is very easy to create and use blog for a student or a teacher.

[22] https://drupalize.me/what-is-drupal

[23] https://www.wpbeginner.com/opinion/wordpress-vs-blogger-which-one-is-better-pros-and-cons

[24] https://geeksontour.com/2017/02/googles-blogger-is-alive-and-well/

So, in summary, Drupal is a CMS that can be managed by multiple users, even though its free, but it is hard to install and maintain for a regular person not to mention lack of support to Arabic and Hebrew languages, compared to Blogger which has full support to both languages, simple to setup and install where student or teacher can create a blog and maintain it in few minutes. Blogger doesn't require technical skills and it can be used in PCs, laptops, iPads, tablets and mobile phones alike. While Drupal requires lengthy technical skills that is required to be learned, it's hard to install, deploy, and to use. Drupal is huge centralized CMS system that supports multi user support. So, for teachers and students alike Blogger is more suitable platform to be used in an educational environment that is open, easy, and doesn't need the requirement of Drupal. Research shows that the use of blogging in Higher Education is associated with numerous benefits for the student, which includes heightening connectedness among students (Miceli et al., 2010), increased understanding of course concepts, and improved knowledge integration outside of class (Halic et al., 2010). So, blog use inside and outside the classroom, even in higher education, often promotes reflection, increases the feelings of connection between class students, and promotes understanding of course content. Reading and writing blog posts, and commenting on other students' blog posts, can promote reflection by allowing blogging students or teachers to pose questions, challenge beliefs, and respond to questions and challenges (Yang, 2009).

2.3. The strategies of the research

Research usually uses different techniques in order to comprehend, explain, analyze and investigate social life issues. Denscombe (2010) argues that there is no fully acceptable strategy or methodology in research. He further adds that the research needs to be scientifically acceptable and the researchers should choose an appropriate approach for their requirements in order to answer their research questions. The term "method" is mostly used to illustrate the procedure that is used in order to collect data (Bryman, 2008). Therefore, methods are mainly techniques that are used to collect and convert data to make it understandable (Denscombe, 2010). Additionally, there are three research strategies, quantitative, qualitative and mixed methodologies that will be discussed briefly as an introductory approach to the research methodology used.

The Quantitative Research

Oates (2006) asserts that quantitative data are means, or data, which is evidence based on numbers. So, the quantitative method has been used as a strategy, which collects information that could be facts or data (Moore 2000). Martyn Denscombe (1998) adds to this definition that quantitative data "will carry with it an aura of scientific responsibility". Because it uses numbers and has the ability to present findings in the form of graphs and tables. Therefore, the data itself conveys a sense of solid and

objective research. This means that collecting data may be from participants or things, which are then translated into words (Oates 2006). Additionally, data may include different types like experiments, social surveys, observations, content analysis and official statistics (Silverman 2009). Qualitative strategy is more effective for communication projects as it investigates a variety of social issues by describing the experiences of individuals or groups (Lindlof & Taylor,2010). Yet quantitative methods have quite a few advantages as well as disadvantages (Oates, 2006; Denscombe, 2010). Quantitative research provides scientific reason. Some researchers trust the generation and analysis of quantitative data and consider it as suitable for some research requirements, especially when the scale is large. The analysis made is also based on well-established techniques and tests of significance which increase the confidence in the findings. The statistical tests that are made can also be checked by others because the analysis is based on measured quantities and not subjective impressions. Hence, the analysis is more like an objective rule rather than value or effect ascribed by the researcher. Another advantage of quantitative approach is that tables and charts used provide an effective way for the data to communicate the findings. Yet there are disadvantages exist, as the researcher has to be clear about what statistical tests, he/she will use, and what kind of quantitative data he/she requires. Additionally, decisions that are taken by researchers may affect the result like the value of the scales and the size of the group which is used for frequency counts. Also, the quality of the data is only as good as the quality of the methods which are used to collect them and the questions that were asked (Oates, 2006). In addition, Bryman (2008) and Gorman et al. (2005) stated that, quantitative methodology can be formulated by two main features; first it is a hypothesis deductive approach in relation of identifying the result which is derived from conceptual theories. Secondly, most of the scientific research papers that use quantitative methodology tend to be positivist and its reality is objective, this means that the guiding principle that claims objectivity adopts the statement that the researcher in independent of his research.

The Qualitative Research

Qualitative methods are used when describing the information is more important than counting it (Moore, 2000). Denscombe (2007) states that this type of research, can be used in a variety of disciplines such as sociology, social anthropology and social psychology." Therefore, qualitative methods are more concerned with sense and the way people deduce issues related to things. It is more concerned with the outline of actions and behavior. Additionally, (Oates, 2006) concluded that data from qualitative research also include all non-numeric words, like images, interviews, sound content, researcher diaries, and historical documents. Denscombe (2007) listed three distinguishing features of qualitative research. First, the information is grounded in reality, which means that the data has its basic roots in the subject of social existence. Secondly, the data is usually rich and detailed, which

means that the information is in-depth and comprehensive. Thirdly, the results may have an alternative explanation, this means that different researchers may reach different conclusions and both are equally valid at the same time even if they may have different conclusions.

Yet, some researchers may need to use both qualitative and quantitative methods at the same time in the same research which called in this case mixed methodology. Denscombe (2007) argued in that situation that the distinction between both approaches has to do with how to relate to treatment of data, rather than the research methods. Additionally, Denscombe also had mentioned that "In the theory, these two approaches are not mutually exclusive," which means that from the theoretical point of view, they cannot be separated from each other. One basic difference between qualitative and quantitative research is with the methods that are utilized, the scale, the technique of gathering data for the given research and the paradigm held which might be in different epistemology, ontology and methodology (Blaikie, 2000). Yet normally, quantitative methods are more concerned with positivism and epistemological research whereas qualitative methods mainly represent the interpretive approach (Orlikowski & Broudi, 1991). Furthermore, quantitative methods are usually used when the information in the research has a statistical hypothesis which is frequently applied to a large research sample while qualitative method usually involve small numbers of participants (Denscombe 2010). Yet Creswell (2009) argued again that associating the problem of the research with the characteristics of each method would eventually lead to choosing the appropriate method. Not to forget also that qualitative method is considered suitable for the exploration and the analysis of relationships and concepts for the research (Oates 2006). In addition, Strauss & Corbin (1990) stated that "qualitative methods may be used to uncover and understand what lies behind any phenomenon about which we know little about" which explains the need to explore the phenomena and study it in-depth in order to get deeper analysis that enhance our understanding.

So, for this research qualitative methods are suitable to describe, explain and analyze the data. Denzin & Lincoln (1994) stated that qualitative research is a multi-method in focus, which involves an interpretive, naturalistic approach which attempts to make sense of or interpret phenomena in terms of the meanings people bring to them. It involves the study and use of a collection of a variety of empirical materials like case study, life story, personal experience, introspective, observational interview, interactional, historical, and visual texts.

Another significant reason to choose a qualitative strategy in this research is the scale of this study, which involves a small group of learners. So, statistical approaches to analysis are not needed. Additionally, in educational inquiry, qualitative research usually aims to improve the depth of interpretation of the data which is provided by the learners which means for instance integrating new methods of instruction into the classroom. Hence, it has also been mentioned that the qualitative method is "devoted more to developing an understanding of human system in general, such as a

teacher using technology with his or her students inside formal classroom". (Spector, 2008) This research is aimed to conduct empirical inquiry with groups of learners. This will require the use of different instruments in order to cover different perspectives like attitudes, knowledge, skills and in depth.

2.4. Research Methods

There is a need to choose a method which will assist in achieving the objectives of the research. Oates (2006) categorized research strategies into six types: survey, experiment, design and creation, case study, ethnography and action research. He believes that all of these strategies could be used in different types of research and since interpretive information is also needed. Each one of these types has special features which make them appropriate for particular issues. So, a number of tools are used to interpret paradigms like questionnaires, observations, structured and unstructured interviews, recording different types of data, and gathering and analyzing it. Thus, selecting the instruments and tools for any research is an important task that normally is based on the nature of the research, the requirements of the data and other proven ability to deal with data in previous parts of the research. Yet Denscombe (2010) has strong arguments regarding the issues under investigation which improves results obtained especially when data is gathered using more than one instrument. Consequently, researchers usually use more than one instrument to ensure the reliability of their data. Furthermore, Clark & Mayer (2011) agree with integrating the previous instruments when researchers investigate situations like whether students learn better with technology because there is a possibility that one of the participants may express more than one opinion that concerns the same issue.

So, in this research the data collection tools that will be used are: case study, interviews, observation, and data analysis. When it comes to case studies, they are used when there are unknowns or when very little knowledge exists about the factors of the inquiry (Benbasat et al., 1987). This explains why qualitative methodology is naturally linked to case studies since it allows the researcher to perform an in-depth exploration of the given issues. Oates (2006) believes that case study uses a variety of data generation methods where the main aim is to obtain rich details into what he calls it "the life "of that case and its complex relationship and processes. Hence, it is possible to use interpretive case studies like current study, because it provides a way to conduct an in-depth investigation by adapting multi-instruments, which is similar to action research and unlike the multi-repeated methods.

2.5. Data Collection Tools: Observation and Interviews

Observation is one of the main strategies for collecting data in qualitative studies (O'Hanlon, 2003). The researcher in this case will be in a position to observe, record and collect data from participants, so it is a method by which live data could be gathered from live situations (Cohen et al., 2007).

Additionally, it is possible that participants may not give accurate or complete set of information during interviews regarding specific situation, hence, observation may provide the possibility for the researcher to correct or 'fill any gap' in the information that has been acquiring. Moreover, observation provides the researcher with the ability to acquire a different perspective and a wider view with deeper understanding of results obtained using different instruments. For example, in this study, the researcher observed the learners' actions during Agile embedded in the blogs approach for education and nine different observations were obtained and compared across semi-structured interviews to students and teachers. This will gain wider understanding for their actual attitudes, since judging their actions through one method does not provide all the required data from participants.

Cohen et al. (2011) suggested three types of observations:

1. Structured observation where the researcher has a full list of data that need to be collected. Yet, it "is very systematic and it enables the researcher to generate numerical data from the specific observation"

2. Semi-structured observation is when the researcher has a small number of concepts and he/she is therefore collecting data to clarify specific issues.

3. Unstructured observation where the researcher intends to observe, then to decide later on what information is relevant and more important for the research

Patton (2002) had noticed that observations in combination with interviews will provide researchers deeper understanding of the field of inquiry. Furthermore, obtaining information from different sources will improve the prospect of getting acceptable validated data.

The advantage of interviews over observation is when data collected cannot be gained through mere observation: an example is like when the data retrieved is based on participants' feelings, or like when there is a need to collect data related to the opinions or perceptions of participants that require discussion (Arksey and Knight, 1999).

2.6. Validity of the Research

This research was practiced creatively in an inductive way during the study. So, while creating or developing the theory during the study, the research will focus on existing practices that have already been developed or on successive experiences (Elliot 1991). Researchers are usually involved in collecting data and frequently intervene in varying extents during the research process which depends on the approach that they had adopted. So, this research uses an in-depth qualitative study to investigate the impact of using blogs on learners' perceptions in order to identify the concepts that affect their attitudes and with the flexibility that is required. Thus, collecting the data may sometimes involve bias (Fraenkel & Wallen, 2003). Thus, generalizations may tend to be drowned by one sampling act or one situation. Therefore, the outcome of the research is mostly reprehensive of the

situation under study which was generated and tries to make claims to generality. Thus, a research must apply rigorous strategies in order for the data to be applied systematically, accurately and continuously (Oates, 2006). And for the same reason it is necessary the processes of the research to be presented in a clear and fully descriptive account for the reader in order to convince him/her of the research's apparent credibility. Another negative side, is that internal validity could diminish with the applicability of the research's interpretations into other situations. Yet this can be overcome and countered on the positive side by a research's detailed description and the collection of accurate data (Eilon, 2001). Another way to avoid bias and to validate the data is by using triangulation (Price, 2007). Triangulation is most likely to be the main technique for assisting researchers in ensure that analysis is rigorous and that data is carefully scrutinized in order to validate the data in literature (Elliot, 1991). Hence, researchers present and document large quantity of references in order to help acquire better understanding of the research. Also, to make sure that the meanings and concepts presented are accurately understood. So, triangulation is more concerned with gathering variety of data from multiple sources where the aim is to construct and obtain a wider interpretation of the issues presented. McNiff and Whitehead (2002) argue that validity involves, "Cross-checking the existence of certain phenomena and the reliability of individual accounts by gathering data from a number of sources and subsequently comparing one account with another in order to produce as full and balanced a study as possible." Additionally, this research has integrated more than one instrument for two reasons. First, to gain a wide view of the situation and in order to avoid reliance on restricted perceptions. As the data acquisition process involved social interaction amongst students, which means that their behaviors possibly may be subject to change for many reasons (Cohen et al., 2011). Secondly, in order to use different data collection methods which provides a vast quantity of data of conflicting perceptions which will require an in-depth analysis. So, contradictions in some of the data may occur and such conflicts may be resolved by observing other behavior during the course or by using different instruments in different situations. So, in order to heighten credibility, the researcher had carried out the research and data collecting in different ways over a long period of time. This means that the researcher had shown how certain findings could be obtained with the same results even when they are transferred to other contexts with similar properties" (Halaweh et al. 2008). So, the aim of using triangulation is in order to ensure that all the required data is gathered for the sole purpose of answering the resulted research questions. This process will allow the researcher to build on the data and in order to make it as reliable and valid as possible (Cohen et al., 2011).

The strategies that were used to store data had moved forward in order to test them, triangulate tentative findings, identify patterns, and work systematically to identify significant truths. So, to obtain validity the researcher needs to use number of sources in order to compare and contrast one account with another so as to reduce and balanced study. So, in this research many data gathering

instruments were used in order to gain wider view of the study, avoid reliance on specific perception, and because that data collected involves social interaction amongst students and teachers which means that their behaviors may be changed during the study for multiple reasons (Cohen et al, 2011). Moreover, when multiple data sources are used conflicting results may arise that require deep analysis. Once the time-interval of the study is extended, the credibility is also increased as more results may support the evidence once it's transferred to other contexts with similar findings.

There was prolonged contact with case study participants, including continuous validation of data. Also, to limit bias in interpretations there was conduction of search for negative cases, using members of the research team in order to critically question the analysis.

2.7. Data Tools in this Research

- For the blogs-based approach for integrating Analytics and Gamification in teaching and learning: The research was started by inquiring the value of introducing Gamification in teacher blogs teaching STEM subject, and to inquire if there are any benefits.

Google Analytics (GA) then are used as a metric solution for two situations: i.e. with or without Gamification, having as premises of the research the evidence of benefits of using blogs in teaching and learning for the case of students at risk.

Then using inductive reasoning, the following aspects are considered:

(1) The student's reactions to using blogs

(2) The usefulness of Google Analytics (GA) in designing a better content for the class blog, and as a learning resource, (taking into consideration with or without using Gamification (G) elements) and based on students' assessments and achievements.

(3) How Gamification (G) improves the students' involvement, engagement in order to find out the reactions of the students at using blogs. This study was conducted on students over four academic years 2013-2017 where they were examined through their responses to the use of blogs as an essential part of learning and reflection.

- For the Agile embedded in the blogs approach for education the students were ninth graders: A class blog was setup on the beginning of the academic year 2018 in order to start learning and working on STEM subject which was Electronics assignments throughout the whole academic year. Another blog was made to include specific Electronics exercises related to the theme of students' projects. The theme is using smart house systems where electronic sensors can be used for building teams projects and using Arduino systems. Teams were directed to setup blogs and post to them once every two weeks as sprints. Two teachers and six supervisors were conducting the experiment. Students randomly formed nine teams. Data was collected during the 2018/2019 academic year and during three academic trimesters. Data sources included one years' worth of blog content, classroom

observation, school students' interviews, supervisors' interviews, and teachers' interviews in order to uncover their perceptions of working on electronics project within class blog during the academic year. It was decided to use Agile methodology to manage team's projects and Scrum was selected for project management over waterfall method. Five-point Likert scale was used to measure perceptions of teachers using SCRUM versus non-SCRUM in managing STEM projects. According to Vagias (2006) levels of support/opposition can be as follows:

1 – Strongly oppose

2 – Somewhat oppose

3 – neutral

4 – Somewhat favor

5 – Strongly favor

While Levels of agreement by teachers to use Gamification during the experiment was as follows:

1 – Strongly disagree

2 – Disagree

3 – Neither agree or disagree

4 – Agree

5– Strongly agree

-***For the experiment exploring the possibilities to Integrate AR in Blogs***: Students were randomly selected, ninth graders required to follow assignments in STEM subject existed in the teacher's blog, Engineering Electronics, in order to post their solutions in their team's blogs based on AR application.

2.8. Conclusion

The chapter presented the process of the flow of the research from the problem statement to the research findings of the proposed solutions.

So, the overall research strategies and framework presented demonstrate how the objectives are achievable and how will be transformed into results.

Also, the chapter presents rather a plea for the use of blogs than a simple justification and it places them at the center of research following to prove its usefulness for solving the stated problem by integrating them in the proposed solutions: Blogs-based Approach for Integrating Analytics and Gamification in Teaching and Learning, Agile embedded in the Blogs Approach for Education, and Exploring the Possibilities to Integrate AR in Blogs

Chapter 3: A Blogs-based Approach for Integrating Analytics and Gamification in Teaching and Learning

The main objective of this chapter is*: Integrating Google Analytics and Gamification into blogs in teaching and learning (O2).*

For achieving this objective, it is explored the link between the Web 2.0 technologies, Google Analytics and Gamification.

The research methodology is materialized in derived observations and patterns in order to formulate theories, and propose a new approach of the of Triple-Loop Learning application.

3.1. Introduction

One of the reasons why education in the 21st century is different, is the use of technology to enhance learning. In this chapter the research will be focused on the use of Learning Analytics (LA) technological tools such as Google Analytics to integrate it along with Gamification elements in Blogs. The definition of Gamification is discussed along with its relationship to education. Two types of blogs used in education will be presented with discussion of Learning Analytics in general: Class Blogs and Students Blogs. Hence, Google Analytics will be discussed in particular and the advantages of introducing Gamification in educational blogs. Using Blogs is part of autonomous school settings which its aim is not only to individualize learning but to have students take responsibility for their own learning, reflect and evaluate their own learning processes (Fraenkena & Wosnitzaa, 2019)

3.2. The Link between the Web 2.0 Tools, Google Analytics and Gamification

3.2.1. The Learning Analytics (LA) – History and Perspective

LA has gained coherence since 2015, when it went from simply counting the events in click flows and calculating percentages, to determining correlations, causal scenarios and theoretical models (Merceron et al., 2015). Yet, according to Siemens (2013), LA is another approach which is applied in order for researchers to make sense of the structures of knowledge that they had accumulated. Additionally, LA was defined by the first International Conference on Learning Analytics to be "the measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs". Other definitions of LA involved business intellect like the definition drawn by Cooper (2012) where Analytics was defined as "the process of developing actionable insights through problem definition and the application of statistical models and analysis against existing and/or simulated future data". So, defining LA refers to the interpretation of a wide range of data produced

by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues (Figure 3-1).
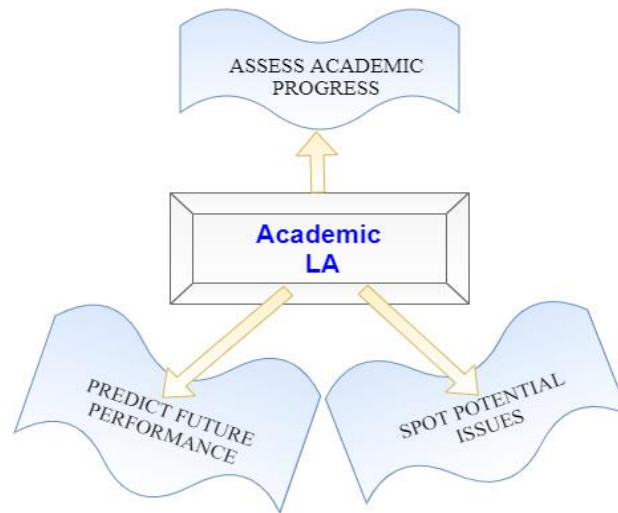
Figure 3-18 LA academic definition

The data is collected from explicit student actions, such as assignments and exams, and from tacit actions, including online social interactions, extracurricular activities, discussion forums posts, and other activities that are not directly assessed as part of the student's educational progress. Analysis models that process and display the data, assist high school members and school personnel in interpretation. So, LA uses dynamic information about learners and learning environments, analyzing, assessing, and eliciting it. The purpose is for real-time modeling, optimization of learning processes, prediction, learning environments, and educational decision-making (Ifenthaler, 2015). The goal of LA is to enable teachers and schools to tailor educational opportunities to each student's level of need and ability. LA needs not simply focus on student performance. It might be used as well to assess curricula, programs, and institutions. It can contribute to existing assessment efforts on a campus, helping provide a deeper analysis, or it might be used to transform pedagogy in a more radical manner. It might also be used by students themselves, creating opportunities for holistic synthesis across both formal and informal learning activities, but unlike educational data mining, which emphasizes system generated and automated responses to students, LA enables human tailoring of responses, such as through adapting instructional content, intervening with at risk students, and providing feedback (Johnson et al.,2011). Additionally, Analytics in education exists in many parts like classroom, university, schools and other educational sections. Buckingham Shum, S. (2012) groups these organizational levels as macro, micro-, and meso- analytics layers. Each level has different set of data and contexts. The historical use of LA can be traced back to Garfield (1955) who stressed on the importance of tracking citations between articles in order to better understand

developments in science. So, by tracking these citations the research can be validated. Google used such algorithm in its early age to make priority for the importance of published internet articles (Page et al. 1999). Another historical aspect for LA is user modeling, where Fischer (2001) emphasized that user modeling is important when dealing with interaction between humans and computers because it helps scientists design better systems. User modeling is the subdivision of human–computer interaction which describes the process of building up and modifying a conceptual understanding of the user. The main goal of user modeling is the customization of systems to meet the user's specific needs.

The system needs to "say the *right* thing at the *right* time in the *right* way". Post-processing refers to the idea of continually improving analytics, by refining the analytics methods, using new methods, including new data sources for example. Until now, a lot of work in LA has concentrated on researching the methods of data collection and analysis; only recently more intensive efforts on their application in educational practice are being made (Ferguson, 2012).

3.2.2. LA – Techniques and Applications

LA power comes from the predictability of regression models but this should not be used in isolation and without the social context for a learner or group of learners (Hernández-García et al., 2015). LA systems also aim to offer a personalized and adaptable learning environment (Ifenthaler & Widanapathirana, 2014). So, a personalized learning environment will be able to promote students' skills in order to monitor, manage and reflect on their own learning (McLoughlin & Lee, 2010). Its features include functions that LA system could provide to the users which include learners, tutors, administrators, and stakeholders. Yet, LA features may include dashboard elements. Furthermore, features may include recommendations about further readings, additional links to related video tutorials, or self-assessment-questionnaires. Features focusing on learners' behavior may include forecasts of academic performance, time spent online, analyses, adaptive learning recommendations, and personalized prompts (Schumacher & Ifenthaler, 2016).

