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A randomised control trial to explore whether Gamification increased student nurse engagement with an E portfolio

by

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ABSTRACT

FACULTY OF PHYSICAL SCIENCES AND ENGINEERING
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A RANDOMISED CONTROL TRIAL TO EXPLORE WHETHER GAMIFICATION INCREASED STUDENT NURSE ENGAGEMENT WITH AN E PORTFOLIO

Pauline Morgan

Background – Gamification has been cited as a potential way of increasing student engagement and learning within education. However, the research within this area in relation to nursing students remained sparse. Since the concept of Gamification was introduced in 2010, it has steadily gained an enormous amount of interest in industry and education. The body of research had grown substantially over the past 18 years. However, the research tended to reflect experiences of computer science, mathematics and engineering students or pupils in primary and secondary school education.

Research aims – This research project set out to explore whether the introduction of a scoring system into an E-portfolio interface changed student nurses' behaviour when using an E portfolio. Specifically, the research project examined their engagement with online formative activities and to detect if any increase in learning had occurred through comparison of changes in summative practice marks between the gamified and non-gamified groups.

Methods – In 2015 (n = 210) undergraduate Bachelor of Nursing degree students were recruited and were randomly allocated to a control or an experimental group. The experimental group was exposed to a scoring system contained within the E portfolio. Those in the control group completed their E portfolio in the normal way. Each practice experience in the E portfolio contained a number of formative activities and a marked summative assessment. The participants completed three x 10 -12 weeks practice experiences. The database underneath the E portfolio was interrogated to capture the participants and their summative marks. Follow-up group discussions were used to explore potential motivational and demotivational factors that might have influenced engagement. These discussions were manually coded.

Results – Statistical analysis using t-tests, proportional comparisons of means and standard regression demonstrated that Gamification did show a statistically significant increase in student engagement. The group and individual discussion data in part, upheld the findings of the statistical analysis regarding the use of scoring systems and increased engagement. However, this effect appeared to diminish over a period time. Correlation between Gamification and age, field of nursing and gender demonstrated no significant findings. There were no significant findings in relation to differences in the mean marks attained by the students. The analysis of the group discussions upheld the findings of the RCTs and raised further question about the role played by gender and personality.

Conclusion – This research project demonstrated that Gamification using scoring systems is an effective way of increasing student nurse engagement with an E portfolio. The evidence relating to Gamification and nurse education is very sparse. This research project has opened up the field for further research related to nurse education and the longevity of scoring systems as a method of Gamification.

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DECLARATION OF AUTHORSHIP

I, Pauline Morgan, declare that this thesis, and the work presented in it, is my own and has been generated by me as the result of my own original research.

A randomised control trial to explore whether Gamification increases the frequency and quality of student nurse engagement in an E portfolio

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signed:

Date: 12th June 2018

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I dedicate this thesis to my late father, James John Morgan. I hope that he would be proud of what I have accomplished.

I would like to thank all those who have supported me during this study and without whose help the completion would not have been possible. In particular, I would like to thank:

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With the oversight of my main supervisor, editorial advice has been sought. No changes of intellectual content were made as a result of this advice.

Definitions and Abbreviations

ANCOVA – Analysis of covariance is used to test the main and interaction effects of categorical variables on a continuous dependent variable, controlling for the effects of selected other continuous variables, which co-vary with the dependent.

ANOVA – An **ANOVA** test is a way to find out if survey or experiment results are significant. One-way or two-way refers to the number of independent variables (IVs) in the Analysis of Variance test.

Bell Curve – A symmetrical **bell**-shaped **curve** that represents the distribution of values, frequencies, or probabilities of a set of data. It slopes downward from a point in the middle corresponding to the mean value, or the maximum probability.

Central Limit Theorem – A statistical theory that states that given a sufficiently large sample size from a population with a finite level of variance, the mean of all samples from the same population will be approximately equal to the mean of the population.

Five Factor Model Personality Questionnaire – A measure of the big **five personality** traits. Introduction: The big **five personality** traits are the best accepted and most commonly used **model** of **personality** in academic psychology. The big **five** come from the statistical study of responses to **personality** items.