Benefits (Figure 3-2) can be divided into three perspectives and for the micro-level as follows:

(A)   Summative: Where there is an understanding of learning habits, compare and analyze learning, learning outcomes, and track progress towards goals;

(B)   Real-time: Where there is reception for automated interventions and scaffolding, it will take assessments including feedback, and providing collaboration;

(C)   Predictive: This has optimization of learning paths, along with adaptability to recommendations, an increase success rates with an increase in engagement.
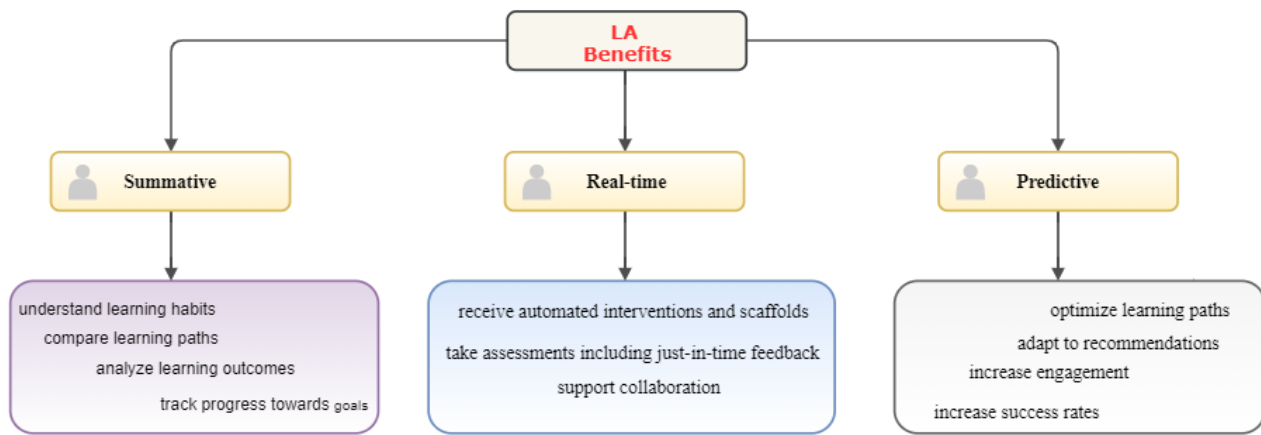
Figure 3-2   LA's benefits

LA features depend on analyses of different data (Ifenthaler & Widanapathirana, 2014) which may include the following:

(A)   Learner characteristics which includes his/her prior knowledge, socio-demographic data, psychometric tests, or previous academic performance.

(B)   External data which includes geographic data, or searches in the library catalogue, or other information from social media in general.

(C)   Traces produced by the online learning environment, this includes activities in discussions and other online interactions, online-frequency and time, results of self-assessment questionnaires, and ratings of content.

(D)   Curricular information is combined with the analyses.

LA can also be used to create innovative design for online classrooms through data monitoring. LA can be used to improve the educational processes in Higher Education through the analysis of students' performance that can be used to devise an improved instructional design to support weaker students as well as provide them timely feedback in order to motivate them to struggle for better grades (Siemens & Long, 2011).

3.2.3. Google Analytics (GA) – Tool for Performance

GA is an example of the power of LA in order to produce statistical data that is related to learning. GA, one of the most widely used tools, is a free tool, based on website data traffic analyzing. It has two versions; one for accessing website from PC and the other one for mobile users using Android and IOS. So, GA hold edge over other web analytics services due to its natural integration with other Google products such as Google AdWord. GA is also preferred over its competitors as it provides time series data and comes with guarantee of Google technology (Plaza, 2009). Another study by Nakatani and Chuang (2011) on selection of web analytics tools, suggested that GA is the most

preferred web analytics tools among the small and medium size enterprises (SMEs). The audience reports include:

1. Demographics (in terms of the location and browser language setting)
2. Visitor behavior (i.e., the number of new and returning visits
3. The duration of their pages' visits
4. Technology used (i.e., the browser version, operating system and the network service provider)
5. Mobile (i.e., the number of visitors via specific phone or other mobile devices)
6. Visitors' flow (i.e., the pathways commonly used through the website).

3.2.4. Integrating GA into Blogs

A Blog is a Web 2.0 technology that has been shown to be useful in education. It's a type of digital composing which research had shown that it promotes iterative writing and gives an opportunity for students to express themselves and hence elevate their learning. Another definition is that blogs are "personal webpages which have typically four features: "an archive of postings, individual ownership, hyperlinked post structure, updates that are displayed in reverse chronological order" (Sim & Hew, 2010). Yet, the site Edublogs.org defines blog as a blend of the term "web log ", which is a type of website. It is possible to use different blog platforms to integrate GA with it like WordPress and Blogger. However, the easier way for integration is to use Google Blogger. The intent is to integrate GA with class blogs not the student blogs. The use of blogs can be authored by students or by teachers. The student blogs are the e-portfolio of their work, which enable them to self-reflect on their posts made in their blogs and hence increase their motivation. Whereas using blogs by teachers as class blogs will enable teachers to customize their instructional materials to suite their student's needs, enabling deep learning, and giving the teacher the ability to make their students focus on specific subjects. Yet, students will have more freedom to learn by their own, hence promoting for them self-regulated learning. Whereas, the integration of GA in the class blog will enable the teacher to analyze data related to his/her blog. Hence, the teacher will be able to see in real data (who is on his/her class blog – LIVE), number of visits per hour/day/month, demographics, countries, referrals and resources. The teacher can even compare how long students spent on the class blog and pages. For integrating GA with blogs, user can follow two steps (Google1, 2018)[25]: Sign up for Analytics, then add Analytics tracking. About Google Analytics Home page (Google2, 2018)[26]: In GA, the home page provides a summary of the interesting data about the blogs. The top row of cards shows:

1. Overall traffic and conversions (Users, Conversion Rate, Revenue, and Sessions).

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[25] extracted on 18 May 2018 from: https://support.google.com/blogger/answer/7039627?hl=en
[26] extracted on 18 May 2018 from: https://support.google.com/analytics/answer/7421425?hl=en&ref_topic=3544907

2. Daily or hourly user volume, where it can be hoovered on to give exact number of users that hour.

3. The first three cards on the home page.

4. The number of users on the blog right now, and which pages they are viewing.

The other cards provide similar snapshots of blogs data. Like how well the users were retained week to week, the channels by which users were acquired, card controls, and goal completions. A card can have up to three controls: Date-range picker, Dimension or metric picker, or Link to the given report. If a card lists metrics across the top, then user can choose which data is displayed in the card. A third-choices across the top is Date range where all of the cards except the real-time card include an option to select different date range. The data ranges vary by data type. So, in summary, Google Analytics (GA) time is one of the metrics used as a behavioral aspect that can be considered in further assessments (Filva, 2014), GA has better performance than other web analytics because it is integrated with other Google products such as Google AdWord and Google other applications. GA has also better preference over its competitors because it provides time series data and is guaranteed by Google tech structure (Plaza, 2009). Another study was done by Nakatani and Chuang (2011) on the selection of web analytics tools, it suggested that Google Analytics is more preferred than other web analytics tools among the small and medium size businesses. The main metrics that were used in GA are: No. of users, Page views, Sessions and Average Session Duration. GA measures periods of time by looking at the difference between time of the first hit and the time of the last hit. An example session below: The amount of time spent on the first page (Time on Page) and Time at hit 2 (10:05) – Time at hit 1 is (10:00), which is 5 minutes.

3.2.5. Gamification in Blogs

Gamification is the application of game elements and digital game design techniques to non-game problems, such as business and social impact challenges (Huotari, 2012). Ernest Adams defines a game as an activity of play in the pretended reality where participants try to achieve challenging goal by acting in accordance with rules" (Adams, 2009). Students' engagement in a gamified learning activity can result in a better learning outcome (Kuo & Chuang,2016). Many studies on Gamification argued that by motivating students through a reward-based learning method, their learning skills will be enhanced which eventually will increase their learning outcomes (Buckley & Doyle, 2016; Kim et al, 2018). So, as the use of LA dashboards support awareness, self-reflection, sense making and impact for learners (Santos et al, 2013), the implementation of game elements like badges in non-game environments has become increasingly popular (Kyewski, 2018). Yet Gamification strategies used different approaches like using competition between players, or using rewards to stimulate interest once a user completed a task. The rewards used can be badges, points, elevating progress bar,

or giving the user virtual currency when he or she wins. The rewards can be visible or hidden to other players depending on the used approach and depending on the strategy for competing between players. So, to apply Gamification, users should have the feeling that when they complete a specific task as if they are playing a game. This is achieved by onboarding with a tutorial, adding meaningful choice, adding narrative and increasing challenge (Hamari & Eranti, 2011). So, comparing gaming to education: in gaming it's all about overcoming obstacles, completing challenging levels, and obtaining certain skills, whereas education is all about progressing to the next grade, obtaining knowledge and skills and passing exams (Van den Boer, 2013). According to Van den Boer there are essential game elements that can be used in a successful deployment scheme of Gamification in education which includes:

1. Feedback: Instant feedback, where the students always need to know how they are doing;
2. Gaining skills and experience: They can start from 0% and progress to 100%;
3. Rewards: Teachers can reward student's badges and trophies.

Several Gamification techniques have been used in different settings in order to stimulate students' learning outcomes and enhance learning (Butler & Bodnar, 2017; Kim et al, 2016; Van Roy & Zaman, 2018). Game mechanics are a set of rules and feedback loops that create the gameplay. They represent the fundamentals of any gamified context. According to Muntean (2011) as presented in figure 3-3, each game is characterized by three attributes:

1. Game mechanics type which includes Progression, Feedback, Behavioral;
2. Benefits include Engagement, Loyalty, Time Spent, Influence, and Fun;
3. Personality types include Explorers, Achievers, Socializers and Killers.
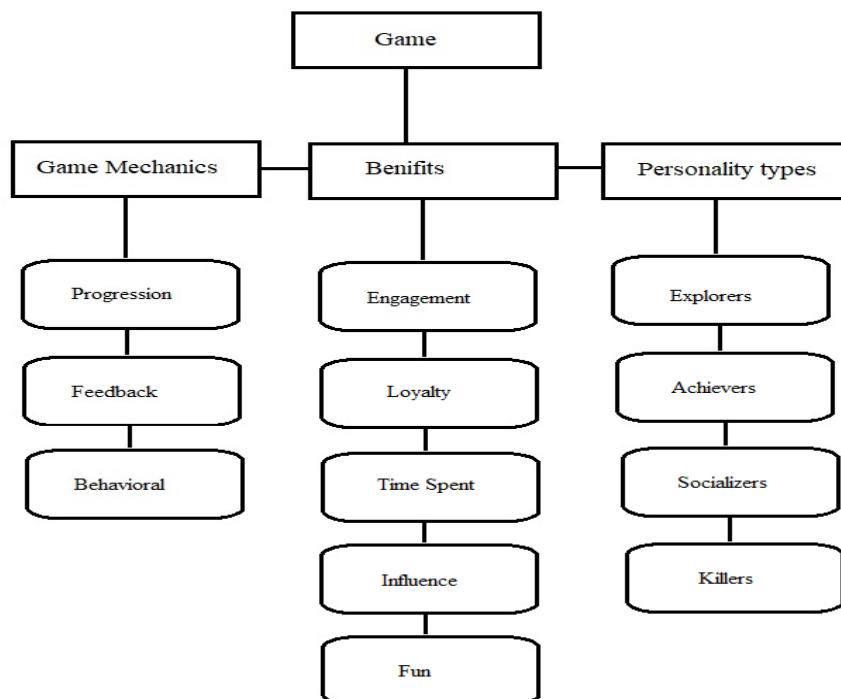
Figure 3-3   Characteristics of a Game (Muntean (2011))

The difference between gamers types is described by Alsawaier (2017):

1. *Explorers* are those who collect virtual goods and discover things.
2. *Achievers* are those who achieve status due to a high level of performance.
3. *Socializers* are those who are good team players and collaborate with others in the game environment.
4. *Killers* are those who compete and play against other gamers.

So, games cannot be used to replace pedagogical methods, but it can be used to improve learning experiences. Folmar (2015) defined gamification as "the use of game thinking and game mechanics to meet non-game ends", so "Gamification is not just making a game inside a lesson; it is rather applying game thinking and the attractions which instills in its users to how we develop that lesson and to continue to develop it based on the feedback from the users (Folmar, 2015). Therefore, the application of Gamification in a pedagogical context provides a remedy for many students who do not resonate with traditional instrument methods. Using Gamification can provide a partial solution to the declining motivation and commitment of students facing the school system today. (Alsawaier, 2017). The benefits can reach teachers too, in an increase in their motivation (Machajewski, 2017), even though there are skeptics on its effect on improving academic performance (Buhagiar, 2017), (Goehle, 2016) & (Martí-Parreño et al., 2016).

3.3. Integrating Analytics and Gamification in Teaching and Learning based on Blogs

Introducing gaming elements in teacher and student blogs will have new aspects that proved to be positive for student learning. Yet, the successful application of Gamification in Blogs needs to take into consideration that students need to stay engaged in learning and need to be motivated. There are two types of blogs: *class blog* for the whole class and *personal blog* for each student. As the *Class blog* needs to be designed for this purpose with appropriate themes; all worksheets and study materials could be designed with this purpose in mind. Gamification is all about competition and social interaction; the feedback section in each post can provide venue for students to answer questions and provide feedback that rewards them extra grades. Inserting videos and audio files can increase motivation to perform assignments.

Instructional videos with complex learning materials will give students the ability to learn on their own pace, in class or on their homes at any time, this will trigger for students Self-Regulated Learning (SRL). Learning with SRL is guided by thinking about one's thinking (metacognition), planning, monitoring, and evaluating personal progress against a standard which is the blogs post (strategic action), and motivation to learn. SRL is a process of taking control of and evaluating one's own learning and behavior (Ormrod, J.,2009). Whereas, the *personal blog* (student's blog) is the second venue that Gamification can be introduced to motivate students and engage them in learning. The

student's blog is an e-portfolio where the student has the freedom to customize its appearance, change background colors, fonts, front appearance and local themes, hence giving the students a sense of ownership. Teacher can evaluate students' blogs and give them instant feedback, reward students and mark top ones to increase competition. Students can provide feedback to each other through post comments; hence many Gamification elements can be used in both types of blogs.

3.3.1. *Research Methodology:*

The research started by inquiring the value of introducing Gamification in teacher blogs and if there are any benefits, then GA was used as a metric solution for two situations: (i.e. with or without Gamification), having as premises of the research the benefits of using blogs in teaching and learning for the case of students at risk.

Using inductive reasoning the following aspects are considered: the student's reactions at using blogs (I), the usefulness of Google Analytics (GA) in designing a better content for the class blog, as a learning resource, (with/without using Gamification elements) based on students' assessments and achievements (II) and finally how Gamification (G) improves the students' involvement, engagement and results (III).

(I) In order to find out the reactions of the students at using blogs, students over four years (2013/2014; 2014/2015; 2015/2016; 2016/2017) including six semesters were examined through their responses to the use of blogs and discussion boards as a key part of learning and reflection. Some samples fo blogs are shown in figure 3-4 and figure 3-5.
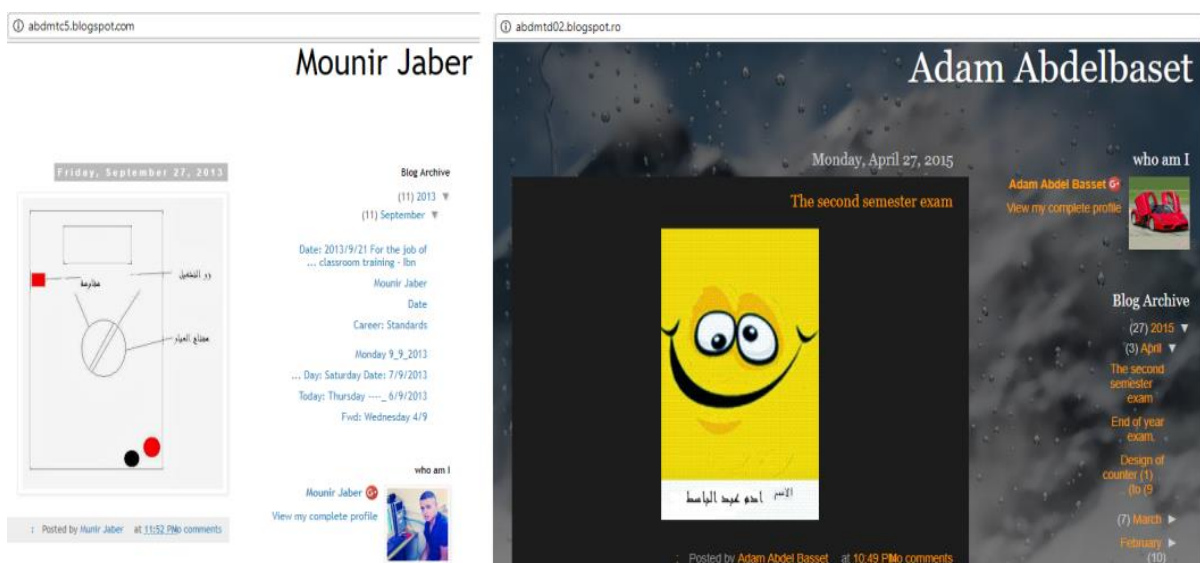
Figure 3-4   Samples of Students Blogs

Figure 3-5   *Class blogs for the last 4 years*

The results from the study carried out over four years showed increased interest of students for learning, by the increasing number of students that are using blogs for their education. As presented in the research and shown in figure 3-6, in 2013 there were 40 blogs uses, 44 in 2014, 58 in 2015 and 65 in 2016. The number of students who were dropped out of the studies are: 6 in 2013, 6 in 2014, 5 in 2015 and 2 in 2016.
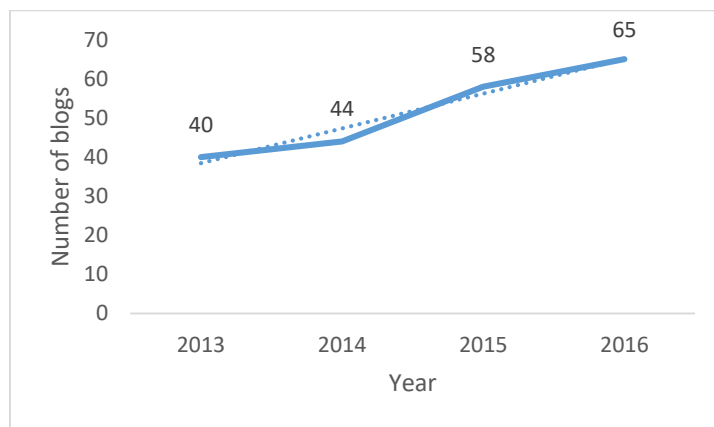
Figure 3-6   *The number blogs*

The average values of blog use per student taking into account all the students participating in the study shows an increasing trend, as follows: 1.8 uses in 2013, 1.9 uses in 2014, 3.4 uses in 2015 and 5 uses in 2016. Considering that the number of drop-out students is decreasing and their blog uses is very low, we can neglect these values and get the following statistics of uses per student: 2.5 uses in 2013, 2.6 uses in 2014, 4.8 uses in 2015 and 5.9 uses in 2016.

Once the research premises have been established based on the results presented above, in order to have better and more rigorous metrics for the degree of learning efficiency and the degree of involvement and satisfaction of the learners, the Google Analytics tools and the Gamification technique are further implemented.

(II)   The proposed approach is based on metrics provided by GA which enables students to receive constant feedback on their progress in the classroom and provide information about their completed activity (Kapp, 2012), therefore a qualitative research was developed in order to find the assessments and achievements related to using blogs in teaching and learning, using Google Analytics. The comparative analysis of students' perceptions and outcomes in using the class's blog without G-elements and using the class's blog version with G-elements is provided. Also, three teachers were interviewed who accompanied students throughout the two semesters. The course material is identical, it includes a blend of digital electronics subjects and programming elements in C Sharp programming language. The blog type for teachers and students was Google blogger since its free to use, easy to setup, easy to use, and is better in integrating GA. The first sample was randomly selected by taking the whole class as the sample any by not interfering with the selection process of students of this class. They were exposed to G elements in class blog. Students were also instructed to fill their assignments using their own blogs during the first semester of 2017/2018. They were 10th graders (n=23) all males in one class in a school in Jerusalem. The second sample was also randomly selected by taking the whole class as the sample any by not interfering with the selection process of students of this class, yet they were not exposed to G elements in class blog. Students were also instructed to fill their assignments using their own personal blogs during the first semester of 2018/2019, they were also 10th graders (n=21) all males in one class in the same school in Jerusalem. Data was collected from teacher blogs, and student's blogs for the first semester of the two consecutive academic year that starts 1st September and ends 25 December, yet students continued the study till the end of the academic year. Data sources for this case includes two complete one semester worth of class blog and student's blogs content, classroom observation, students and teachers interview to find out their perceptions of classroom blogging practices and students' perceptions to the use of blogging both in class blogs and in student's blogs with or without Gamification elements.

3.3.2. Results and Discussions:

The following figures present samples of students posts to their own blogs as shown in figure 3-7 and figure 3-8.
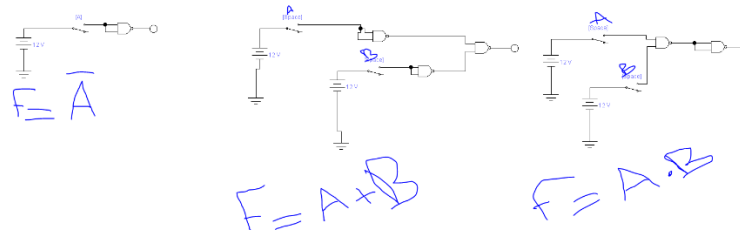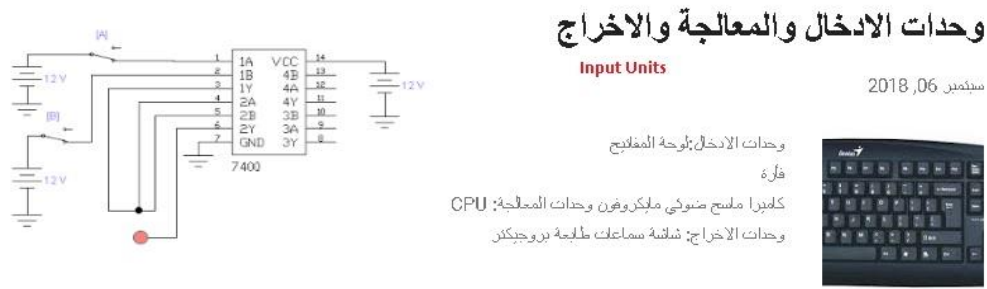
Figure 3-7   Examples of student's blog posts from 2017/2018
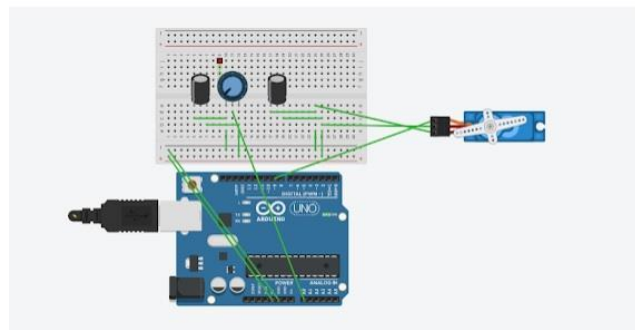
Figure 3-8   Examples of student's blog posts from 2018/2019

While figure 3-9 and figure 3-10 show examples for GA time of users visits and sessions along with audience overview, the following figure 3-11 shows number of views for the blog from Jan 2108 to July 2019. While the upper figure captured the highest viewed post in the blog, the bottom figure shows the overall views for the whole blog within the time period.
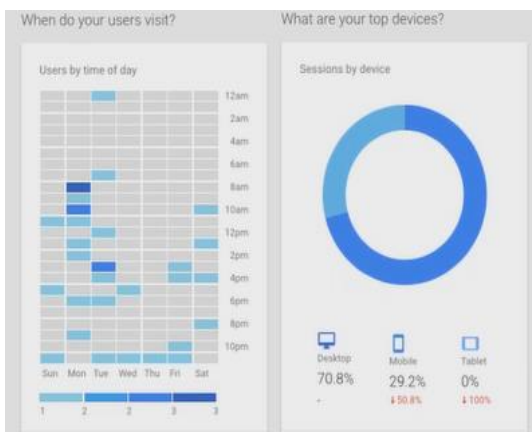
Figure 3-9   GA time of users visits and sessions
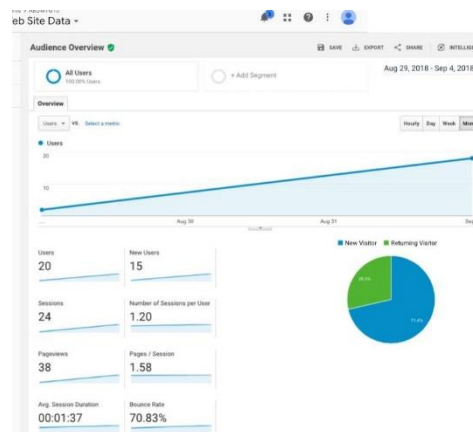
Figure 3-10   GA audience overview

An increase of number of students posts after introducing Gamification was noticed when comparing number of blog posts of student's blogs with Gamification (2017/2018) and without Gamification (2018/2019). It was also noticed that there is an increase of number of posts as shown in figure 3-11 due to G elements, where the horizontal axis represents the month and the vertical axis represent the number of posts during the month
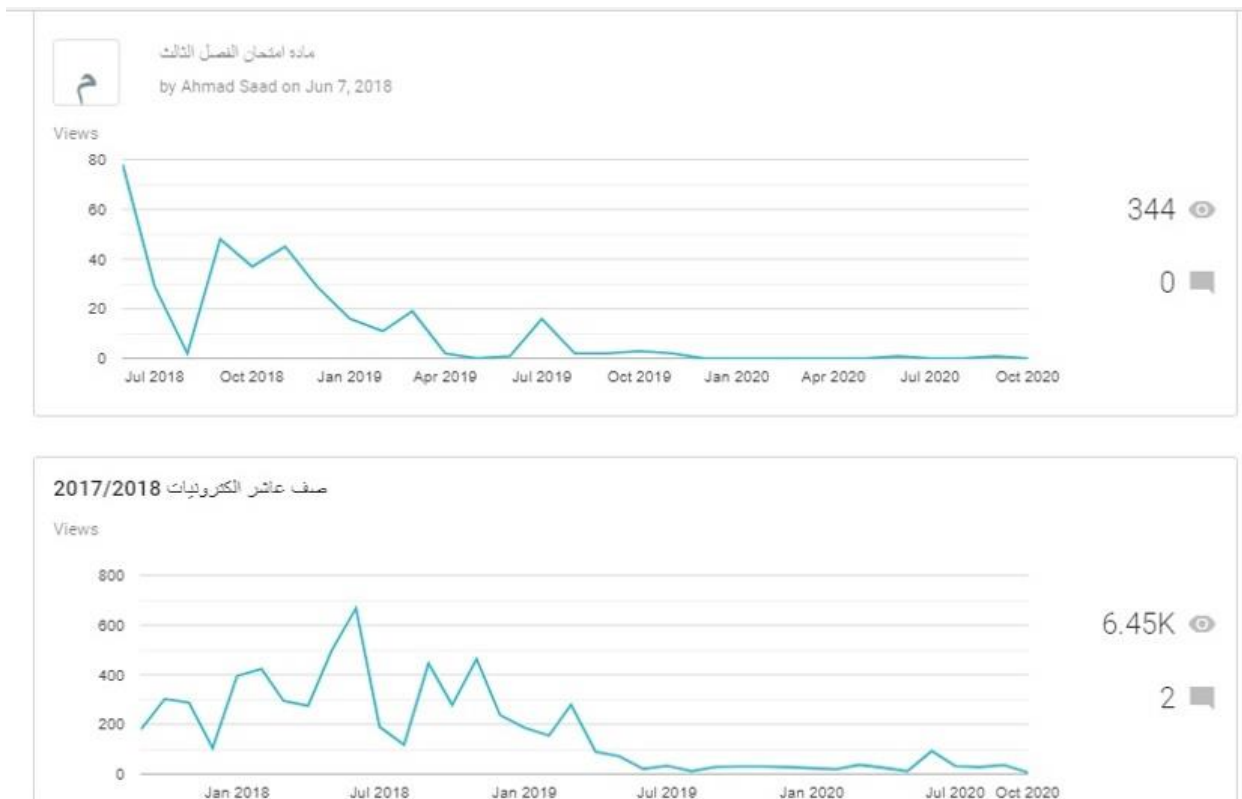
Figure 3-11   Print screen of the use of GA in Blogs

It was also noticed using Google Analytics a significant difference on stats of the class blog, regarding number of users posts Table 3-1 and Figure 3-12, and number of page views Table 3-2 and Figure 3-13 after introducing Gamification elements.

Table 3-1   Number of users' posts with & without G

	No. of users' posts with G	No. of users' posts without G
September	24	17
October	26	13
November	24	11
December	24	10
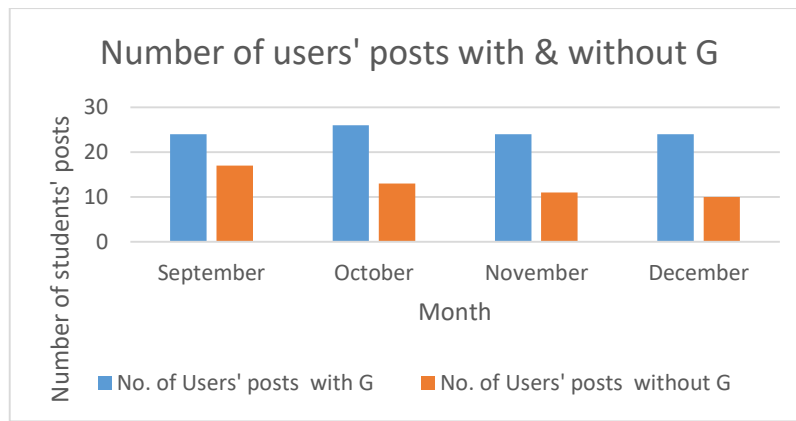
Figure 3-12   Number of students' posts in blogs w/ & without G elements

- Increase of number of page views after introducing Gamification

Table 3-2   Number of Page Views with and without G

	Page Views with G	Page Views without G
September	27	23
October	34	16
November	26	14
December	28	13
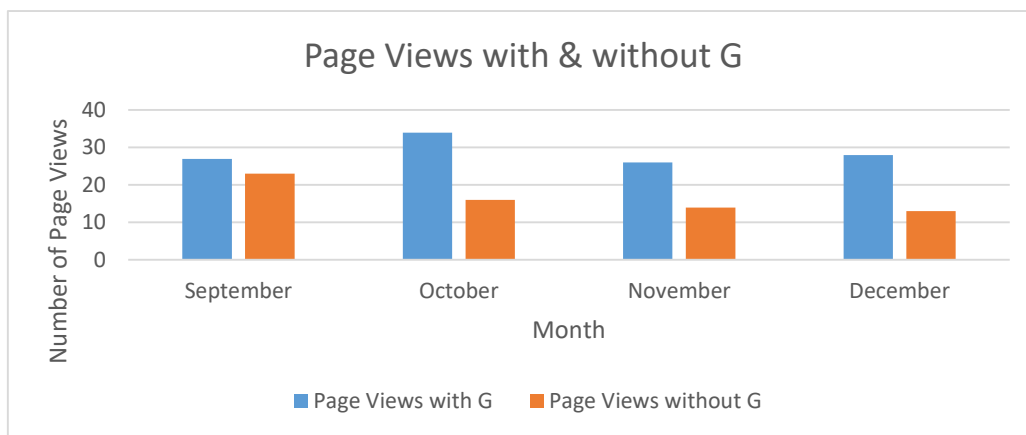
Figure 3-13   Number of Page Views with and without G elements

- There is also an increase of number of sessions after introducing Gamification as shown in Table 3-3 and Figure 3-14.

Table 3-3   Number of sessions with and without G elements

	Number of Sessions with G	Number of Sessions without G
September	29	26
October	43	17
November	27	15
December	29	13
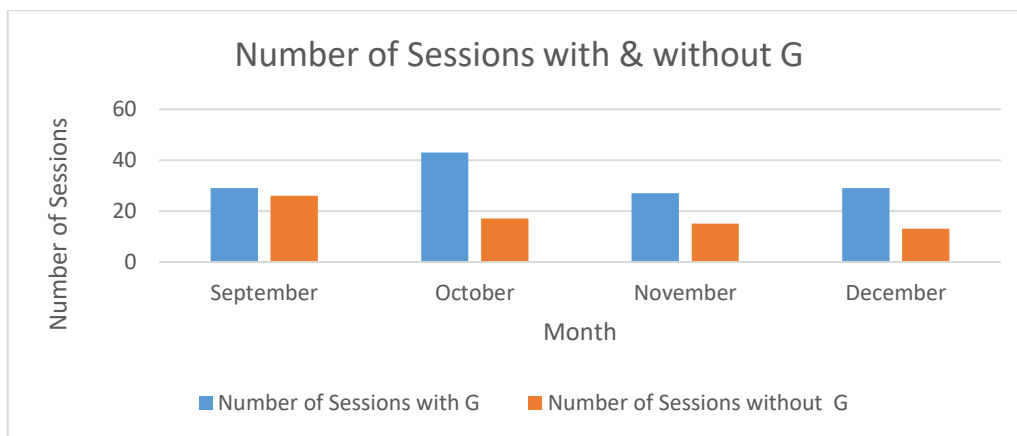
Figure 3-14   Number of Sessions with and without G elements

- There was also an increase of average session duration in minutes after introducing Gamification as shown in Table 3-4 and Figure 3-15.

Table 3-4   Average Session Duration in minutes with and without G

	Average Session Duration in minutes with G	Average Session Duration in minutes without G
September	6	5
October	5	3
November	6	5
December	7	4
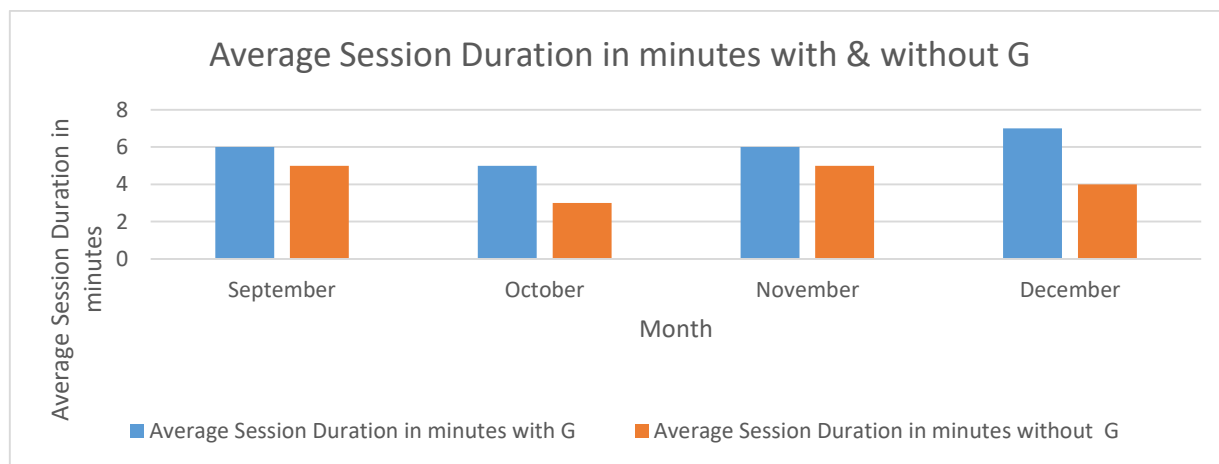
Figure 3-15   Average session duration with and without G

III. Using Gamification, the teaching strategy is modified in order to integrate game elements where, in a gamified classroom the teacher presents a challenge or a quest for the students to undertake leading them to the learning experience and achieving the learning objectives. Gamification elements used for the first case includes, adding points and levels, badges, avatars and quests as shown in Fig. 3-17. The main theme in the Gamification of the educational course using class blog is a Space shuttle in Space Fig.3-16 and the students are captains in this Space Shuttle. Samples of using badges and points are shown in Figure 3-18.

Figure 3-16   Class blog using Gamification elements: Theme: Space Discovery

Figure 3-17   Points & Badges during the use of G elements

Figure 3-18   Samples of using badges and points in blogs

The students are divided into groups like space shuttle teams, each has his own distinguished title and their mission is to achieve more points, collect more badges in order to enter new stages and discover new space frontiers, then they will post their assignment in their own blogs after achieving their mission. As players advance in their stages of their epic quests, they start gaining badges; while the progress is starting from simple to more advanced levels, they are exposed to scaffolding techniques that encourage them to proceed and accumulate badges associated with different achievements. Students' groups will compete with each other: Teacher will grade their group assignments based on who finished first. The researcher tried to find out about Bartle's Player types for Gamification in students that include, the killer, the Achiever, the Socializer and the Explorer[27].

Aspects about using Gamification (G) for improving the students' involvement and engagement:

(1) The most commonly used techniques are similar to the previous works: points (75%); badges (68%), leaderboards (63%), levels (38%). Other Gamification techniques were found to be less utilized which conforms to Alomari results (Alomari, 2019).

(2) Using badges and points had added more motivation and engagement for users to work on their assignments as perceived by students and teachers alike. Student2 for instance talked about how he became more motivated when badges were introduced for who finishes the experiment first. Same for student7, student9 and student13.

(3) Teachers reiterated the notion that there is a slight significant difference in the average grades and Gaussian distribution between the two groups for the benefit of using G.

(4) Both teachers and students didn't think that adding G elements increased their reflection on their own blogs yet some teachers felt that it may add to a distraction from the pedagogical objective of the lesson.

(5) Teachers felt that even though group competition may motivate students and engage them, it may distract students from pedagogy into trying to finish first.

(6) As the Achievers are playing for all about points and status, they want to be able to show themselves and their friends how they are progressing, they comprise around 10% of students. Explorers want to discover new secrets and to see new things they want. They're not interested or bothered about points or prizes; they comprise another 10% of students. Yet, the vast majority of student players are Socializers. That's about 72% of them. Students who can be socializers experience fun in their games while they interact with other players. But the Killer students are similar to Achievers in the way that they get a thrill from gaining points and winning status but they differ from Achievers that the Killers want to see other people lose, they comprise another 8%.

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[27] https://www.interaction-design.org/literature/article/bartle-s-player-types-for-gamification

In order to observe patterns and formulate the theories that emerge from the approach the findings according to the teachers' investigation point of view and students' achievements during the observations and tests that were performed are correlated with literature as follows:

1: The introduction of a challenge in class blog within gamifying courses will help students complete their tasks and post more blog posts or it may encourage or motivate them to access class blog. This is consistent with Nicholson, 2015 who stated that "it is important when designing a gamified course fully or partially to create a challenge, when possible, that is appropriate to the level of the students to maintain their engagement ". Making the challenge very hard will lead to student's frustration and lead to negative effects on motivation and engagement.

2: Introducing G elements, will increase students blog posts which is also consistent with Brewer et al.'s (2013) study on children that has shown the use of gamification increased the percentage of task completion from 73% to 97%. So "The gamification of education approach has the advantage of introducing what really matters from the world of video games which is increasing the level of engagement of students without using any specific game" (Simões et al., 2013).

3: A unified quest theme (like space discovery) gives students and teachers alike a unified path to follow, in other words quests and challenges give students a sense of direction or a purpose in a gamified environment (Zickermann & Cunningham, 2011). It supports the sense of adventure and activate critical thinking skills by setting the exploration and discovery elements supported with previous literature like (Dale, 2014; Powers et al, 2013).

4: Gamification allows for learning to happen individually as the learners feel extrinsically and intrinsically motivated through blogging and reflecting upon their blog posts and through gaining points and winning awards. This is supported by Chalco et al. (2015) research.

5: When players (students) feel fun it occurs through their feeling of achievement, a sense of exploration, the reward of completing a level, or simply winning a game, which is supported by Zickermann (2010).

6: Badges helped elevate motivation and engagement, they are chosen in a gamified environment to accommodate different learners considering their motivation levels and capabilities which is supported by Abramovich et al, 2013. Badges then serve as an "online record of a learner's achievement" (Devedžić & Jovanović, 2014). According to Richter et al (2015) badges can help enhance qualities such as "self-competence and self-efficacy".

7: Some consider points as an essential part of a gamified world or an "absolute requirement for all gamified systems" (Zickermann & Cunningham, 2011), like Attali and Arieli (2015) where they used it as the main gamification component that they included in their study of performance measuring fluency and understanding of math concepts.

8: With Gamification introduced there is a possibility for students to fail frequently, Kiang (2014) recommended that the teacher "needs to try providing ways for the students to 'fail' frequently in many small ways, rather than in just one big high-stakes test". In a gamified environment, failure is redefined in a new way where it is no longer a setback for retreat but rather "an opportunity to learn from mistakes and correct them" in order to proceed (Hanus & Fox, 2015).

9: Giving students the options to use G elements, research has also shown that intrinsically motivated students experience gradual disengagement and loss of motivation when they feel that they are forced to use game features (Hanus & Fox, 2015). This means that through the curriculum design with Gamification element there should be no force use on any part of the assignments included.

10: A successful gamified design needs to support collaboration among the students and a successful gamified design which incorporates collaboration will help the emergence of positive learning behaviors, theory also emphasized Zhang and Clear (2015).

11: Teacher efficacy is very important in designing a successful gamifying course in order to motivate and engage students throughout the gamified course. There is also the importance of Gamification design to meet the inner psychological needs of the students. These inner psychological needs represent the principles of self-determination theory that includes relatedness, competence, and autonomy.

There are in an increase number of students using blogs in their education Figure 3-19: in 2017 there were 22 students, in 2018 there are 25 students, and in 2019 there are 29 students. The number of students who dropped out had also decreased: 7 students in 2017, 5 students in 2018 and only 2 students in 2019, as it also affected number of drop out students Figure 3-20.
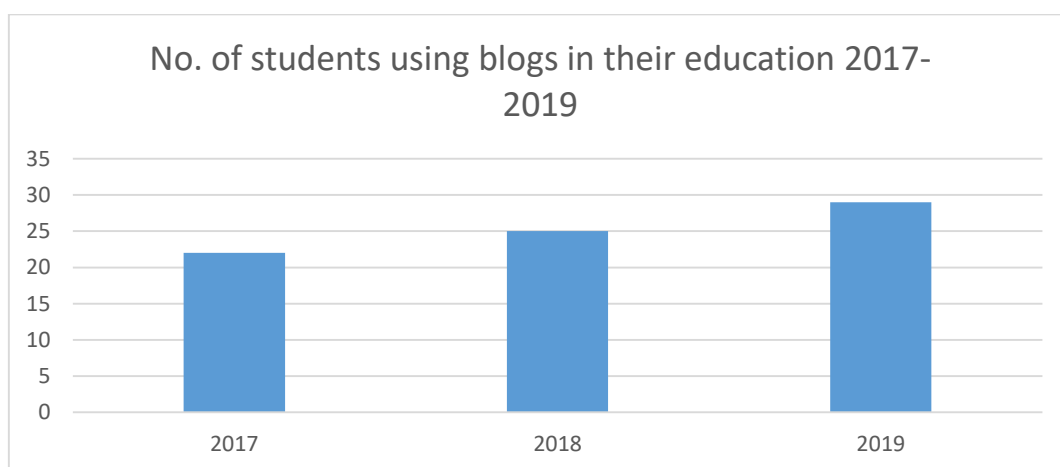
Figure 3-19   No. of students using blogs in their education 2017-2019
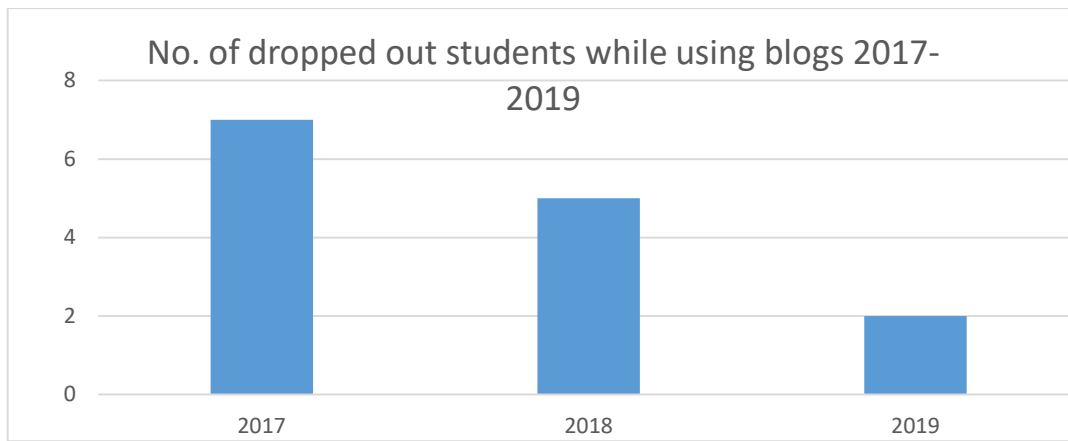
Figure 3-20   No. of dropped out students while using blogs 2017-2019

Observed patterns

I.   Blogs were useful for four groups of students at the Industrial Computer Maintenance course

II.   GA measured for all observed courses, an increasing tendency for the number of pages displayed, the number of sessions and the average session duration, and also, for the level (percentage) of tasks completion in the context of using the class's blog version with G-elements

III.   The group that used G elements showed more interest and involvement than the group that was not subject to G elements.

Theories

As shown in Figure 3-21:

T1: Blogs are useful for students at risk

T2: GA in learning is useful in students' assessments and achievements monitoring

T3: G elements in learning are useful for motivating the student's involvement/engagement

So, **Integrating GA and G elements in blogs is useful for students at risk.**
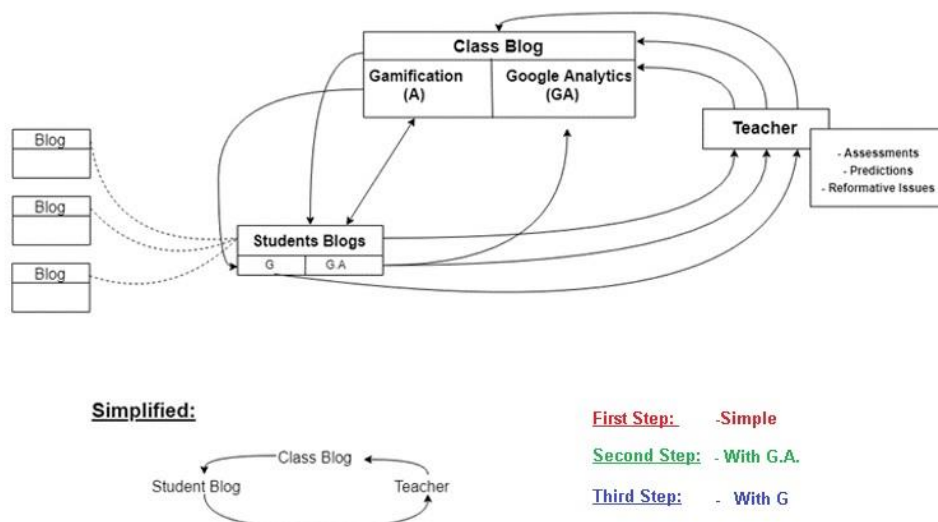
Figure 3-21   Framework for Gamification (G) and Google Analytics (GA) using teacher and students Blogs

3.4. Triple-Loop Learning Based on PDSA Cycle Approach

The results of the inductive approach were used in order to develop a new framework that integrates GA and G for teaching and learning using blogs for students at risk. So, from the findings resulted that G elements are useful in the involvement of the students, using GA it was shown that with the involvement of the students their results are improved, and the blogs provide an asynchronous learning environment. Till now it wasn't provided a logic glue among of these. The proposed approach will gradually integrate on three nested loops.