G Power – A free-to-use software used to **calculate** statistical **power**. **G*Power** has a built-in tool for determining effect size if it cannot be estimated from prior literature or is not easily calculable.

Inferential Statistical Testing – **inferential statistics** try to infer from the sample data what the population might think. I**nferential statistics** provide information to make judgments of the probability that an observed difference between groups is a dependable one or one that might have happened by chance in this study.

Interpretivist Paradigm – The **interpretive paradigm** is concerned with understanding the world as it is from subjective experiences of individuals. Interpretivists use meaning (versus measurement) oriented methodologies, such as interviewing or participant observation, that rely on a subjective relationship between the researcher and subjects.

Interquartile Range (IQR) – a measure of variability, based on dividing a data set into quartiles. Quartiles divide a rank-ordered data set into four equal parts. The values that divide each part are called the first, second, and third quartiles; and they are denoted by Q1, Q2, and Q3, respectively.

Levene's Test for Equality of Variances – An inferential statistic used to assess the **equality of variances** for a variable calculated for two or more groups. Some common statistical procedures assume that **variances** of the populations from which different samples are drawn are **equal**. **Levene's test** assesses this assumption.

Likert Scale – A **Likert Scale** is a type of rating **scale** used to measure attitudes or opinions. With this **scale**, respondents are asked to rate items on a level of agreement. For example: Strongly agree. Agree.

Mann-Whitney U Test – A nonparametric **test** of the null hypothesis that it is equally likely that a randomly selected value from one sample will be less than or greater than a randomly selected value.

Measure of Central Tendency – A single value that describes the way in which a group of data cluster around a **central** value. There are three **measures of central tendency**: the mean, the median, and the mode.

Outliers – An observation that lies an abnormal distance from other values in a random sample from a population. Examination of the data for unusual observations that are far removed from the mass of data. These points are often referred to as **outliers**.

R Square Value – Also known as the coefficient of determination, or the coefficient of multiple determination for multiple regression. The definition of R-squared is straightforward; it is the percentage of the response variable variation that is explained by a linear model.

Rand Function – Random number function (uniform distribution). RAND(**x**) returns a computer-generated random number: (a) when **x** $\leq$ 1 then the result is a number between 0 and 1, or (b) when **x** > 1 then the result is a whole number between 1 and **x** (inclusive).

Randomised Control Trial (RCT) – A study in which people are allocated at **random** (by chance alone) to receive one of several interventions.

Shapiro-Wilk Test – The Shapiro-Wilk test is a way to tell if a random sample comes from a normal distribution. The test gives a W value; small values indicate that the sample is *not* normally distributed.

SPSS – The acronym of Statistical Package for the Social Science. **SPSS** is one of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions. It is designed for both interactive and non-interactive (batch) uses.

STATA – A data analysis and statistical software. **Stata** is a complete, integrated statistics package that provides everything you need for data analysis, data management, and graphics.

T-test – An analysis of two populations' means through the use of statistical examination; a **t-test** with two samples is commonly used with small sample sizes, **testing** the difference between the samples when the variances of two normal distributions are not known.

Wilcoxon Ranked Pairs – A non-parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e. it is a paired difference test).

Chapter 1: Introduction

This thesis presents a research project that explored Gamification as a way of increasing nursing students' engagement with activities contained within an E portfolio. This introductory chapter provides an overview of the background to the research. In addition, it explains how the chapters of the thesis have been structured. It outlines the rationale, significance and context of the research as well as details of the research aims and objectives, methods and strengths and limitations.

1.1 The Author

The Author is an experienced nursing academic with an interest in Technology Enhanced Learning. She has led several eLearning projects and has a good understanding of eLearning pedagogies as well as the challenges that introducing eLearning can present. The Author had been tasked with the conversion of a paper-based assessment practice portfolio into an online E portfolio. The reasons for undertaking this change included meeting rising student expectations, the need to reduce the amount of academic and administrative staff time associated with verifying each portfolio, security of the students' marks and feedback, and compliance with the University's Sustainability Policies.