The results of the study have created the premises of the researches on the use of blogs for students at risk and also, introduced the Triple Loop Learning showing how blogging moves students from a single-loop learning process to double-loop learning which includes reflection, and enhances the learning and reflection for the educator. This contributes to the third loop by enhancing the organizational learning approach and demonstrates an increased student satisfaction which was measured by student evaluations. Also, there was an elevation of self-reflection on content specific knowledge, which improved individual learning and overall classroom learning.

The proposed approach does not capture a critical review of the ways in which triple-loop learning has been conceptualized by organization and management scholars, but only mentions that while it seems to be inspired by Argyris and Schön's (1978) notion of single- and double-loop learning, it has more obvious links to Bateson's (1972) Learning III (Tosey et al., 2012). Knowing that the Triple Loop enables new learning strategies, so as inspires complex problem-solving and increases the performance of organizations (Barbat et al, 2011), the aim of the approach is to capture the core values and use it in the context of learning. A representation of Triple Loop Learning is presented in figure 3-22.
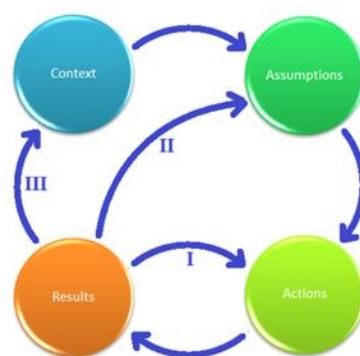
Figure 3-22   Triple Loop Learning representation (Sad et al, 2018)

I = First loop; II = Second loop; III = Third loop

Also, the relationship between the well-known PDSA cycle from Quality Management and the Triple-Loop Learning model was explored. For the blog-based learning and teaching case, the link between the logical sequence of the four repetitive steps for continuous improvement and learning of the PDSA cycle and the core elements of the Triple Loop Learning are presented next.

PLAN	CONTEXT
Formulating a theory, defining goals and metrics	Formulate learning strategies. Process for generating mental maps and goals for learning in a curriculum context: • Increased learner effectiveness or performance gains – The degree of learning efficiency • More positive student attitudes to learning – The degree of learner engagement and satisfaction.
DO	**ASSUMPTIONS**
Implementing plan components	Standard representations Mental maps and models Set implementation hypotheses for the established goals using ICT & Web 2.0 tools: • Selection and application of ICT systems and devices in an effective manner. • Utilization of common software tools in their private lives • The usage of specialized tools for work • The Flexibility to adapt to changes in applications and infrastructure.
STUDY	**ACTIONS**
Monitoring to test plan validity for pluses and minuses of students' progress and further improvement	Practices and behaviors Implement the ICT tools and technics in learning (e.g., WiKis, Blogs, Social Networking, Social Bookmarking, RSS, podcasting, media sharing)
ACT	**RESULTS**
Integrating the learning generated by the entire process and adjusting the theory, methods, goals and purposes	Feedback for the next loop of learning based on consequences and outcomes, from the well-known key domains: Cognitive: critical thinking, problem solving, information literacy; knowledge; creativity Intra-personal: intellectual openness; positive self-evaluation Inter-personal: communication; collaboration (teamwork); leadership.

Figure 3-23 Triple Loop Learning and PDSA Cycle

A new approach on Triple Loop Learning model based on the PDSA cycle was proposed by Sad et al. (2018) Figure 3-23, while in the approach reveals that the third loop as a continuous improvement process.

The first loop is accomplished when students do their homework online posting on their own blogs based on assignments posted on teacher "Class" blog. They are tested and the teacher evaluates their blogs posts. So, the question "Are we doing things, right?" is answered.

The second loop is when students were able to demonstrate their interconnected technological pedagogical knowledge and, in their reflection, to justify their competencies. There is an ongoing assessment and adaptation of both the student and the teacher, answering the question "Are we doing the right things?".

Whereas the third loop occurs through discipline-specific framework to guide students' reflection of learning that includes insuring teacher's efficacy, advanced teacher influence, goal consensus, and responsiveness of leadership trying to get the answer to "How do we decide what is right?".

Discussions about using a blogs-based approach for integrating Analytics and Gamification in teaching and learning to make Triple-Loop Learning emerge:

- For the first loop the introduction of a challenge in class blog within gamifying courses will help students complete their tasks and post more blog posts or it may encourage or motivate them to access class blog;

- The second loop is shown by interviewing students and teachers to get feedback on their perceptions of how introducing G elements helped them reflect more on their blogs. Teachers said that grouping students under space mission groups like space x, unified force, discovery team gave students a sense of unity between them and drove them to collaborate to do the assignment yet in some groups as one teacher said "you have one or two students do the work and the rest just copy from them". So, there is a lack of authentication. Another issue, as one teacher raised, is that not all students are used to the notion of gamifying education some students did not take it that seriously or they thought that gaming and education could not be mixed. Yet most students felt that they were more motivated and more engaged by using G elements especially accumulating points and badges;

- For the third loop that relates to teacher efficacy both teachers and students said that it's important in designing curriculum that is related to the gamifying curriculum by going from simple to advanced level, also by interacting with students in a way that motivates students and increase their engagement. Both teachers and students felt that the lessons' structure needed to be designed more effectively to reflect upon the Space Discovery theme.

- The importance of the third loop stems from the ability of a teacher to maintain pedagogy against gaming. This means that the first loop may show significant difference with and without G elements as shown by number of posts with and without applying G in teacher's blog, also by teachers and students' feedback. The second loop may not show a big importance as shown by insignificant difference in student's grades with and without applying G, but the

third loop is very important in order to carry out successful integration of G elements in student and teacher blogs providing a discipline-specific framework to guide students' reflection of learning. The student and the teacher are partners in the teaching-learning process for "deciding what is right", learn and share.

3.5. Conclusion

Blogs are web 2.0 tools that have a great potential in education, the main two types of blogs are class blogs and students' blogs, both have different criteria and different application settings. Learning Analytics (LA) is a new tool to analyze learning and teaching to optimize successful learning, Google analytics (GA) is a technology aspect of (LA) that enable more information to be gathered about learner attitudes, learner habits and learner's response to such educational content. Gamification is the way of using games elements in non-gaming environment such as education. The integration of both GA (by using adequate metrics) and Gamification in class blogs and students' blogs will carry a new potential for successful learning since improving the motivation and engagement of learners in learning activities is important for the development of skills and competences. By using the proposed approach of Triple Loop Learning based on PDSA cycle the results showed how the blogging process moved students from a single-loop learning process to double-loop learning with reflection and increased motivation and engagement, but for enhancing the learning and reflection for the educator in order to contribute to the third loop, more preparation is needed to use specific methods and the intrinsic qualities of the teacher (teacher efficacy) in order to enhance the learning approach to demonstrate an increased student satisfaction which was measured by student evaluations and an elevation in self-reflection on content specific knowledge which will eventually improve individual and classroom learning. Gamification is not effective by itself, but different game design elements may trigger different motivational outcomes. So, competence and autonomy regarding task meaningfulness will be affected by badges, leaderboards, and performance graph. Also, social relatedness may positively be influenced by using avatars, which is a meaningful story, and teammates (Sailer et al., 2017). Using GA in the proposed approach will provide "measures" of and for the improvements dictated by the PDSA cycle for adapting the educational process to the needs of each student.

Chapter 4: Agile embedded in the Blogs Approach for Education

The main objective of the chapter is: ***Identifying the proper project management methodology for implementing the approach that integrates Google Analytics and Gamification into blogs in teaching and learning (O3)***

4.1. Introduction

A successful education process delivers effective learning being designed in order to enhance it. In the context of the research, blogs proved to be useful educational tools with significant results especially when integrating elements of Google Analytics and Gamification.

The educational process will be presented as a result of the project management approach considering previous experiences regarding education projects and exploring the possibilities of adapting to the dynamics of the digital age. So, Agile methodologies in educational environment are considered, and Scrum methodology for the case of blogs - based approach in education integrating Google Analytics and Gamification is applied.

4.2. Educational Process and Project Management

The educational process success is the result of a successful Project Management (PM). That is why, we need to plan well for the educational process, to implement it effectively, and to manage it professionally in order to achieve the drawn objectives of time saving, effective cost and functional performance. However, in general, PM has evolved as one of the means of effectively managing human capital and other resources gathered in order to deliver a predetermined product or service that has a specified requirement, time scale, budget, including quality standards (Kenny, 2004). Therefore, in PM, we need to apply a series of standard techniques and processes in order to bring about projects in a fixed period and within budget proposed. These techniques are used across a wide range of subjects. Many questioned the application of PM processes to other areas of the educational process like curriculum development. They pointed out to several problems, which include the cultural aspect of the educational environment, and the independent nature of the academic work. However, they still saw a role for some aspects of the PM process, "particularly noted the educational infrastructure" Phelps et al (2000). While Bates stated that the main advantage of introducing PM approach to educational projects is the allocation and the use of scarce resources efficiently. He also noted that there is some type of tension between the classical approach of PM and the nature of academic work. So, in order to overcome such a problem, he introduced a lighter approach to PM (Bates, 2000). Yet, the definition of PM came from the Project Management Institute (PMI) which was established in 1969 and has its main base in the United States. PMI has more than 100,000 members worldwide and

it publishes a guide to the Project Management Body of Knowledge, it defines project management as "the application of knowledge, skills, tools, and techniques to a wide range of activities so as to meet the requirements of a specific project" (Kenny, 2004). The new definition from 2019 expanded it to include five different groups: starting from initiating, planning, executing, monitoring and controlling. However, Project Management Knowledge affects ten areas, which include: integration, time, scope, cost, quality, human resources, procurement, communications, risk management, and stakeholder management. So, all management is concerned with these areas, but PM specifically brings a unique focus and emphasis shaped by the goals, resources and schedule of every project (PMI, 2019). But usually, the education projects are favored for decision-makers to gain control of it because the objectives, budgets and time periods are usually clearly defined. The United Nations Development Program (UNDP, 1997) defined the education project as the smallest operational unit, which is prepared and implemented as a separate entity within the educational program.   Nevertheless, the education project plans have two functions:

(1) To mobilize efforts for educational development.

(2) To provide a coherent framework that is needed for the integration of these efforts.

But education project manager has to play an important role in the planning process of the educational project. He / she will be involved in defining the educational policy, the estimation of resources and the elaboration of projects so as to achieve the educational project objectives. Hannam (2019) suggested five ways to apply PM methods in the school education. He stressed out the importance of every school to acquire the ability to manage projects. With a simple management process, schools can overcome problems with organization, communication and tracking which includes the need to keep everyone in the same circle. One of the difficulties when managing a project is making sure that all people involved are notified. Having a system that works across platforms, which is truly mobile is important. It means that team members can have notifications live. Staff members can work how they like, while guided by the current system and are free to interact how they see fit, which means they do not need to be at their class desktop.

The importance of Liven up the planning documents, having a project management system that includes all of the relevant project related details like breakdown of tasks, members' responsibility, projected financial cost, deadlines, and actual benefits if the tasks were completed.

Another important aspect is keeping track because, the key to a successfully managed team in a project, is to ensure that team members are: accountable, driven and responsible.

Finally, is the need for money constraints, by this means that the two things that happen to be true in life is that there is never enough money to spend, and there is never enough time to do the required job and being able to save or reduce one or both of these factors is the golden ticket to great project management, especially in the education sector.

Yet management of class in the 21st century is different due to new challenges arose; Google stressed on the importance of meeting these challenges. In its paper titled "Google for education: the future of classroom ", Google listed important items to be addressed for a well-managed class:

- Digital responsibility where schools help students to have a healthy relationship with technology and to be safe and confident in exploring the digital world, secondary schools need to prepare students for life skills and workforce preparation.

- Life skills. Google meant by social and vocational skills like emotional intelligence which is equally in its importance as math and science lessons, students need to understand themselves, their connections to others and to the world in order to function properly.

- Computational thinking where students are able to develop problem solving skills alongside with digital skills in order to be prepared for future jobs.

- Student led learning where students take responsibility for their own learning, some call it autonomous learning which is enhanced by introducing technology in the classroom at a pedagogical level this can be a flexible approach where the aim is to meet the individual needs of students. It may also include what it's called as student-centered learning.

- Introducing the concept of collaborative classroom where schools need to focus on openness, flexibility, and collaboration between students, it may also have called networked learning where more collaboration between students will mean more effective learning that includes the acquirement of 21st century skills. This requires redesigning the class structure where no longer all students are facing the instructor and blackboard. A landmark study has found out that classroom design alters students' academic progress over the school year by 25% (Edutopia, 2018). As Vikas Pota, Group CEO of Tomorrow Digital puts it "Collaborative layouts will benefit instructors in the way of managing groups, managing different abilities of groups and encouraging peer-to-peer learning" (Google1, 2019).

4.3. Landmarks of the relationship Agile Development – Educational Process

4.3.1. About Agile methodologies

Agile Project Management methods and processes which emphasize action and feedback over planning had continued to gain prominence for information systems projects. Even though Agile methods were initially used by multi-functional teams in projects related to software development, it was found out that it can also facilitate teamwork in a collaborative research process over waterfall model Figure 4-1 (Hidalgo, 2018). Agile teams do not follow a strictly defined action plan throughout a given project; rather, they operate in cycles, using frequent iterations over time, which allow for periodic recordings and feedback from other colleagues, along with their final product customers

(Krehbiel et al., 2017). In 2001, a team of 17 leading software leaders published what they defined the "Manifesto for Agile Software Development" where they define the values and principles of Agile software development as a summary of what they authored "better ways of developing software by doing the software and helping others do it better" (Beck et al., 2001). The main idea is to insert an incremental and iterative method instead of an in-depth planning in the beginning of a software project.

I.The requirements analysis which involves many meetings with managers, stakeholders, and other users in order to identify the business requirements. Hence, the team collects the bulk of detailed, quantifiable, and relevant information, like who will mostly use the product, and how they will be using it.

II.The planning phase where once the idea becomes feasible and viable, the team will then split it into smaller pieces of work in order to prioritize and assign them to different iterations.

III.The design where the team will look for a solution for the other requirements in order to test the strategy.

IV. Development in which the features are implemented

V.Testing where once the produced code is tested against the other requirements so as to make sure the software is actually solving the customer needs.

VI.Deployment where at this point, the product has been delivered to the customers to use it which does not mean the end of the project, yet the delivery can be partial and new requirements could arise.

Figure 4-1   Waterfall Stages

Agile methodologies in general are open to many changes in requirements and encourage constant feedback from end users and customers alike. Usually in an Agile lifecycle there will not be a strict sequence of events to follow as is the case in classic Waterfall model. The stages are more flexible and they always evolve, yet many of these stages can happen in parallel (Salza et al, 2019). The stages of the Waterfall model are presented above in figure 4-1.

Agile way of handling projects had produced several methodologies, all following its philosophy (Dingsoyr et al 2012).

These Agile Methodologies are:

(1) Adaptive Software Development (ASD) which focuses mostly on the problems that are developed in complex and large systems. This method encourages strongly the incremental and iterative development but with constant prototyping. Its main goal is to provide a framework that has enough guidance in order to prevent projects from failing in a way that could suppress emergence and creativity (Abrahamsson et al., 2002).

(2) Crystal Methods which are comprised of a group of methods for co-located teams coming from different sizes and has different colors like Clear, Yellow, Orange, Red, and Blue. Crystal Clear, which is the most used one, focuses on the communication in small teams for developing software that is not life-critical. The method of clear development has seven characteristics: frequent delivery, improvement, reflective, osmotic communication, focus, personal safety, easy access to expert users, and other requirements for technical environment (Dyba & Dingsoyr, 2008).

(3) The Dynamic Software Development Method (DSDM) which divides big projects into three distinct phases: pre-project stage, project life-cycle stage, and post project stage. Nine principles are present in this methodology: user involvement, frequent delivery, empowering the project team, addressing current business needs, allowing reversing changes, iterative and incremental development, testing throughout the lifecycle, high-level scope being fixed before project is started, and efficient and effective communication (Dyba & Dingsoyr, 2008).

(4) Extreme Programming (XP) which had started in 1996 from Kent Beck, who is one of the Agile practitioners that signed the Agile Manifesto, is a development methodology intended to improve the quality of designed software and its responsiveness to change in any customer requirement. So, XP allows frequent releases in short development cycles, while improving the productivity of the team, and eventually new customer requirements could be adopted. In XP user stories are employed and it associates acceptance tests to them which are needed to be successfully passed over before the stories can be considered as done entity. Yet the programmer is expected to write many tests for the individual tasks that need to contribute to a user story. So, XP puts tests before code, and each piece of code is required to be associated with a test, otherwise it could not be integrated. So, it focuses on the best practices for developing diversified projects and job shifts that range from planning a game, to metaphor, small releases, testing, simple design, refactoring, collective ownership, Pair Programming, Continuous Integration, onsite customers, 40-hour workweek, and coding standards (Dyba & Dingsoyr, 2008).

(5) Feature-Driven Development (FDD) where it combines Agile development and model-driven with emphasis on the initial object model, division of work in features, along with iterative design for each feature. It consists of two phases: design and development (Dyba & Dingsoyr, 2008). FDD is claimed to be suitable for the development of critical systems. An iteration of many features that are consisted of the two phases (Palmer & Felsing, 2001).

(6) Kanban is a scheduling method developed by Toyota for Lean production. It was mainly designed as a system for scheduling to facilitate the production and inventory control. By using Kanban, work teams can achieve a Just In-Time (JIT) manufacturing. This will reduce flow times within production system and it will reduce response times from suppliers to customers (Sugimori et al. 1977).

(7) Scrum, where the focus is on project management in a situation that is difficult to plan. It has mechanisms for "empirical process control", while the feedback loop constitutes the main element. Scrum was created in 1993 and was presented to the scientific community in 1995 by Schwaber and Sutherland both being among the authors of the Agile Manifesto. In Scrum the software is developed mainly by self-organizing teams in increments called "sprints "which start with planning and end with final review. The tasks are allocated to what it's called "user stories" as a quick way to handle customers' requirements without the need to create formalized documents. The Scrum lifecycle follows a set of roles (Babic, 2019) along with adhering to responsibilities and meeting new challenges. The Product Owner (PO) decides which backlog item needs to be developed in the next sprint. So, in Scrum, team members always coordinate their work in a daily stand-up meeting. One of the team members, whose name is Scrum Master (SM), will be responsible for solving problems which might affect the efficiency of the team work (Schwaber & Sutherland, 2013).

4.3.2. *Agile in Education*

Many researchers had tried to tailor Agile methodologies to the educational environment. Stewart et al. (2009) presented a cross relation of the Agile methodology in education showing how agile methods can be applied to many educational projects. They provided a mapping between many of the values and principles of the Agile Manifesto and how can be fulfilled to specific educational methods and themes. The mapping is summarized in table 4-1 which compares between Agile in general and Agile in Education.

According to the Agile Manifesto in Education (Jazillify, 2019; Kamat, 2012): Instructors and Students are more important than Administration and Infrastructure, Attitude and Learning skills over Aptitude and Formal degree, Competence and Collaboration over Compliance and Competition, Employability and Marketability over Syllabus and Marks.

The application of Agile principles in learning according to Lang (2017):

(1) Kamat (2012) "Individuals along with interactions are important than processes and tools." When applied to the context of learning, the suggestion for the instructor is to focus on working with students on one-to-one basis and to be flexible in adjusting the process and any tool used in the classroom.

(2) When "working software over comprehensive documentation," this suggests shifting the emphasis from a student writing a report to student building products which can be used in a professional environment.

Table 4-1   Comparison between Agile in General and Agile in Education

	Agile in General	Agile in Education
(1)	When it comes to high priority for customer satisfaction, in order to early and continuously delivering valuable software.	High priority for preparing student to be self-organized, and at the same time delivering continuously course components which reflects competence.
(2)	Requirements that can change at any time for the advantage of customer's competitiveness.	The instructor and students' willingness to adapt to changes continuously in order to facilitate learning and to better develop marketable skills.
(3)	Delivering working software frequently with a preference to a shorter timescale.	Obtaining working deliverables from the student over short time periods to allow for frequent feedback.
(4)	Business people and developers need to work together daily.	Iterative interaction between the instructor and the student or students in groups (teams).
(5)	Building projects around motivated individuals and the need to support them in a proper environment.	Giving students the environment and the support, they need in order to succeed in their learning experience.
(6)	Face-to-face conversation between customer and developers.	Allowing direct face-to-face interaction with students or student groups.
(7)	Working software as the primary measure of progress.	Students work, like software, models, presentations and project deliverables, as the primary measure of student progress.
(8)	The users, sponsors, and developers need to maintain a constant pace all the time.	Cooperative learning environment as the basis for teaching the skills needed for life-long learning.
(9)	The need for continuous attention to technical excellence and good design enhances agility.	Learning enhancement occurs when focusing on the need for continuous attention to technical excellence and good design.
(10)	The call for simplicity as an essential component.	Understanding the problem and solving it simply and clearly as an essential component.
(11)	The element that addresses the best requirements, architectures, and best designs which emerge from teams that are self-organized.	Student groups and student teams should self-organize, and they all should participate equally in the effort to succeed.
(12)	In regular intervals, the team reflects, then discusses how to become more effective, then adjusts its behavior accordingly.	Students and instructor's reflection and their feedback show them how to be more effective, then all the participants will adjust accordingly in order to be more efficient.

(3) "Customer collaboration is more important than contract negotiation." When applying this to learning, the instructor needs to collaborate with students instead of enforcing assignments and associated rules and orders.

(4) "The need to respond to change over the need to follow a plan". This is further emphasized with the need for the instructor to be willing and available to shift from the traditional course schedule and to adjust his/her schedule in order to respond to students' needs as they arise during the semester.

Thus, the main goal of the agile learning is to improve the instructor's power and ability to facilitate learning in an agile learning environment (Lang, 2017). By adopting the agile way of teaching and learning it will have students on the center with a focus on collaboration between students. So, by adopting Agile methodologies, there will be more engagement of participants, along with reflection and adaptive actions, has the power to give a greater sense of ownership and a better experience (Krehbiel et al., 2017).

As learning becomes more personalized and related to the learner in an individual manner it requires to adjust to ever-growing changing conditions and requirements with the need also to fulfill the strict accreditation standards requirements, so there is a need to continually search for new pedagogical methods that can meet the new challenges for change and for what it's called Education for Sustainable Development (ESD) (Gannod et al., 2015). For that reason, new pedagogic practices within formal learning environments have to be examined to search for innovative practices that support learning in a connected, collaborative way (Royle, 2016). So, one of the important challenges for ESD is to define new pedagogies and tools that allow the transmission of competencies in a modern way to allow sustainability to expand beyond teaching methods that are traditionally bonded to subjects taught in K-12 and Higher Education (Ryan, 2011). Hence, Agile methodologies were introduced mainly as an alternative to traditional project management methodologies that are based in thorough and sequential planning in what is called Waterfall models. Since education is mainly based on planning and implementing multiple projects that are based on a series of specifications, hence programs, courses, sessions and assignments are all projects with different magnitude in which both instructors and students participate together. Additionally, agile methods praise adaptive development by introducing short continuous cycles of planning phase, action phase, correction phase and adjustment phase in order to produce valuable increments in outcomes. In general, the project is first defined before executing it, which includes all the specifications, human resources, financial resources, tasks and timing need to be defined before starting the actual work. At the same time, Agile methodology is oriented to the quick obtaining of results and satisfying customers which is accomplished by recognizing changing requirements, delivering products frequently in phases, using human centered methods, and making the customer engage in regular collaboration. But more emphasis is focused on articulating goals, facilitating interactions, supporting collaboration, improving team dynamics and encouraging experimentation and innovation (Gannod et al., 2015). So, in implementing Agile in education the focus is in using incremental or iterative approach in place of deep planning in any educational project, as Agile methodologies are flexible and open to new changes and new requirements in order to encourage constant feedback from educators and students alike. Hence, the use of Agile in K-12 education specifically is also documented in many scientific papers (Fronza et al., 2017; Kastlt al., 2016; Romeike & Gottel, 2012). Fronza et al. (2017) for

instance described the design and practical implementation of an educational project framework which uses animations and programming with Scratch in order to teach computational thinking skills based on Agile practices for K-12 students. The framework proposed had covered 60 hours of work, as 4 hours per week. The K-12 students will start from brainstorming phase in the beginning and then they produced storyboards and many mind maps. In each Agile iteration covered, they will draw and they will program, then they check if they conform with the assignments. They then analyze the whole project and plan for future activities. Some scientific papers also mentioned the effectiveness of applying Agile methodologies in online courses (Noguera et al., 2018; Vivian et al., 2013). For example, Noguera et al. (2018) proposes an approach for implementing the Agile method in online academic education context. The results in the paper showed that Agile strategies which are incorporated in project-based learning had facilitated project management and team regulation. The instructor in this case acts as a facilitator and supervisor, he/she helps students improve their learning in an iterative way throughout the projects. In Agile methodology many methods can be used to teach other subjects. Seman et al., (2018) reported a study which applies Agile methodology in two project-based learning courses in a specialized subject like electrical engineering. The results also showed the importance of the human aspect in learning, given by applying Agile, as a main part of the education process in Electrical Engineering. The literature also reports many cases in which Agile was used for its many useful tools like using the Kanban board in project-based learning (Ahmad et al., 2014; Heikkila et al., 2016). Kanban boards are electronic tools that are used for the management of work in groups in order to improve quality level for delivering the product or service. This includes many aspects like product or service quality, predicting life cycle, and required time frame.

Two methods are chosen to be used in Educational Process: Extreme Programming (XP) and Scrum. A description and justification will follow based on previous studies.

XP in Education

Many of methodologies used in XP had attracted educational researchers. For example, Lembo and Vacca had proposed an instructional design methodology which exploits XP along with project-based learning (Lembo & Vacca, 2012). They revealed the usability of the XP methodologies for teaching based on the framework of the continuous change in the educational environment. Students are human beings and it is hard to detect their learning response all the time because it is changing. The proposed instructional design framework constitutes from the functional roles of the team players like students, instructors, student's families, and leadership teams. Hence, each of them is performing specific activities like solving problems, lecturing, and studying. So, similar to Agile Manifesto in Education, Lembo and Vacca adapted the similar values of Agile to the educational environment in order to apply the XP methodology which includes the following:

(1) The collaboration between students and instructors over processes and tools.

(2) The collaboration between students, instructors, and parents over educational agreements.

(3) Exciting activities over instructional design documentation.

(4) The design, problem solving and task performing over concepts and knowledge.

(5) Respond to feedback is more important than following plans. This means that the highest priority for the project leader is to satisfy students and their parents through continuous production of projects validated by team members, and hence results are achieved.

So, collaboration between instructors, students, along with student's guardians will take place during each step or iteration of the project, with preference to face-to-face communication between team members. More important is the note that the chosen educational projects have to be designed in a way so as to solve complex real-life problems but they must be of a short duration in order to generate the level of expected knowledge, skills, and capabilities. Therefore, the project has to require critical activities, analysis, problem-solving, and synthesis in order to be applied individually or collaboratively and cooperatively between the team members. Yet project proposals need to be presented in the form of stories and to be shared with students and guardians because they represent the important stakeholders.

There is plenty of literature that presents many works done regarding using XP in education for methodology in software engineering courses (Stapel et al, 2008). The literature presents the experiences and the best practices deduced from applying XP in three different XP labs that conducted the experiment during a software engineering three years course (Stapel et al., 2008). It was found out that when organizing the labs to practically experience most of the XP practices, other than entertaining students, XP had resulted in a valuable experience in improving the programming and social skills of students. Melnik and Maurer had conducted a similar study over five different academic levels of XP practices that had shown that all students accepted and liked XP (Melnik & Maurer, 2005).

Scrum in Education:

There are many scientific papers that tried to harness the power of Scrum in order to use it in education as shown in the work of Delhij et al., (2015) in eduScrum where it tried to translate the Scrum process into educational context, where the guide translates the Scrum process that includes roles and responsibilities in a pedagogic term so as to be able to use it in any subject at all education levels. The guide translates the instructor role to a Product Owner (PO) who is responsible to decide what materials need to be learned then he/she will monitor, process, and evaluate students. His/her main goal is to deliver the highest value which is translated into both discipline specific learning outcome and soft skills that includes organization, collaboration, planning, and teamwork. The student team is

considered to be self-organized; its aim is acquiring learning results in an iterative and incremental way. Then, the eduScrum Master (SM), who is chosen by the instructor who is the PO as mentioned earlier, will act as a coaching leader and he/she will help the team to perform up to its highest level of performance. The sprints are also mapped into the education context. The planned tasks are considered as time boxed events with a specific duration and designed to allow for inspection and critical transparency. Thus, the sprint is merely a collection of tasks which is organized coherently in order to achieve the learning goals. They usually have a period of less than two months. The ceremonies expected in eduScrum consisted of a planned meeting at the beginning of the sprint in order to define the team formation, its learning goals, and the planned work which needs to be done. There is a stand-up at the beginning of every class that last about five minutes in order to synchronize activities and to make plans for the next meeting. There is also a review of past activities of the last sprint in order for the members of the team to display what they have learned so far. There is also a review in order to create a plan for improvement and to prepare events for the future sprint. As for the Scrum process that was used to teach software engineering, the scientific literature reports many practices that was successfully employed (Zorzo et al., 2013). Figure 4-2 shows Scrum Framework for applying Scrum in Education.
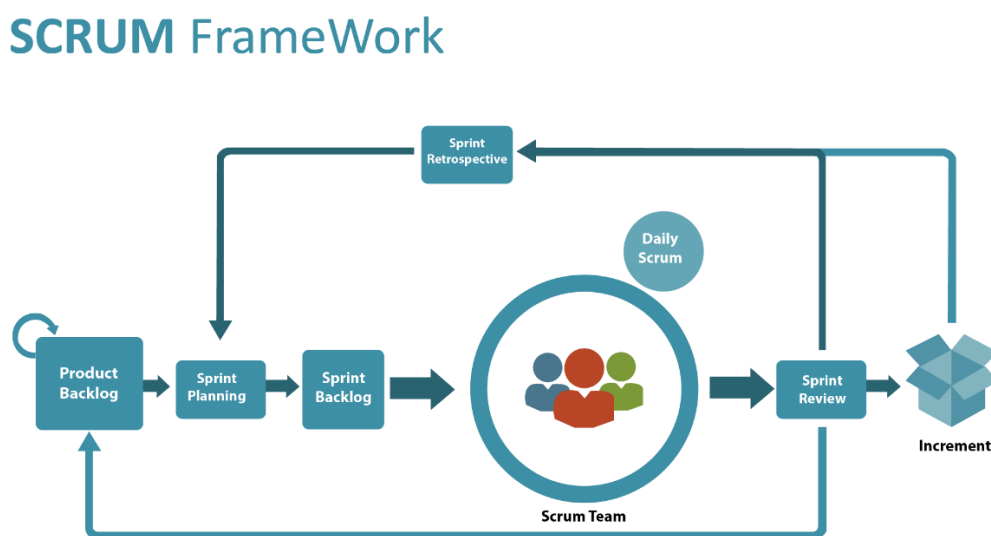
Figure 4-2   Applying Scrum in Education (scrum.org)

Scrum is mostly adapted in development of projects in undergraduate and graduate levels but Scrum can also be used in K-12 and High Education projects. The students are organized mainly into small teams and they execute the projects according to Scrum rules and regulations. As mentioned earlier the instructor will take the role of PO then one of the team members will be the SM. Missiroli et al (2017) had studied the use of Scrum in K12 setting and presented a case study of software development teaching using Scrum. They designed an experiment in seven classes from different schools but they assigned the same software project in all of them. They created two teams in every

class each with different methodology, one for classic waterfall and one for Scrum. In the Scrum methodology the Product Owner was the instructor. Even when considering the young age and shallow experience of participants, the authors suggested strikingly that Scrum was more effective in education than the traditional Waterfall methodology. Yet there was a compromise between the two methodologies in planning and structure as in Waterfall method or creativity and reactivity as in Scrum method. Another successful use of Scrum in Higher Education was in the areas of games as mentioned in many scientific papers like (Steghofer et al., 2017; Von Wangenheim et al., 2013). The type of game used in Steghofer et al. is LEGO game. In this kind of games students in their own teams will learn Scrum roles, the related events, and main concepts in practice, then by simulating multiple development sprints, they incrementally plan and build a product of LEGO blocks. Another example used in games is SCRUMIA, but it involves different setup, after forming student's teams then they are asked to develop different artifacts using only paper and a pencil and over multiple sprints (von Wangenheim et al., 2013). Additionally, Scrum was employed effectively as an educational and management method in interdisciplinary educational settings (Gestwicki & McNely, 2016). Gestwicky and McNely managed groups of programmers, artists, and user interface designers in order to produce six different educational game projects (Gestwicki & McNely, 2016). The students background is a variety of degree programs. They worked in teams and in collaboration along with one or more faculty mentors and with community partners outside the university. Scrum was also used to teach other subjects (Ringert et al, 2017). Duvall et al. (2017) also implemented Scrum methodology in classroom management procedures in higher education and specifically in a discrete mathematics course. The aim was to get students take more responsibility for their learning. The method used was to get students divided into teams, to make them enjoy the self-management and the crafting of their learning process. The teams had the option to choose from lecture-based learning, traditional or interactive online textbook reading, and online video-learning. Each team kept a project management progress board in order for the product owner "i.e. the lecturer" to track team progress toward self-selected indicators. Teams work independently to achieve their goals, but some periods were dedicated for lecturing, but students felt that the time periods used were more like group discussions. Additionally, Grimheden also investigated the use of Scrum methodology in a mechatronics university level course. The materials used were defined as an integration of electronics, software engineering, mechanical engineering, and control (Grimheden, 2013). The results showed that Scrum methodology enabled the students to reach and produce better results faster.

4.4. Agile in Blogs for Education

4.4.1. Agile for the Blogs-based Approach in Education Integrating Analytics and Gamification

Blogging as an educational tool has been used across many subjects in many educational levels and over a long time. Blogs had been used to foster collaboration through virtual communities in order to encourage cognitive growth along with deeper reflection (Jimoyiannis & Angelaina, 2012), and blogs promote deep learning as Xie et al. refers to it as deep cognitive thinking which means that blogs promote learner's purposeful and conscious manipulation of ideas toward meaningful learning (Xie et al., 2010). The open-source software package WordPress is one example of a tool used for easy web publishing (Stephens, 2016) as well as Blogger by Google which both are provided as a free service. Other blogging software are also available with similar mechanisms but different features. Yet the new improvements to software related blogging have improved the uses of it in many educational communities like K12 and Higher Education. In fact, researchers have found out that students blogging can lead to improved learning outcomes and also provided positive experience with blogs as blogging can also be used to enhance student reflection (Cameron, 2012). Xie et al. (2008) found out that in student blogging reflection is useful to learning in that it makes learning meaningful. Wang et al. (2014) proposed a new model for assessment of blogging systems in order to be used toward educational use. Their model featured six variables: system quality, context and linkage quality, content quality, system use, student satisfaction and learning performance. They also argued that blogging is a participation activity that involves learner-learner, learner-instructor and also learner-content interaction.

Agile methodologies can be used when introducing blogging in educational setting. Both are based on the constructivist point of view where students need to move away from traditional way of learning in to using technology to enable collaboration, foster communication, build 21st century skills, and make students responsible on their own learnings. This will empower students to follow the path of lifelong learning that will enable them to acquire what they need to succeed in the 21st century and beyond.

In Figure 4-3 the phases of a simplified Agile Software Development Lifecycle are presented. The simplified SDLC was designed for the case of startups looking to implement the Agile approach in their activity. (Dovleac & Ionica, 2017). Applied for education projects it maintains the basic idea behind the Agile SDLC.
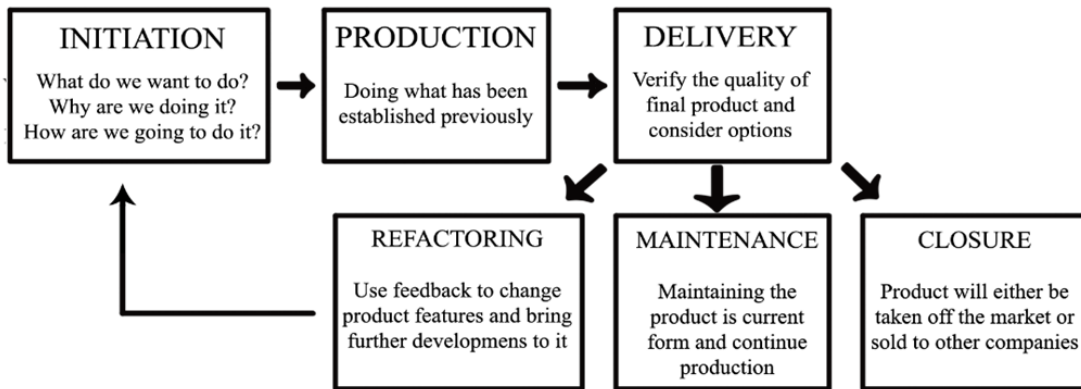
Figure 4-3   Simplified Agile Software Development Lifecycle (SDLC) (Dovleac & Ionica, 2017)

So, the simplified SDLC will be used for education projects, the case of blogs - based approach in education integrating Google Analytics and Gamification (Figure 4-4 & Figure 4-5)
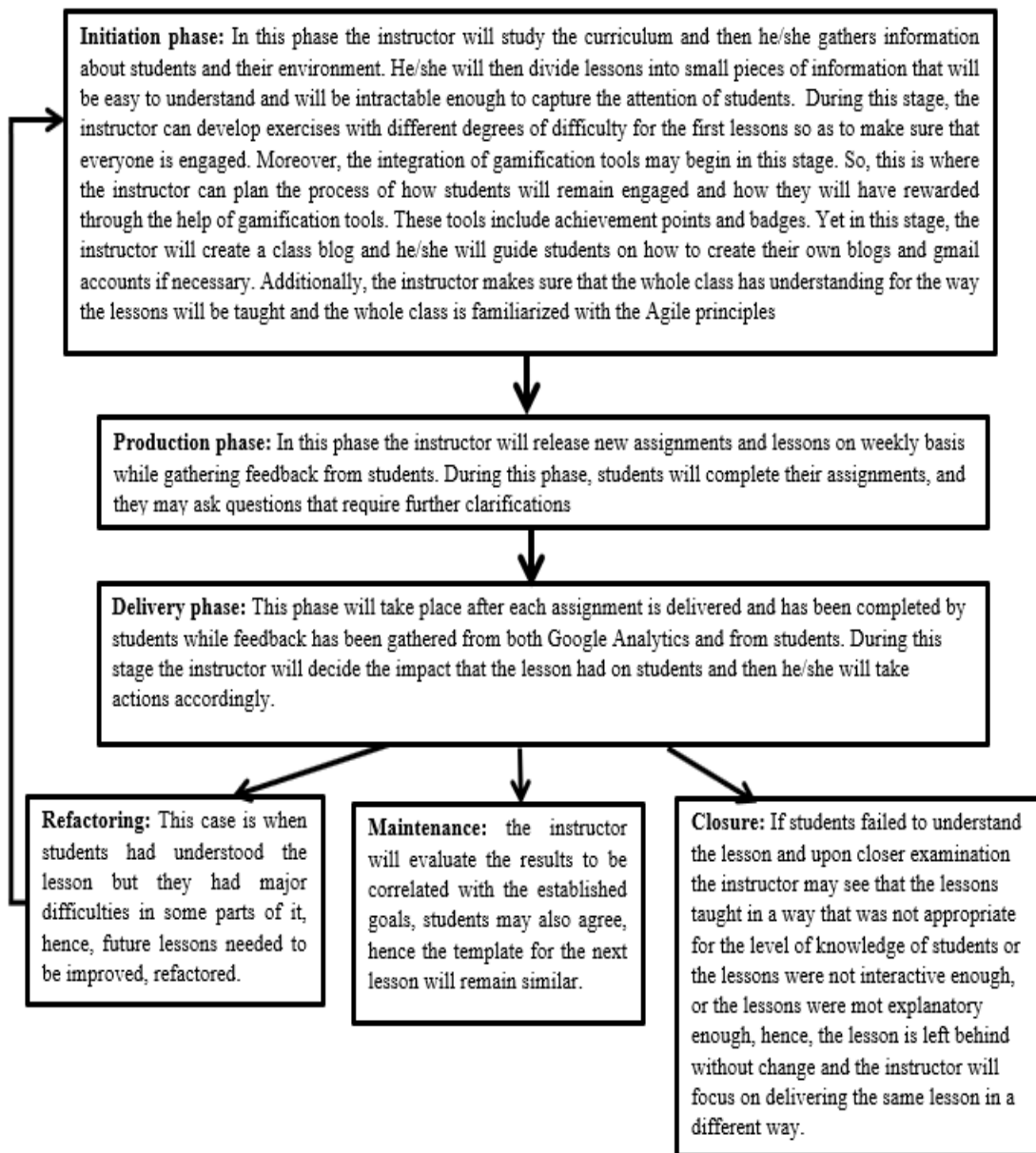
Figure 4-4   Applying the simplified Agile Software Development Lifecycle for the Blogs-based Approach in education Integrating Analytics and Gamification

Since Agile approach is focused on delivering iteratively small pieces of product rather than the whole product at once, the cycle will be repeated in the sense that after the instructor completes one of the three options following the delivery phase, he/she must return to the Initiation phase again in order to design and deliver the next lesson or assignment to students.
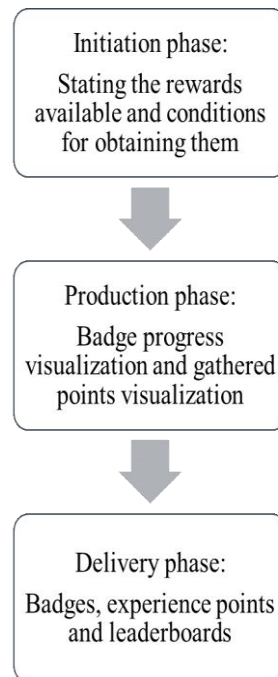
Figure 4-5   Gamifications tools used in Agile teaching approach (Dovleac et al., 2018)

As shown in figure 4-5 gamifying tools used in agile teaching requires three phases that start from the initiation phase in order to state available rewards and the conditions needed to be met in order to get these rewards. Then comes the production phase, and finally the delivery phase. In figure 4-6 Quality Management tools integrated in Agile teaching approach are introduced where the condition is introduced after the delivery phase in order to check if students completed their assignment successfully.

The integration of quality management tools for every stage of the development process in the case of the Agile teaching approach had proven to be useful in order to guarantee that quality assurance best practices had been met. Figure 4-5 shows how Gamification tools and techniques may be implemented in order to obtain the best results, while figure 4-6 shows how quality management tools can be integrated in every stage of the educational process.

Further, the proposed approach is the use of Scrum Agile methodology in a setting of using blogs in education. Since Scrum educational framework is based on a framework within which students will be able to tackle complex adaptive problems, while achieving learning goals in creative and productive way alongside personal growth of the highest possible value.
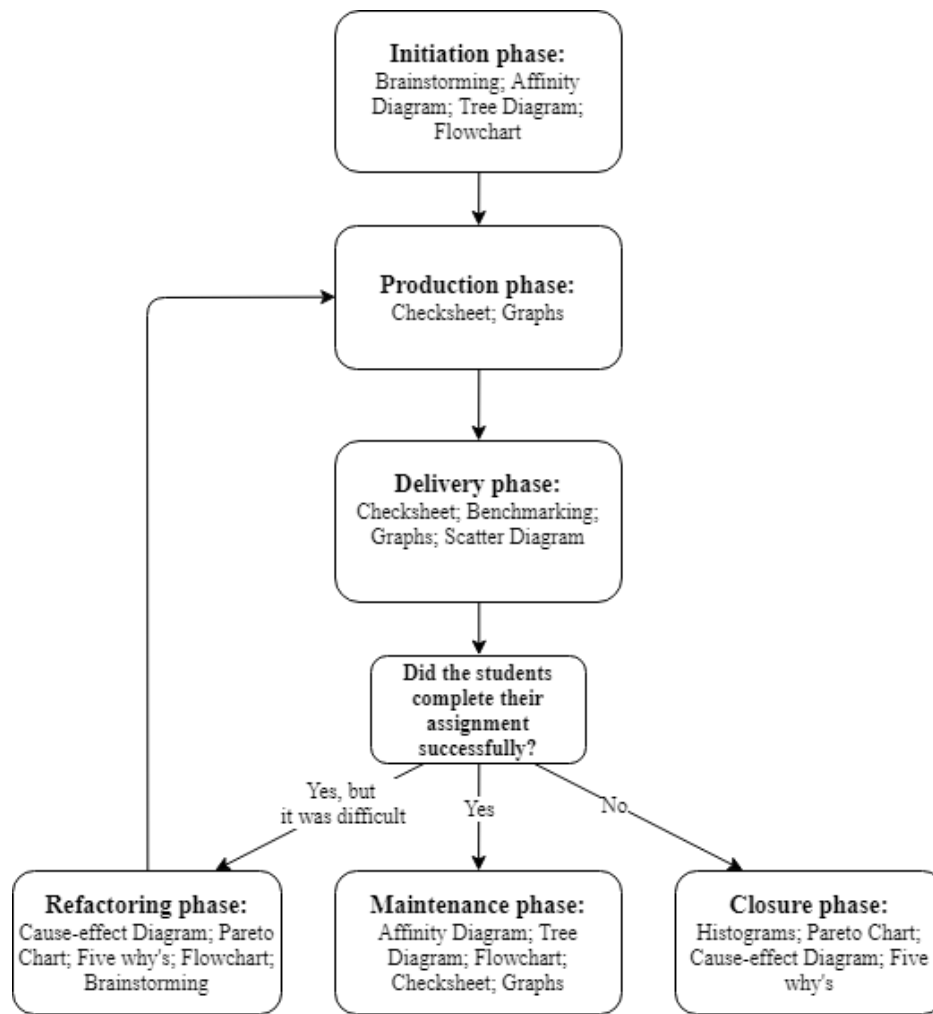
Figure 4-6   Quality management tools integrated in Agile teaching approach (Dovleac et al., 2018)

4.4.2. Scrum embedded in Blogs for Education

The study investigated the effect of teacher blogging using various training exercises and using PBL STEM discipline (Electronics) using Scrum from Agile for investigating their motivation to learn and achieve high scores. The use of Gamification was also monitored along with the use of Google Analytics to explain data retrieved. The experiment explored the motivation of these students working on Electronics project selected from the teacher blog postings and how students interacted with the blog throughout their projects.

Design and Methodology

The students are ninth graders from two classes all males in a technology school where class A (N=28) and class B (N=28). A class blog (http://abdmth9.blogspot.com) was set up starting from the beginning of the month of September, 2018 which corresponds to the beginning of the first semester in order to enable students to start learning and working on Electronics assignments throughout the whole year which represent a dynamic curriculum. Another blog was set up to include specific

electronics exercises related to the theme of students' projects. The overall theme was using smart house systems where electronic sensors can be used for building their projects (http://sts2019.blogspot.com). The projects were to build smart home using sensors within Arduino systems. Students class had two sessions for electronics and two sessions for programming (45 minutes each) per week. For electronics class there was one session theoretical which is conducted inside the classroom. Another practical session is in the electronics lab which houses Pentium i5 PCs and electronics kits. Two teachers were working with both classes one for Electronics and one for Programming. After two months from the beginning of the academic year the teachers were joined with six college students in their senior years from a local Academic Technological College to support students on their projects and work as supervisors. Students had the free choice to choose their own groups within their class in order to design their prototype (resulting nine groups presented in Appendix 4-2). Data was collected during the 2018/2019 academic year and during three academic trimesters. Semester one was from September 1st-December 23rd, while Semester two was from January 10th – April 3rd, and semester three was from April 23rd – June 20$^{th.}$ Data sources in this case included one years' worth of blog content, classroom observation, school students' interviews, supervisors' interviews, and teachers' interviews in order to uncover their perceptions of working on Electronics project within class blog from November 2018 till May 2019. It decided to use Scrum over Waterfall model because the project requirements are not simple, not well-defined, not fully understood, un-predictable, and they are subject to change until the completion of the project.

Limiting Bias in Interpretations:

The researcher conducted search for negative cases, and checked for alternative explanations for cases using multiple members of the research team so as to critically question the analysis. The members of the research team had also reviewed their results and verified it with multiple data sources.

Results and Discussions

The following observations were monitored and documented during the experiment:

Observation 1: An educational blogging Scrum team operated with a set of sprint length which remained the same for all sprints in order to make tracking easier with a defined goal or multiple goals. The blogging team collaborated to reach that goal within the designated proposed time frame (for example, the blogging team group 3 decided on a two-week sprint). The goal in this was to write a specific post for the education blog which will be completed with keyword research, visuals and other items, in order to share the post on social media, and in order to formulate a link-building approach. This had reached out to other famous sites for the purpose of building links to their post. The benefits of using Scrum in blogging, as mentioned by student a6, was that this iterative approach

had given the educational blogging team clearly defined increments of the needed work, so it can be analyzed and modified much faster and without wasting time on other related issues. Scrum's emphasis was on experimentation which meant that it encouraged teams to be fully transparent, to keep reviewing and analyzing their work, and to be able to adapt accordingly. So, for sprints, was able to provide structure and more focus for the team. Student a10 said that it enabled him to identify his goals and to work accordingly in order to achieve them. This facet of Scrum created a situational environment for continuous accomplishments, which was important because educational blogging is a continuous process that runs for a long time. So, applying educational blogging in sprints helped teams to better understand the length of the project and the amount of effort needed which helped the team to plan ahead and succeed in their planning.

Observation 2: Specifications of teachers and students' roles within the Scrum team were as follows:

(1) The Product Owner (PO), in our case was the instructor like teacher1 and teacher 2 where their main responsibility was to increase and maximize the value delivered by the Scrum team. The PO maintained the product backlog which clearly defined and ordered neatly the product backlog items. He made sure that everyone in the team understood these product backlog items well enough in order to work on them throughout the project lifecycle.

(2) The Scrum master (SM) was one of the students, like student a6, student b19. He acted as a servant-leader for the team. The SM helped everyone in the team understand and practice Scrum through advising, coaching, and making sure the work done is applied properly towards the planned objectives. He also was responsible for removing any internal or external obstructions that may prevent the team from doing its work properly.

(3) The Development Team (DT), included students formed as teams like groups 1-9. These groups had delivered an increment of the blog project which was called product and in which the team decided what is done in the sprint. It should be clear, though, that inside the DT there was no hierarchy between students in the same team or titles what so ever Figure 4-7 shows group4 project.

Observation 3: For educational blogging Scrum teams, it was noticed that it is more likely the PO – instructor and the SM - one of the students, were both active part of the development team which meant doing practical work as shown in group5 and group8 respectively. The advantage of Scrum in this case as stated by superviser2 was that it provided a great framework for organizing the work in a special way that made clear for the team members to understand who was working on what, to realize the main purpose, and why something was being done in terms of the list of tasks that was formulated earlier. So, the term product backlog was a prioritized list of everything needed for the blog project and that product-project was a blog content. The product backlog also included Product Backlog Items (PBIs) like light emitting diodes, motion, temperature and light sensors, which described the work the team that had been accomplished to add value to the product which is the educational project

like with group3 when adding a motor for opening the door garage with motion sensor. So, all of these PBI items shared these specifications like, clear descriptions, value which was determined by the blogging team, order by which the items were done, estimated time needed to be completed like group2 estimating one month for planning, three months for purchasing and installing components, and one month for debugging and testing.
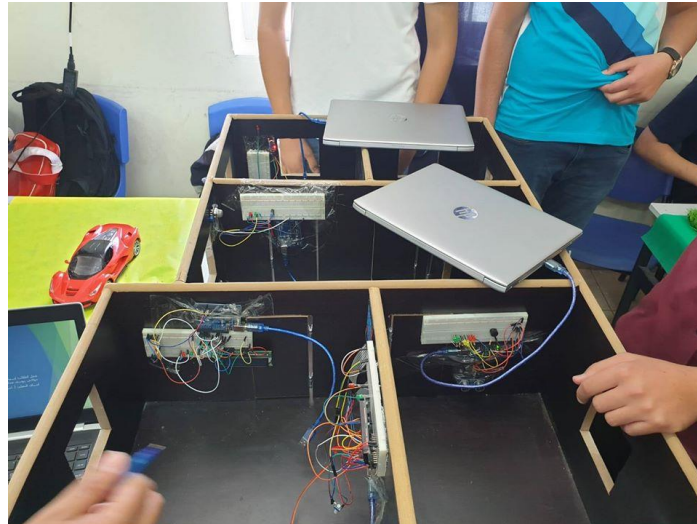
Figure 4-7   group4 project

Observation 4: The instructor as the PO consulted with the educational blogging Scrum team about the product backlog items. But, since he was the sole person responsible for the backlog and its items, the PO was able to bring focus and clarity to it. Yet, not all product backlog items were itemized or specified correctly in great detail like the case with group 6, so the PO needed to go into details on product backlog items being specified in the next sprint or two.

Observation 5: As mentioned by supervisor 4 the product backlog was not a static list but a dynamic list that was kept changing over time. That's why when his team group3 started a new sprint, the DT pulled the product backlog items required to reach the sprint goal into the sprint backlog, for example, the DT formed by students decided about the topic for the blog post in the blog like installing the light sensor (i.e. when the lights turn on once it gets dark), then they researched the topic, researched the main keywords for the blog post, wrote and formatted the blog post, created visuals like video, audio, and animations for the blog post, then proofread the blog post that was created. Then the post was published in the blog. Some other tasks that followed were setting up a social media sharing schedule, creating visuals for social media sharing, working out a strategy or a plan for link building, researching possible websites and owners, writing outreach email and finally starting an outreach campaign. All these tasks, though, were done by the DT formed by the selected students who were doing the work and had the final decision on each sprint as shown clearly in group1 and group4.

Observation 6: The Scrum teams did not use Scrum board effectively to realize the work in the sprint. That was a physical board with sticky notes posted on it. Another form was a virtual board for student's teams that used Scrum methodology. This board was applied first by group2, group4 and group7 for a short period of time only and only at the beginning in order to jump start their work. The work then moved across the Scrum board as team members were able to see all the product backlog items that have been pulled into the sprint. In this case, some of them were seen as completed, while some other were seen as in progress and some were shown on the board as still needing to be started. An example of Scrum board is shown figure 4-8 for team9 about sprint5 which details the drawing of the block diagram.
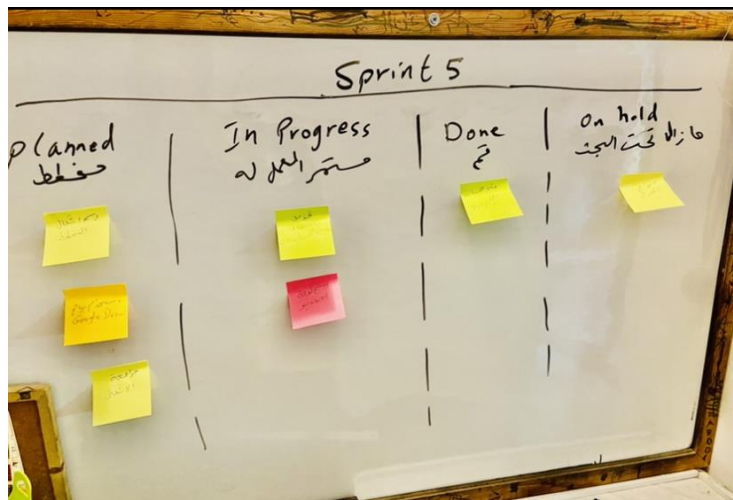
Figure 4-8   Sample Scrum board used

So, Scrum enabled a very clear, transparent, and effective way in organizing work, providing actual clear data on who did what, where the obstacles might be, and how the sprint was doing as it moved forward. This encouraged collaboration among students as team members, and it moved them forward towards the sprint goal without wasting any time or resources.

Observation 7: Scrum meetings as shown in Figure 4-9 were held regularly in order to help improve the teamwork between students and the overall educational project.

Figure 4-9   Scrum Meeting

But these meetings occurred before sprint started, at the planning meeting, the product owner who was the instructor suggested product backlog items that the students in the team needed to work on, then the development team discussed what to take on and then they planned the best way to do the work. For example, the PO (i.e. the instructor) suggested that group4 needed to work in a sprint of two weeks' period in order to write a post in their blog, to share it on social media, and then to conduct an extensive link-building campaign for their post. But the development team pointed out that there wasn't sufficient time to complete all of this work in a two-week sprint. Then the team of students agreed to prioritize their work, by taking on writing the blog post, sharing it on social media, and planning the link-building campaign for the post. They talked about how to do all these things which was necessary to accomplish the set of goals that were agreed upon. Additionally, some of these Scrum meeting had occurred daily. The team talked about what they had accomplished so far, how the whole educational project was going, and what was their plan for today. The Scrum team had identified all the possible obstacles and problems and then they discussed possible ways to overcome these obstacles and to solve these problems like in figure 4-10 where cause and effect diagram was made by group5 for smart house environment monitoring system and for tracing the reason no display was shown on the LCD 2x16 matrix display. A cause-and-effect diagram (Ishikawa diagram) examined in this case why the LCD screen did not show the desired results by organizing potential causes into smaller categories. It was useful for showing relationships between contributing factors.
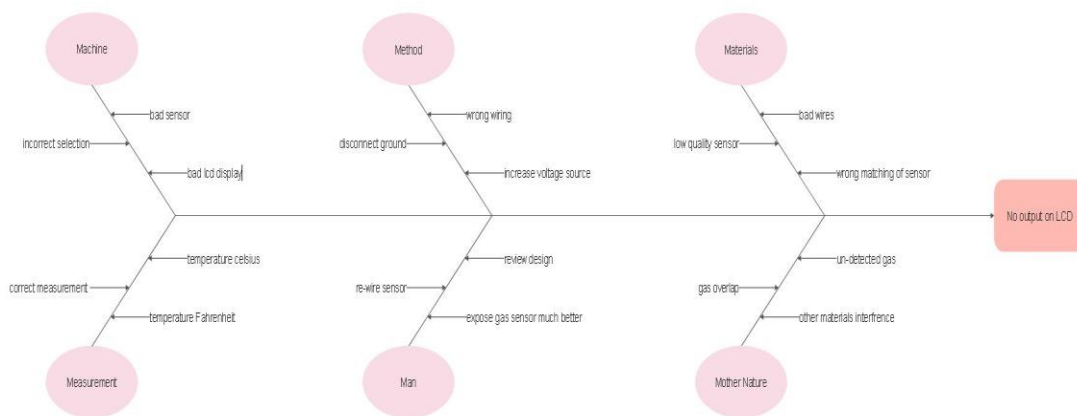
Figure 4-10   Cause and Effect diagram for Arduino gas sensor – group5

But once the sprint had finished, the Scrum team members met to review the work accomplished. They talked about what they did well in the current sprint and what could have been improved in future sprints.

Observation 8: The sprint review, as shown Figure 4-11, was a chance to show the teams work to other students, instructors, student's guardians and other stake holders and to get feedback from those stakeholders in the school system.

Figure 4-11   Sprint Review

The sprint retrospective focused on how the team of students had collaborated as one-unit, what obstacles they had faced, and how they were able to be more productive and collaborative team. The purpose of the sprint retrospective was not to find who to blame but rather to have a positive meeting which had strengthened the feeling of belonging to the team as one unit as they were working in the blog project.

Observation 9: The instructor was able to divide the project into sprints which corresponded to blog posts that lasted two weeks to one month. Some groups like group 2 and group 8 started with two weeks' sprints and ended up with 4 weeks' sprints. For students it meant working in teams and each team had their own blog to go along the project. The sprints again meant working with team blog posts to correspond to working with actual development task.

Data analysis

Figure 4-12 below provides a detailed analysis of the metrics of one of the student blogs within the project where number of users where stable within the team members. Most of the visitors are returning visitors since they are the members of the team itself reflecting upon their own posts. Pages per session were around 1.3 which means that same member of team was using blog pages over and over again in order to document the project progress.

As shown in figure 4-13, teachers' perceptions to the use of Scrum had higher percentage value in Likert scale than using non-scrum. This is due to their understanding of the value of Scrum.
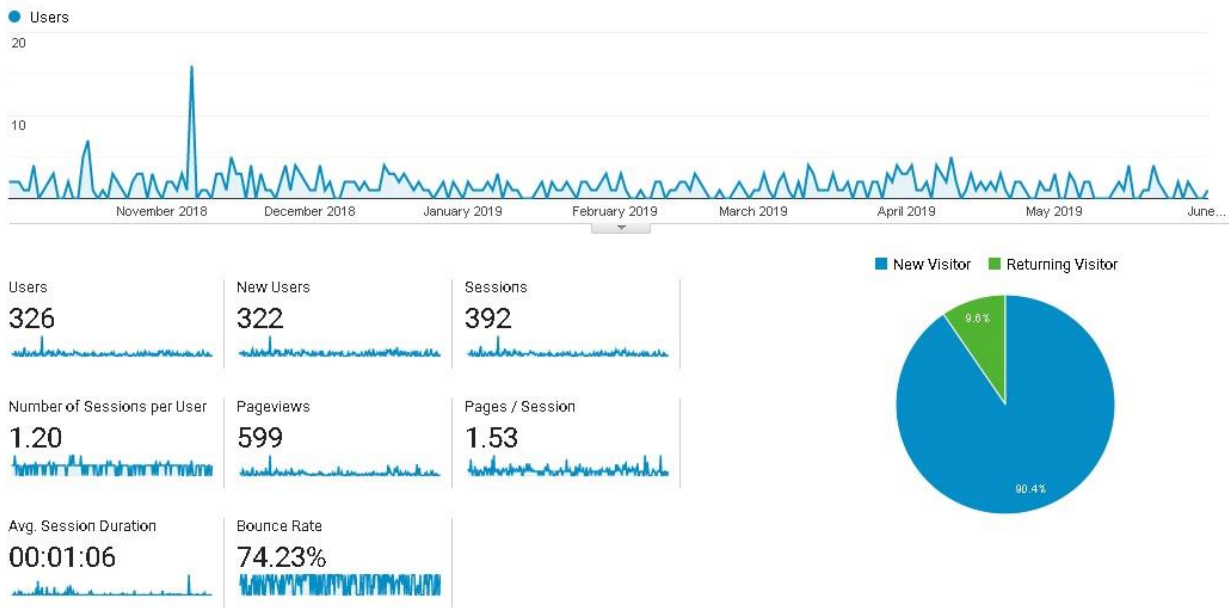
Figure 4-12   Google Analytics data for the Scrum blog-approach
[https://analytics.google.com/analytics/web/#/savedreport/fGkm2lvsQ6Gr5Z7OcuvgqA/a107544102w160593621p161787939/_u.
date00=20181001&_u.date01=20190601&_r.dsa=1&_.advseg=&_.useg=&_.sectionId=/]
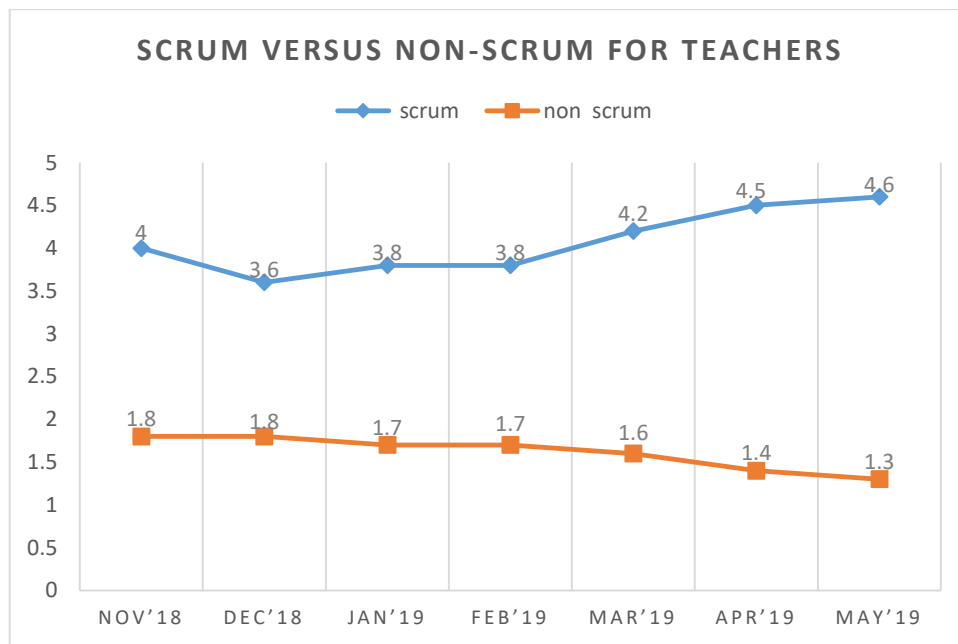
Figure 4-13   Teachers' perceptions of using Scrum

But when asked about the use of Gamification elements like badges and rewards within the use of blogs and Scrum in the Electronics project all categories had voted for it as more engaging and more motivating for students. This is shown in figure 4-14 where teachers favor on the use of Gamification (TC-Game) versus not using Gamification (TC-NGame), Supervisor's favor on the use of Gamification (SP-Game) versus not using Gamification (SP-NGame), and Students favor on the use of Gamification (ST-Game) versus not using Gamification (ST-NGame). Teachers have higher understanding of Gamification but more cautious to use it. As teacher2 puts it: "It may hinder the

educational process if not used the proper way". Yet teachers and supervisors both agreed that using blogs and Scrum in STEM had promoted more authentic assessment where authentic assessment: has the aim to evaluate students' abilities in 'real-world' contexts like these projects in electronics. Students learn how to apply their skills to authentic tasks. Authentic assessments do not encourage rote learning and passive test-taking. Instead, it promotes students' analytical skills; ability to integrate what they are learning; it promotes creativity; ability to work collaboratively; and written and oral expression skills. It has more value for the learning process as much as the finished product itself (Teacher vision, 2012).
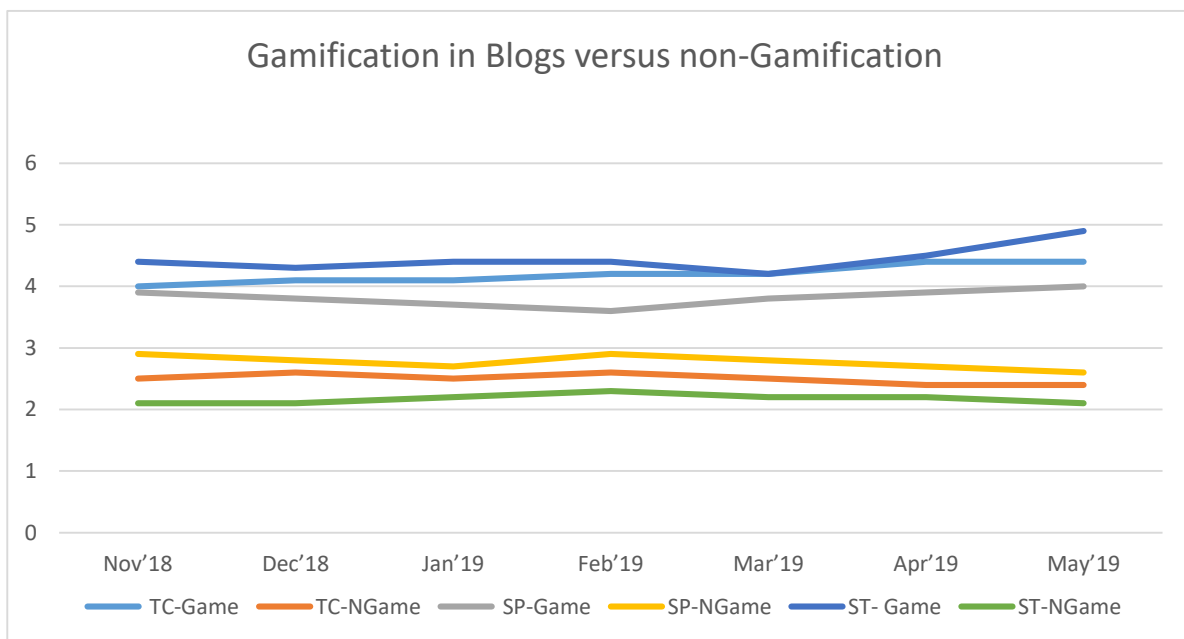
Figure 4-14   Teachers, supervisors and students' perceptions of using Gamification elements in Blogs in the context of using Scrum

The Scrum methodology was applied for creating blog content. These were useful tools in achieving the proposed theme, namely Smart House. In the end, there was a materialization of the themes. Each team presented their project and was evaluated. The evaluation method and the results are presented in Appendix 4-1. All the teams were declared winners, but the highest score was obtained by team9. For this reason, in Appendix 4-5 (1-3) is presented how the experiment was carried out by team9. An extract from the Backlog (Appendix 4-7) and the tasks performed on the sprints are presented.

4.5. Blogging in Education through the Covid-19 Pandemic

The Covid-19 Pandemic had affected education in a drastic way worldwide which had led an almost total closure of schools, colleges and universities and forced them to convert their educational procedures to on-line education (Bhamani, 2020). But many problems arise due to insufficient resources to disadvantaged students, and lack of teacher preparation to full on-line teaching. Other

problems include the inability to truly grade or evaluate students correctly, and the lack of social and psychological healthy symptoms for students within the k-12 educational system, though upper education suffered less in this aspect. Other problems concern the health of students during the pandemic where the American Center for Disease Control (CDC) had suggested that students need to get plenty of rest, exercise regularly, and that they need to eat well-balanced meals in order to assist them in coping with the mental stressors of the pandemic (CDC, 2020). Yet blogging can play a vital role in the education process even when school is using content management systems. The teacher blog can be used to organize easy to access educational materials that is synchronized and in one place like schematics and source code for electronic experiments. On the other hand, the students blog can be used more efficiently during the covid-19 epidemic to assess students learning on the condition that assignments used allow for differentiated answers like drawing an object or writing comprehension or editing a photo or recording a unique voice.

4.6. Conclusion

ICT is widely considered, among the scientific community, to have the ability to lead to significant educational and pedagogical outcomes along with support to students' development. Additionally, ICT can acquire students the knowledge and skills that they need to succeed in the 21st century society and after the Covid-19 Pandemic. Such skills needed for graduates of secondary school includes digital literacy requirements which contain ICT skills, critical thinking skills, and ethical skills. So, using Web 2.0 technologies which includes blogs, wikis, social bookmarking, social networking, RSS, media sharing, podcasting, etc., have enabled students to acquire many parts of the digital literacy requirements, hence, academics, researchers, educators and policymakers have encouraged the use of these emerged Web 2.0 applications and acknowledged the potential to offer for enhanced learning opportunities for students along with the support it has for lifelong competence development. So, based on the blog application and implementation in the educational process, there are certain approaches meant to help improve education through the emerged agile approaches. The contribution of the author of the thesis is related to the applicability that was demonstrated by the results of the Scrum methodology application as well as of including Gamification tools and Google Analytics techniques for the blog project. The aim in this case was to help raise student interest and motivation and the proposed approach can be enhanced by integrating newly emerged Quality Management and Gamification tools which can further improve the educational process.

Chapter 5: Exploring the Possibilities to Integrate AR in Blogs

The objective of the chapter is: ***Exploring Augmented Reality integration in Blogs in teaching and learning (O4).*** The research contained in this chapter was done during the pandemic period in order to offer a solution for better communication in teaching context for students and continue on using blogs as ICT tool.

5.1. Introduction

Augmented Reality (AR) has the capability to facilitate technology's usage integrated in education field in a different way than before. There's evidence from scientific literature that AR has positive effects on learning. Combined with blogs, AR will have new frontiers to be explored. Two approaches are proposed here that introduce the strength of AR combined with Blogs in an educational framework: First AR usage, which is aroused by markers, in order to upload the solution to a problem-to-solve in a blog (as e-portfolio). The second approach used is Engine Based Blog. Both approaches may benefit the power of AR in order to enhance learning, provide students with 21st century necessary skills and increase the level of motivation. The first approach is simple using the case of electronics course that uses Electric Circuit AR to solve electronics problems without using any hardware elements. The second approach used is more complex, where the issues presented are the principles of designing an AR engine for blogs using an example from electronics smart house system course.

5.2. AR and Blogs in Education

An important reason for using AR technology in an educational setting is its simple requirements since there is no need extra equipment which might be hard to find. For that reason, AR technology is simple to deploy; it can be accessed using computer or mobile devices at the same time, which makes it available to various educational levels. All the student needs are a mobile phone while the AR-VR class, there is a need to meet the specific hardware and/ or software requirements. For the hardware side, the students will need smartphones, Smart glasses or HMDs. For the software side, the graphic elements which will be presented are an integral part. It will need to be accomplished at high resolution. The best suitable AR-VR interface will enable both the presentation of the graphical elements and the communication established between the teacher and the students in different levels. An AR-VR class has mainly two settings where the course is taking place, first is the AR setting, and second is the VR setting. Students in the class will do their work in the AR setting. Graphics used will be available through the HMD, the Smartphone or the Smart glass. The students and the teachers will be able to represent their real image, hence the use of the avatar not a must. In the VR setting,

students and or the teachers have the option to present simultaneously in the class. In this case, the use of the avatar is default, and is accessed via VR HMDs, such as, Oculus Rift, Sony VR, or HTC Vive and other similar devices.

Using Blogs in general have become popular at some point as a need to have student or teacher voice heard individually. The world is perceived as a different setting which has led to a next step in using blogs that contain elements of VR. These types of blogs are called AR based blogs. Yet these AR blogs do not lose contact with reality, they just add VR elements which improves reality. Hence, these elements will capture the interest and the attention of the students as they become interested in new technologies and to the simulation of a world drawn by them. Additionally, instructional design needs to adapt to twenty first century challenges so that information is accessed and also to ensure the effectiveness of the teaching and learning. So, teachers should be always willing to innovate. Students, on the other hand, will be able to build their knowledge in a creative way. The proposed approach is going from simple applications to complex ones, and for different study subjects. The new implementation used by students and teachers will lead to better knowledge and other benefits like an increase in motivation as well.

Blogs have changed in a positive way the instructional methods inside the classroom (Ozcan & Genc ,2016), they also have enabled students to master different parts of the digital literacy requirements. So, working on applications that use Web 2.0 technology along Augmented Reality (AR) have the potential to offer improved learning opportunities for students which can also support lifelong competence development (Jimoyiannis& Angelaina, (2012). Since in a blog a student is engaged in participatory advanced reflective composing and revising activities (Hashemi & Cederlund, 2016), hence AR can be used in blogs to represent personal webpages for students (Sim & Hew, 2010). AR requires interaction which most blogs are, this allows visitors to leave comments and message each on the blogs. This interactivity distinguishes blogs from other static websites. AR also require gathering information, Interactivity, blogs in this case are also used to gather information related to a particular topic. They can be used as personal journals to record information on life events or other events. It can be used as a course management tool; or as an assessment tool as well. It can also be used as a communication and interaction tool. Hence a Blog can be seen as an internet-based diary that can facilitate interactive communication (Agarwal et al., 2012). Blogs could be perceived as publishing tools that can give users the ability to share with others on the web and instantly their thoughts and their ideas in different forms like text and living multimedia format most of the time with chronological order. Hence blogs are electronic diaries and publications which are composed for some audience (Li, 2005). Students and teachers can use blogs for different purposes like a knowledge log, for recording personal daily life, learning journal, or, for communication with others, or as an assessment or task management, or for expressing emotions or feelings (Sim & Hew, 2010).

Blogs can also be used as a supplementary medium to promote an achievement or knowledge acquisition for a student, it can also be used as an information sharing method within a learning community in order to advance student learning (Tekinarslan, 2010; Hume, 2012). Using a blog as an electronic portfolio enable learners to reach the information on virtual environments, to assess themselves and to monitor their progress while developing computer skills, and professional growth (Karademir et al., 2016; McBride et al., 2015). Blogs which contain all students work considered a valued assessment tool (Theodosiadou & Konstantinidis, 2015). Many e-portfolio vendors exist, so choosing the best one requires careful planning and consideration of the current and future uses (Papp, 2014). Feedback and interaction in e-portfolio blogs offer a number of advantages that were not possible before (Karlin et al., 2016). The impact goes beyond student academic motivation to performance and Self-Regulating Learning (Blaustein & Lou, 2014), Augmented Reality (AR), on the other hand, which emerged recently had many studies which has been conducted to see how different types of AR are used for learning (Akçayır & Akçayır, 2016). It's one of the innovative technologies that is believed to have a big effect in education by producing optimal augmentation in the learning and teaching environment (Sari et al., 2021). With the smallest degree of immersion or by the most advanced devices (like smartphones, or tablets) to the use of desktop computers, many were ideal for Augmented Reality applications, specifically for low and intermediate level of education since they are independent, accessible and portable (Henrysson et al., 2005). AR can increase social interactivity through encouraging educational activities outside the classroom (Chiang et al, 2014). For the use of higher immersion level other devices can be used like Smartglass or Hybrid such as Hololens or Meta 2, or devices like Head mounted Display (HMD). Yet HMDs are still expensive and it may take some time before it becomes available for the regular consumer, whereas Smart glasses are still not available fully on the market today. Although, AR technology increases students' performance and their immersion by "improving their practical skills during laboratory activities" (Akçayır et al., 2016). Student-material interaction concept recommends AR technology methods as a "learning by doing" method (Tekinarslan, 2010). But Augmented Reality motivates students for a short period, due to the novelty effect that they bring (Di Serio et al., 2012), but if AR does not alternate with the classical methods that existed in the curriculum, then student's attitudes and motivations will decrease while they become familiar with AR practice (Hsiao et al., 2012). But AR tool was perceived by students as pleasant for them, it increases their satisfaction and engagement, by developing the students' perception about their competence to deal with curriculum concepts (Baran et al., 2020). The educational materials provided (video, text and images) must though be well organized and relevant in order to enable students to research additional information related to curriculum. So enriching content with 3D graphics along with interactive animations (which is the elements of AR) will help students find lessons easier to understand than lessons made through

classical teaching methods and it will facilitate an enhanced understanding of the complex structures and can be applied in taught courses as well as during the self-study of students (Hume, 2012; Jonas et al., 2020). The interface though must be intuitive and it must help student's immersion through as many senses as possible auditory, visual and tactile (Lu et al., 2015). In the study (Bressler & Bodzin, 2013) it was shown that educational lessons based on AR technology can reduce cognitive overloading of students if the lessons are organized as games in which collaborative learning is implemented that help students to take their own decisions, however at the same increase student and/or student-student interaction. In the AR world virtual graphic elements are projected over objects from the real world, so students in this case can perceive abstract concepts or unobservable phenomena with their naked eye (like electron movements or like Earth magnetic field simulation) (Wu et al., 2012). So, by moving "among" virtual elements, physical activity will improve, along with improvement of motor skills (Bressler & Bodzin, 2013). Still, in order to speed up the time to create content and to make quick use of augmented reality technology, it is recommended that the teaching materials created to be in small, easy quantities, provided by quality equipment and devices (i.e. in order not to have errors or mistakes during the teaching course). Also, student participation in these activities must be in small groups (Furió et al., 2013). Also, Avci and Tasdemir (2019) have designed a visual virtual and augmented reality (mixed) game for the periodic table in chemistry with the Unity 3D game engine. Students learned the chemical elements in the periodic table in an audible, visual and entertaining environment and were able to experiment as if they were in an experimental environment. Hence students who do not have a science laboratory in their schools were able to do lab activities. In addition, with such application, students experienced more impressive understanding in an interactive environment without being affected by the risks and hazards in actual chemicals in the experimental environment. Heather Bellini of Goldman Sachs Research group had predicted that, by 2025, the AR market will reach the today desktop PC market size, of $80 billion. According to Cakal & Eymirli (Baum, 2016). Augmented reality technology in general consists of four different environmental tools, a camera, a computer, digital marker and real-world setting. AR adds sounds, graphics, feedback and smell of the natural world as it exists around us. Both cell phones and video games are driving the development of AR (Bonsor, 2018). AR has the power to increase learning and deepens impressions of students: According to Stanford University Virtual Human Interaction Lab researcher Jeremy Bailenson the brain usually absorbs things 33% more effectively when it is exposed to the immersive atmosphere of VR and AR. Additionally, people that are exposed to the "embodied cognition" VR and AR are 20% more likely to change their behavior by experiencing the impact of their decisions (Baum, 2016).

5.3. AR based Blogs Approach

Two simple-to-complex approaches are presented to integrate Augmented Reality into blogs.
The first is an interactive approach that give students tools to practice using Augmented Reality and the second is tutorial oriented using Augmented Reality as a mean to present knowledge.

5.3.1. AR based e-Portfolio

An e-Portfolio with Augmented Reality in a simple approach method, the use of Augmented Reality in blogs means using a marker which is proposed by the teacher for students in the class's blog, so students in this approach are accessing the problem to solve either in a PC or in a mobile phone in AR. In the AR environment students have access to all the tools needed in order to solve the problem, and when they are able to find the solution, they will make a snapshot of the phone screen where they can upload the solution to their personal blog (figure 5-1).
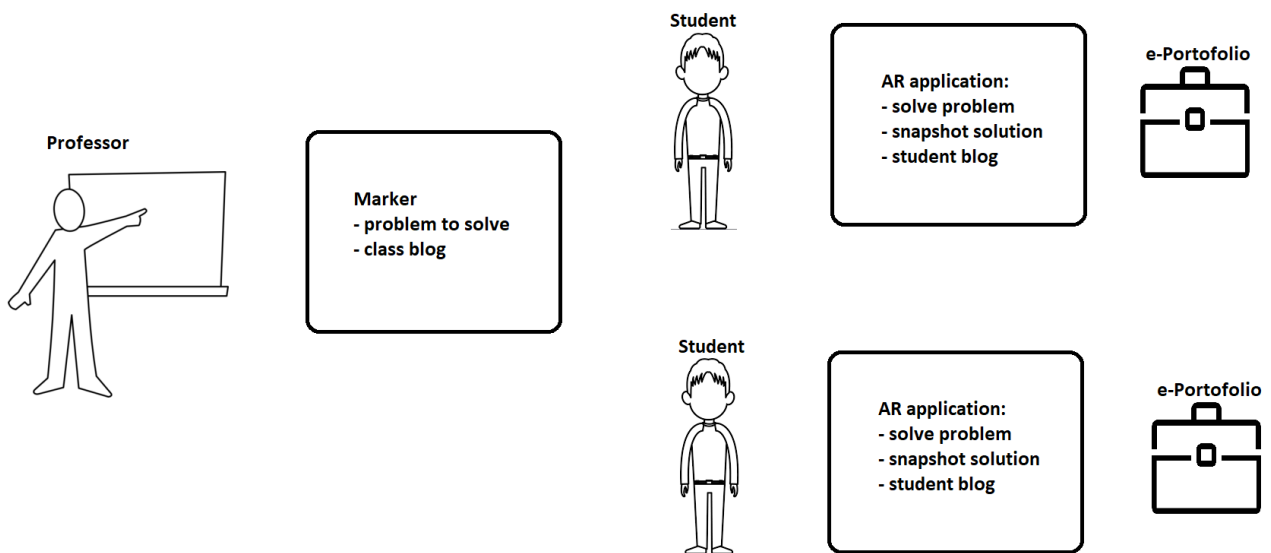
Figure 5-1   Simple Blog using AR

The present case is based on students on the ninth grade for the basic electronics course and using their blogs as e-portfolio with Augmented Reality methodology. The application of AR proposed in their case is AR circuits mobile app (https://home.cet.ac.il/) which is available in Google play at (https://play.google.com/store/apps/details?id=com.cet.circuitar&hl=iw&gl=US) and in App Store at: https://play.google.com/store/apps/details?id=com.cet.circuitar&hl=iw&gl=US)
The blog application used is Google blog (http://blogger.com). With the AR Circuits (figure 5-2) application students can practice building circuits without an actual electronics kit.

Figure 5-2　　Example of electronic AR program https://home.cet.ac.il

Figure 5-2 relates to a simple student's blogs with AR Components by using flash cards and using a mobile device with augmented reality technology application. The simple electronic circuits proposed include flash cards that can be arranged together to build circuits with power source (battery) (multiple batteries can be used), Lamps, Resistors in series configuration, digital multi-meters, diodes. Student can arrange flash cards in 4 or 6 arrangements according to the given problem. The student then will be able to take snapshots of the answers to the given problems and upload them to their own blog as in figure 5-3 where students are required to compute the value of three resistors in series by getting the reading of the Ammeter and then using ohms' law to compute the total resistance.
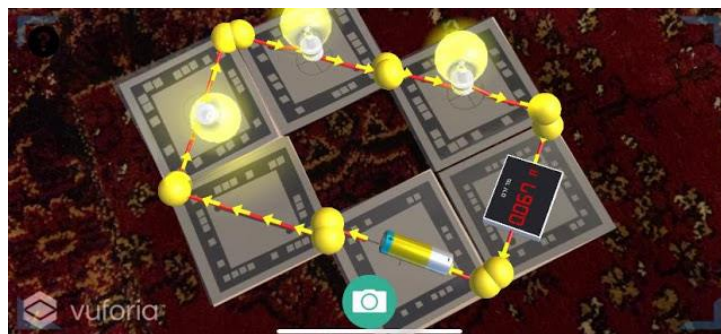
Figure 5-3　　sample of circuit built in AR: Computing the value of three resistors in series

This is used as an e portfolio as mentioned before in figure 5-1. The advantage of this learning method is that Google blogger is available for free and simple to use and customize the way the students like, there is no need for students to purchase actual electronic kits or collect physical components, there is no need for hands-on practice with electric circuits. Students will not have to face the expense, safety concerns, and other obstacles that come with physical electric components, while building and testing realistic circuits. Students will be given instructional worksheets to follow in teacher's blog. Then they will use flashcards and they will use their own mobile phones to create AR environment in an individual variation between students according to the given problem and using different flash

cards, once they combine it with AR, they will take snapshot and upload it to their own e-portfolio blog. Two types of blogs are needed in this configuration: Teacher's blog where assignments are uploaded, and students' blogs where students can work on teams or individually. Three experiments were carried out in a 45-minute session for three consecutive days. The first one was to explore the direction of the current coming out of the battery and going through a lamp. Students built a simple electric circuit and saw in real time the direction of current going from the positive terminal of the battery going through the lamp and coming back to the negative terminal of the battery. In the second experiment going to the next level (Scaffolding) by building on the previous experiment to add a multi-meter in order to measure the resistance of the lamp used. Students read the display of the multi-meter which gives the value of the current in the circuit and from that value using ohms' law students calculated the value of the resistance of the lamp. Another Scaffolding step for the next experiment and building on the knowledge obtained on experiment 2 students were required in experiment 3 to build three lamps in series with battery and multi-meter in order to verify the law of resistors in series.

Students loved using their own phones in their learning and they were immersed in learning combined with the advantage of saving snapshots on their own blogs that boosted their self-reflection, enhanced their learning, and optimized their motivation.

5.3.2. AR Engine Based Blog

The second approach used is a complex approach which includes the design of the whole AR content along with integration into blogs from scratch, just like using a Virtual Reality application. The advantage of AR to VR in this case is that, for AR, the environment already exists so there is no need to be created, but it will only be improved with various elements like virtual objects. These virtual objects are of three types: interactive, fundamental, and contextual. The fundamental elements mainly (Figure 5-4) are those that create the basic structure of the lesson hence they are at the first level in the course structure (the list with their description is in the Appendix).
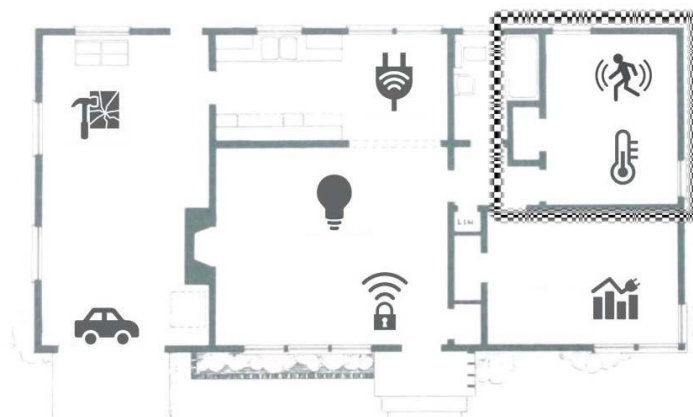
Figure 5-4   Example of Fundamental Elements - http://www.mofits.com/products-services/ 1

Interactive elements on the other side are parts of the fundamental elements, but are more detailed, which in turn may become fundamental elements to be the subject of another lesson. Contextual elements (Figure 5-5) will provide the needed additional explanations in a visual form to the description of the interactive or fundamental elements.
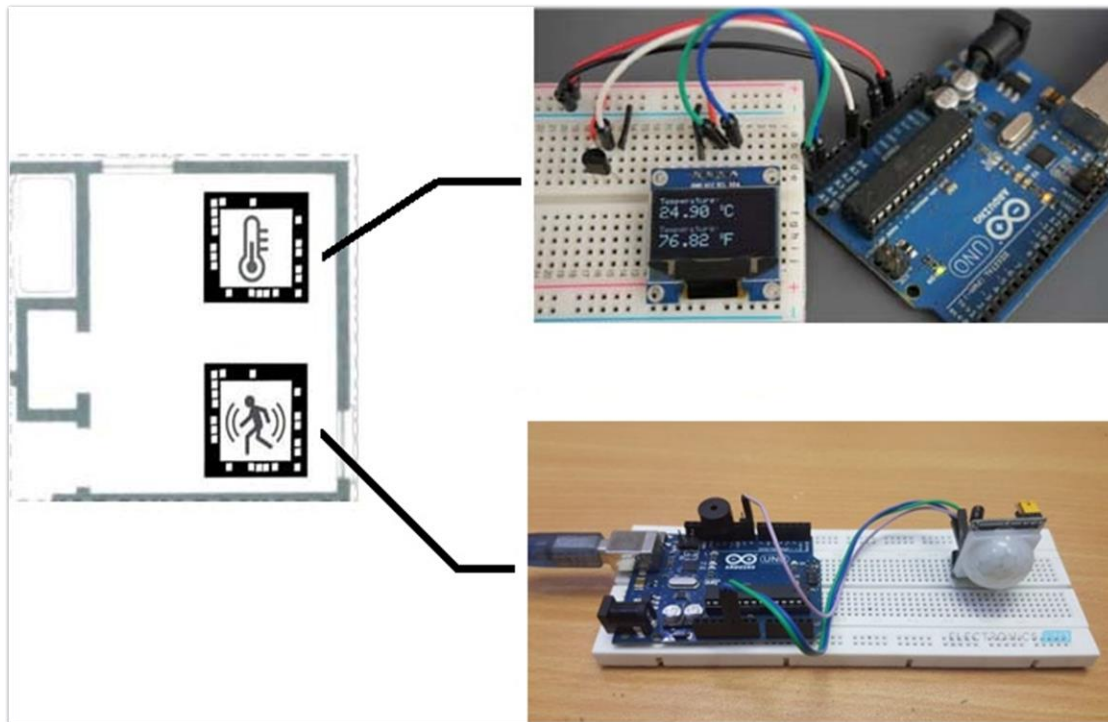
Figure 5-5   Interactive and Contextual Elements

These elements can be in the form of text, video, audio, static images or 360 degrees, as shown in figure 5-5. Interactive and contextual elements. So, in order to obtain these files, it's possible to use an audio-video editing software, or 3D geometry software, or it's possible to use products made by digital artists or other online sources. But these online sources need to be in high-quality, which is obvious that there are charges when obtaining them and that they are not available for free. Additionally, teachers can access online 3D graphic sources such as Tinkercad, or audio-video: such as Avidemux or audio: such as Audacity, and other online sources). In fact, Audio-video elements are important in creating a realistic form of virtual environment. It may vary, though, between abstract or realistic. But by using digital or real- recordings it will become closer to real life environment. So once the virtual 3D is made, it is possible to convert it to simple or interactive animated image. Meanwhile, it's possible also to use Computer Aided Design (CAD) software to create these animated or 3D images, then they can be converted simple or interactive animations. Then these images can be used inserted into "joints", or "motors", or source code can be added later on. Another example is the use of online software like Tinkercad in order to draw electric circuits and then add scripts to 3D

object which is made also in Autodesk Tinkercad. This software can be accessed through multiple platforms and various operating systems like windows 10 or apple IOS. Another example, is creating a simple animation of a security camera lens which may include: Bracket which can be adjusted in almost any direction. It also includes Infra-Red LED array, zoom and focus adjusters which includes caps to cover the adjusters with adjustments, like cowling which can be moved forwards or backwards in order to reduce glare into the camera from the sun. Also, by using photogrammetry it may also include 3D images of real objects using AR software. Once a multiple of photo snapshots are taken to the desired object, they will be digitized using any photo scanner software, and then it will be refined and modified using any CAD software. But an AR platform needs to be used in order to access the product images. Hence, virtual objects are recognized, using AR platform, in both ways: either by means of a linked image which is called a marker or it may be recognized through the analysis and recognizing the environment. The linked image will be then of two types: QR code or a manifestation of the object. By using the second path then vertical planar surface along with the horizontal planar surface will be interpreted. As a result, those elements will be resolved depending on their types like table on the floor or painting on the wall. So once the user establishes link between the marker and the object the AR software will upload these virtual elements to the server to be used later. Figure 5-6 presents the Object-AR Software-Blog to access virtual cloud objects.
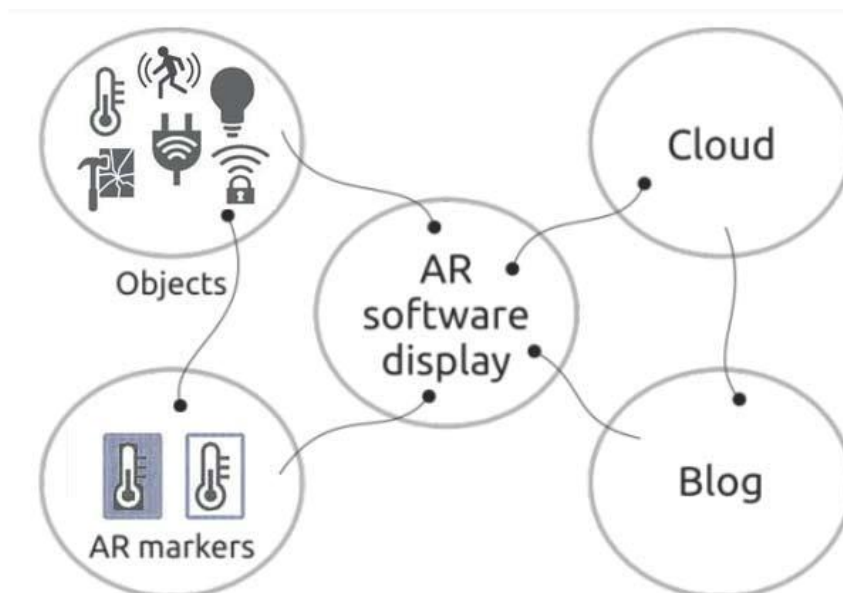
Figure 5-6   Object AR Software Blog

In this case the background image marker will post on the blog. The fundamental elements during their construction phase will have buttons that is part of the general picture. In Fig. 5-6 each component of smart home is a button in itself for triggering an animation or a contextual element. The two approaches presented can be used together to provide a full teaching and learning experience.

5.4. Conclusion

The AR applications are still in the infant stage mainly because the AR is a new technology that has not been exposed fully, yet the power that it is inside it can produce a promising effect to enhance many fields including teaching and learning. Once it's implemented in learning in a suitable manner it will then increase motivation, and provide learners across the educational system with 21st century skills. One of the promising applications of AR in education is the implementation of AR with blogs especially when using a blog as an e-portfolio in order to record AR posts, this setting had shown enhancement in learning, it promoted deep learning, it enabled students to self-reflect on their own posts and promoted for them self-regulated learning which is indeed a 21st century learning skill. Another approach to blend AR with blogs is engine-based blog which is a different approach that has a promising positive effect on students learning and their motivation. The courses proposed that support using AR can be carried out in the micro learning system and in the virtual elements that was presented which then can be used in the laboratory, as a practical part of the course, and in a relatively short time. It can also be applied in modules which can help achieve a learning objective or it can solve educational problems.

Chapter 6: Conclusions and Contributions

This research investigated the use of ICT tools in a project management approach in teaching and learning for the case of "students at risk". This was achieved by utilizing established educational theories and the work of other researchers which was obtained from a review of the relevant literature. Selected empirical studies which were conducted by other researchers in the field were reviewed. Case study research with adapted multi-instruments was used for the empirical study. An example of ICT tool used in social media is blogging which plays an increasing role in our life, being adopted for educational purposes for successful teaching and learning across two challenges: a STEM (science, technology, engineering, mathematics) subject and the case of students at risk. This study shows improvement in students' motivation and achievement with special conditions to be taken into consideration like teacher efficacy, and educational curriculum selection. The research also showed the importance of using ICT in education (the use of web 2.0 tools like blogs) and especially in STEM subjects that are usually hard for students and especially students at risk who tend to have low motivation, lower grades, and tendency to drop out of school system. Hence, comes the importance of exploring new approaches to motivate these students as the current COVID-19 epidemic pose new challenges in teaching and learning. Yet ICT tools like blogs become more important for such situations and, as the research showed, there are more scientific evidence to support and positively impact in such critical situations about how blogs give opportunities for multi model expression, scaffolding and feedback, along with reflective composing and revising activities. But not to forget the importance of assignment selection and teacher efficacy in the deployment of blog-based instruction. The use of Gamification (G) in instructional design had also a positive impact on learning, as students' engagement in a gamified learning activity resulted in a better learning outcome. The use of G along with the use of Google Analytics (GA) accurately measured student's immersion in learning. So, the use of ICT tool like blogs had proved useful as a lever to raise students' motivation, academic learning in general and the self-regulated learning in particular which is considered important as a 21st century skill and during the COVID-19 pandemic period. The use of blogs was proved useful as student blogs to show their work or as teacher blog to present dynamic curriculum to students as it considered Asynchronous Learning versus Synchronous Learning. Once Project Based Learning (PBL) is introduced in the approach of ICT in teaching and learning there arises the need to manage these projects using an Agile methodology which, in our case, was Scrum. The results conform with scientific literature which asserts the advantage of using Agile methodology in managing educational projects and in this case in STEM subject where Agile provides students with workforce ready skills like collaboration, critical thinking and gives them better performance in group projects. Additionally, the introduction of new ICT technology like AR, as further enhancement of

this research, could enable students to perform better and be more immersed in learning by improving their practical skills during laboratory activities. Yet, with the COVID-19 pandemic, in the early study performed, AR had enabled students to use teacher blogs to get their pedagogical knowledge and post their work on their own blogs to show their work with an increase in motivation. Students stated it clearly that AR tool was pleasant for them, it increased their satisfaction and engagement, by developing the students' perception about their competence to deal with hard-to-understand STEM curriculum concepts. Two simple-to-complex approaches were presented to integrate AR into blogs the first one was an interactive approach that give students tools to practice using AR which was making electronic circuits, while the second approach was tutorial oriented using AR as a mean to present knowledge where the approach was based on smart home system and using sensors and smart gadgets to represent various parts of the smart home, so both had used applications from STEM subjects. However, the educational materials provided (video, text and images) must though be well organized and relevant in order to enable students to utilize the advantages of bringing reality to a hard to comprehend scientific concepts and to reduce cognitive overloading.

Contributions

Theoretical contributions

1. Conducting a thorough literature review of students at risk which includes a view of the research field as it currently is, a broaden search area, exploration of related articles in depth, and following the citations of related articles.

2. Reviewing the concept of ICT tools in education, the definition of the concept, the importance of ICT in preparing students for 21st century skills which includes scientific statistics.

3. Analyzing the use of blogs in K-12 setting, including many definitions of blogs, types of blogs, the educational value of blogs, and up to date review of main blogs providers.

4. Highlighting the importance of teacher efficacy in motivating students. This includes the definition of the term, reviewing literature related to the connection between teacher efficacy and motivation of students.

5. Composing a lengthy review of Learning Analytics, its history and perspective, LA-Techniques and applications, the values of learning analytics, and its importance to education in general. The review also includes a revision of Google Analytics (GA), Integrating GA in blogs, the use of Gamification in blogs, and Characteristics of a Game.

6. Formulating new theories of integrating Analytics and Gamification in Teaching and Learning based on Blogs.

7. Examining the relationship between Agile Development and the educational process.

8. Devising a theory of integrating blogs with Augmented Reality (AR).

Methodological contributions

1. Designing the Framework for Gamification (G) and Google Analytics (GA) using teacher and students Blogs. GA was used as a metric solution for two situations: first with G and secondly without G elements based on students' assessments and achievements and how Gamification (G) improves the students' involvement and engagement supported with factual data.

2. Constructing an approach that integrates Triple-Loop Learning based on PDSA Cycle showing how blogging moves students from a single-loop learning process to double-loop learning which includes reflection, and enhances the learning and reflection for the teacher.

3. Producing a methodology in Agile for the blogs-based approach in education integrating analytics and gamification using Scrum embedded in student's blogs by organizing them mainly into small teams that execute the projects according to Scrum rules and regulations.

4. Devised a scheme to integrate Augmented Reality (AR) in teacher and students' blogs since both can be simple to deploy in any education setting through two simple to complex approaches, first using simple approach AR e-Portfolio by applying a marker, and secondly by using complex approach through examining AR Engine based Blog using virtual objects.

Practical contributions

1. Applying the proposed framework for evaluating the students' perceptions and outcomes in using the class's blog without G-elements and using the class's blog version with G-elements.

2. Scrum implementation for the Blogs-based Approach in Education, Integrating Analytics and Gamification.

3. AR Integration in Blogs in teaching and learning - AR based Blogs Approach.

4. AR based e-Portfolio, AR Engine Based Blog.

Limitations of the research

1. The research is based on data collected mostly during 2016-2019 and just before the spread of the Covid-19 pandemic.

2. Students during the research were Arab males, in East Jerusalem area yet ethnic variables may affect the range of response during data collection, but results may not differ entirely.

3. The design methodology is based on qualitative approach which is more suitable to address social issues and analyze human response, and human interactions.

4. The sample size range between one or two classes of students in K-12 education with numbers of students between 22-43 students depending on the subject.

Further Enhancements

1. As this research explored the use of ICT tools in a project management approach in teaching and learning for the case of "students at risk", further study is needed to explore the effect of COVID-19 pandemic on the use of blogs within on-line learning setup along with or without using content management system. In fact, COVID-19 pandemic poses new challenges to teaching and learning in general and to education of STEM subjects in particular. These were addressed by the early study on AR embedding in blogs.

2. Both the use of blogs in Synchronous Learning versus Asynchronous Learning needs further study.

3. The interaction of students with small screens in their mobiles or on their screen monitors for multiple hours is raising questions on how to manage STEM educational projects using Agile methodology.

4. The use of Gamification has different variables during a lengthy on-line learning.

Additionally, new frontiers and new dimensions are opening wide through such pandemic that poses new challenges to teaching and learning through these tough times.

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Appendices

Appendix 3-1: List of Students Blogs with Gamification

Class Blog 2017/2018 *with Gamification*: http://abdmtg10.blogspot.com

Students Blogs:

student1	http://abd1063.blogspot.com
student2	Deleted his blog accidently
student3	http://abdmtg69.blogspot.com
student4	http://abd1083.blogspot.com
student5	http://abd106.blogspot.com
student6	http://abd1073.blogspot.com
student7	http://abd1013.blogspot.com
student8	http://apd1072.blogspot.com
student9	http://abd103.blogspot.com
student10	http://abd1077.blogspot.com
student11	http://abd1043.blogspot.com
student12	http://abd1042.blogspot.com
student13	http://abd1051.blogspot.com
student14	http://abd10711.blogspot.com
student15	http://abd1016.blogspot.com
student16	http://abd1052..blogspot.com
student17	http://blogmt1032.blogspot.com
student18	http://mohammadqunber.blogspot.com
student19	http://yaghmourmustafa.blogspot.com
student20	http://muawiah223.blogspot.com
student21	http://abdmtg207.blogspot.com
student22	http://abd1014.blogspot.com
student23	http://abd1041.blogspot.com
student24	http://abd1053.blogspot.com

Appendix 3-2: List of Students Blogs without Gamification

Class Blog 2018/2019 *without Gamification*: http://abdmth10.blogspot.com

Students Blogs:

student1	http://abdmth101.blogspot.com
student2	http://abdmth102.blogspot.com
student3	http://abdmth103.blogspot.com
student4	http://abdmth104.blogspot.com
student5	http://abdmth105.blogspot.com
student6	http://abdmth106.blogspot.com
student7	http://abdmth107.blogspot.com
student8	http://abdmth108.blogspot.com
student9	http://abdmth109.blogspot.com
student10	http://abdmth1010.blogspot.com
student11	http://abdmth1021.blogspot.com
student12	http://abdmth1011.blogspot.com
student13	http://abdmth1012.blogspot.com
student14	http://abdmth1013.blogspot.com
student15	http://abdmth1014.blogspot.com
student16	http://abdmth1015.blogspot.com
student17	http://abdmth1016.blogspot.com
student18	http://abdmth1017.blogspot.com
student19	http://abdmth1018.blogspot.com
student20	http://abdmth1019.blogspot.com
student21	http://abdmth1020.blogspot.com

Appendix 3-3: Sample of form used to interview students

Question No.1:

Have you used blogs in education before?

Question No.2:

Did you like using blogs in this course

Question No.3:

What things you didn't like in using blogs throughout the semester

Question No.4:

Did you feel that your motivation to learn had increased throughout the semester?

Question No.5:

Do you have any information to add about using blogs?

Appendix 3-4: Sample of form used to interview teachers

Question No.1:

Have you used blogs in Teaching before?

Question No.2:

Do you think that students benefited from using blogs in this course?

Question No.3:

What things you liked and you didn't like in students using blogs throughout the semester?

Question No.4:

Do you think that student's motivation had increased due to using blogs?

Question No.5:

Do you think that introducing gamification elements in blogs had positive effect on students learning?

Question No.6:

Do you have any information to add about using blogs and Gamification throughout the semester?

Appendix 4-1: Project evaluation criteria used in the final Exhibition

That took place on June 12, 201928 :

Score of 20 for: Complexity of project, number of sensors used

Score of 30 for: Project functionality

Score of 20 for: The overall appearance of the project

Final Score: 70

Four groups of engineers and teachers had evaluated the projects independently and were divided into group A, group B, group C, and group D. Each evaluated the project out of score 70 as mentioned above, and then the average was taken out.

Team No.	A	B	C	D	Total	Average	Winners
1	49	47	57	57	210	52.5	5
2	46	41	59	55	201	50.25	6
3	36	42	51	51	180	45	7
4	51	47	48	55	201	50.25	6
5	48	60	56	55	219	54.75	4
6	55	60	60	54	229	57.25	2
7	32	30	45	49	156	39	8
8	57	47	56	61	221	55.25	3
9	66	61	65	66	258	64.5	1

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28 https://drive.google.com/open?id=1-_FgPmU42LtCrOABARyatOmr5ZLflq2J

Appendix 4-2: Students Groups Blogs

Team No.	Blog Address
Team 1	https://abd10653.blogspot.com/
Team 2	https://abd10651.blogspot.com/
Team 3	https://abd10655.blogspot.com/
Team 4	https://abd10654.blogspot.com/
Team 5	https://abd10656.blogspot.com/
Team 6	https://abd10652.blogspot.com/
Team 7	https://abd10658.blogspot.com/
Team 8	https://abd10659.blogspot.com/
Team 9	https://abd106599.blogspot.com/

Appendix 4-3: Students Teams

Team No.	Names in Development Teams	Product Owners
Team No.1	Scrum Master: Student a27 Team Members: Student b17 Student a26 Student a5 Student a14 Student a15 Student a25	Supervisor1+supervisor2
Team No.2	Scrum Master: Student b26 Team Members: Student b12 Student b23 Student b13 Student b25 Student b8	Supervisor1+supervisor2
Team No. 3	Scrum Master: Student a6 Team Members: Student a10 Student a17 Student a12 Student a7	Supervisor 4+ Supervisor5
Team No.4	Scrum Master: Student b19 Team Members: Student b18 Student b28 Student b3 Student b11 Student b1 Student b27	Supervisor3+Supervisor6
Team No. 5	Scrum Master: Student a9 Members: Student a4 Student a28 Student a20 Student b16 Student a13	Supervisor4+ Supervisor5
Team No. 6	Scrum Master: Student a2 Team Members: Student a22 Student a3 Student a19 Student a21 Student a11 Student a24	Supervisor 4

Team No. 7	Scrum Master: Student b10 Team Members: Student b20 Student b9 Student b15 Student b7 Student b24	Supervisor3+ Supervisor6
Team No. 8	Scrum Master: Student a1 Team Members: Student a8 Student a16 Student a18 Student a23	Supervisor3+ Supervisor6
Team No. 9	Scrum Master: Student b21 Team Members: Student b2 Student b4 Student b5 Student b6 Student b14	Supervisor2+ Supervisor3

Appendix 4-4: Student numbers and scores for the two classes

These classes were involved in the experiment which includes final grades and lab grades.

9A 2018/2019		
	Score	Lab
student a1	98	20
student a2	81	16
student a3	81	16
student a4	81	15
student a5	82	14
student a6	82	17
student a7	62	15
student a8	80	16
student a9	99	20
student a10	73	14
student a11	70	16
student a12	77	15
student a13	81	17
student a14	83	14
student a15	90	21
student a16	61	12
student a17	80	16
student a18	86	18
student a19	81	14
student a20	86	18
student a21	84	17
student a22	90	20
student a23	87	20
student a24	70	18
student a25	70	18
student a26	71	15
student a27	89	20
student a28	80	15

9B 2018/2019		
	Score	Lab
student b1	71	15
student b2	80	20
student b3	70	18
student b4	93	17
student b5	92	20
student b6	88	17
student b7	65	15
student b8	90	20
student b9	54	15
student b10	92	18
student b11	77	17
student b12	85	20
student b13	65	17
student b14	81	20
student b15	78	19
student b16	71	17
student b17	58	15
student b18	80	21
student b19	85	20
student b20	75	15
student b21	91	20
student b22	67	15
student b23	80	21
student b24	75	19
student b25	73	17
student b26	90	21
student b27	77	19

Appendix 4-5: One sample of form used to interview students

Question No.1:

Have you used or were exposed to blogs, Scrum, Gamification before?

Question No.2:

Did you like using blogs, Gamification and Scum within this project?

Question No.3:

What things you didn't like in using blogs, Scrum, Gamification throughout the semester?

Question No.4:

Did you feel that your motivation to learn had increased throughout the semester?

Question No.5:

Do you have any information to add about using blogs, Gamification, Scrum throughout the semester?

Appendix 4-6: One sample of form used to interview teachers and supervisors

Question No.1:

Have you used blogs, Scrum, Gamification in Teaching before?

Question No.3:

Do you think that students benefited from using blogs, Scrum, Gamification in this project?

Question No.5:

What things you liked and you didn't like in students using blogs, Scrum, Gamification throughout the semester?

Question No.7:

Do you think that student's motivation had increased due to using blogs, Scrum, Gamification?

Question No.8:

Do you think that introducing gamification elements in blogs, Scrum, Gamification had positive effect on students learning?

Question No.9:

Do you have any information to add about using blogs, Gamification, Scrum throughout the semester?

Appendix 4-7: Team9: Extract from the product backlog list

This includes everything needed for the project

product backlog items (PBIs):

Prepare introduction about home security systems

Why it's important to build a home security system

What is the type of home security systems?

Types of sensors needed for the project

What different Arduino boards needed for the project: Arduino Uno, mega, mini, etc.

What outputs that can be used for the project: LCD, sirens, lamps, LEDs, etc…

Is it possible to use interface systems connected to mobile phone (GSM) or just Bluetooth or Wi-Fi?

How complicated the project is needed to be?

What information need the user to collect for the project?

What will be the cost of such project?

How easy to get the required components? May be through local vendors or there is a need to import some of the components.

Other requirements needed that are non-technical like glue, ice cream sticks, wooded parts, etc.

How to draw the block diagram and what software to use and on what platform?

Describing the block diagram components starting with Infra-red sensor (IR)

The need to describe the Bluetooth hc-06 part and its physical dimensions

The description of reed switch mounted on doors or windows for security

The description needed for piezo buzzer and the flame sensor

Documenting the project steps in order to follow through

The need to discuss various schemes that can be chosen form in order to start building the project

Appendix: 4-8: Sprint number, Tasks, and Print Screen of blogs

Sprints	Tasks	PrtSc of the Blog of Team 9
1	1- Collect info 2- Brainstorming about home security 3- Priority steps needed to advance 4- Summarize ideas 5- Type on blog	Introduction to Home security system1 September 01, 2018 מבוא
2	1- Continue to collect info 2- Discuss voice sensor 3- Summarize ideas 4- State text on blog	Introduction to Home security system2 September 16, 2018 עם DIY DIY, מערכת הגנה כי הוא הולך ללכת בקלות על הכיסים שלך. את מערכת חדירה DIY לא לדאוג לאנשים! להביא לך בעיה חינם
3	1- Specify type of sensors like 2- Study Arduino needed 3- State type of LEDs needed 4- Formulate text to add in blog post	מערכת הגנה October 01, 2018 אספקה:
4	1- Choose Google account 2- Use Google Draw 3- Draw Block Diagram 4- Import to blog post	Block Diagram October 16, 2018 לוח מקשים → [ ] → לדים רכיב תקשורת Bluetooth →
5	1- Characteristics of the IR sensor 2- Collect photos to include 3- Paraphrase text to post in the blog	Block diagram description of the Home security system November 01, 2018 הסבר מעגל החשמלי
6	1- Collect info about the Bluetooth module 2- Rearrange info 3- Organize ideas 4- Prepare text to be published	hc-06: בלוטוס November 16, 2018 hc-06: בלוטוס האם טכנולוגיית התקשורת של להקה של גלי רדיו קצרים קצרים שנועדו לשדר נתונים על פני מרחקים קצרים ממטר אחד למאה מק

| 7	1- Collect info about electric switch 2- Add text about Flame sensor 3- Organize text 4- Publish to blog	מתג חשמלי ו חישן להבה December 01, 2018 מתג חשמלי: מתג ריד הוא מתג אלקטרומגנטי המשמש לשליטה על זרימת החשמל במעגל. הם עשויים משני קצוות ברזל או יותר עטוף בתוך
8	1- Prepare text about buzzer in Hebrew 2- Collect info in English 3- Add sample Arduino code for buzzer 4- Organize text 5- Publish to blog	Components December 16, 2018 Piezo Buzzer
9	1- Study up to date progress to formulate text 2- State functions of project 3- Formulate final text 4- Publish text	תיעוד הפרויקט January 02, 2019 תיעוד הפרויקט
10	1- Submit project final proposal 2- Choosing components 3- Buying parts 4- Study connections 5- Prepare text to be published to blog.	Diary1 January 15, 2019 **נובמבר**: הכנת והגשת הצעת הפרויקת

Appendix 5-1: Sample of Teachers Blog using AR program

https://mtc-ag-teacher.blogspot.com/
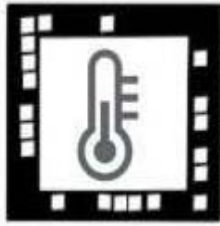
Appendix 5-2: Sample of Students blog using AR program

https://mtc-ag-student.blogspot.com/
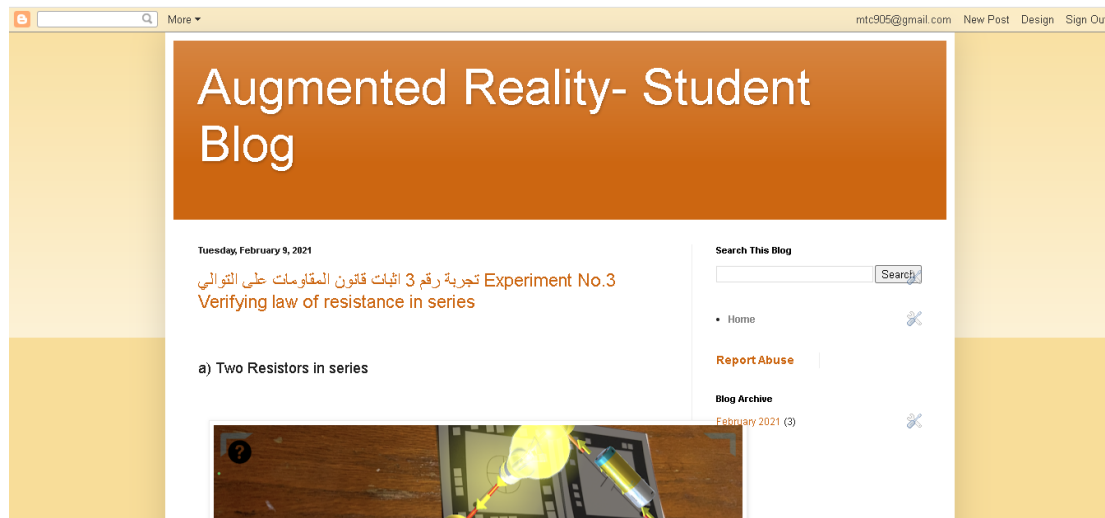
Sample of other photos:

https://drive.google.com/drive/folders/1XIHlm7gpA9Mf9HaDb4ZG_0BmfigSR1N7?usp=sharing

Appendix 5-3: List of Fundamental elements in the Smart Home

Temperature Control

Motion Detection

Light Control

Keyless Entry

Energy Management

Glass Breakage Detection system

Remote Control Appliances

Garage Control