1.2 Transition to an E portfolio

The previous paper portfolio was held by the student and was only submitted for academic verification twice a year. On the day of submission, more than 350 paper portfolios were submitted to the Faculty, where they were reviewed by a member of academic staff and the summative entries photocopied. The portfolios were then returned to the student within a 24-hour period. Once the student had completed their programme, they took the portfolio with them to show to future employers. As such, monitoring how well the student had completed the formative activities during their practice placements was practically impossible. Using an E portfolio that was accessible to academic staff online presented the opportunity to collect data that could be used to gauge levels of student engagement. Once the E portfolio was in use, it became apparent that students were not fully engaging with all the activities. The scale of non-engagement is detailed in chapter 2.

This raised the question as to how to best maximise student engagement and presented an opportunity to explore potential solutions. One solution that was considered was to increase the level of tutor scrutiny of the E portfolio entries. However, one of the reasons that the E portfolio was introduced was to reduce academic staff time. In addition, no penalty could be applied if the formative activities were not completed. Therefore, a solution was sought that would tap into the student's own intrinsic motivation. This solution needed to be both cost and time effective, in terms of development and implementation.

1.3 Gamification

As part of the Author's eLearning role, she was aware of a recent phenomenon that was attracting attention in computer and human interaction. This stemmed from the gaming world and was known as Gamification. Gamification was described as using elements of game design in non-gaming contexts to promote behaviour that would not normally occur (Kapp 2014). Gamification can take many forms, including the awarding of points and badges for challenges completed, to elaborate collaborative activities situated in highly interactive multimedia platforms.

Gamification has been increasingly used within business, conservation and areas such as health and fitness, as a way of increasing people's engagement with a variety of different activities (Edwards et al. 2016, Lithium n. d.). From 2008 onwards there has been a growing interest in the use of Gamification within education. Having looked at some of the Gamification successes, as reported by companies such as Nyke (Burke 2014, Bunchball N. D.), it was proposed that Gamification might be a way of increasing student engagement in E portfolio. The background literature and theories of Gamification are explored further in chapter 3, with a more focused review of key research papers and the findings being presented in chapter 4. The significance and contribution of this work is that very little research has been done globally in the use of Gamification in nurse education, work-based learning and the use of E portfolios. Therefore, the findings of this thesis are unique to these subject areas.

1.4 Student engagement and learning

Two fundamental questions that needed to be addressed were: What constitutes engagement? and Does engagement equate to learning? A plethora of definitions for engagement have been put forward with no universal definition being agreed upon (Webb et al. 2014). A simple definition offered by Harper and Quaye (2008) stated that:

> **'Student engagement is simply characterised as participation in educationally effective practices, both inside and outside the classroom, which leads to a range of measurable outcomes.' (Harper & Quaye 2008, pg. 1)**

This definition was chosen as it was relevant to education and linked engagement to measurable outcomes that could be operationalised to create testable hypotheses.

The importance of student engagement is that there is a consensus in the literature that student engagement increases student retention, student attainment and student learning (Trowler 2010, Inceoglu and Shukla 2011). Learning in this context was operationalised as the summative assessment percentage mark. The literature surrounding engagement and learning is also explored further in chapters 3 and 4.

1.5 Context of the research

Another consideration was that of the context in which the research was taking place. Work in Gamification in education had mainly focused on computer science students or mathematics students. Prior to 2017, very little research had taken place with undergraduate nursing students in the UK. Nursing students were very different from computer and mathematics students. Computer and mathematics students were primarily male and undertook little or no work-based learning; in contrast, nursing students were predominately female, and 50% of the undergraduate programme was undertaken as work-based learning in clinical settings This work-based learning is called Practice Experiences (PEs).

In 2003, the Royal College of Nursing (RCN) defined nursing as:

> **'The use of clinical judgement in the provision of care to enable people to improve, maintain, or recover health, to cope with health problems, and to achieve the best possible quality of life, whatever their disease or disability, until death.' (RCN 2014, pg. 3)**

Nursing is a highly practice-based profession and whilst practice is supported with theories, frameworks and evidence, developing the skills to deliver competent care requires nursing students to undergo significant periods of practice-based learning. Therefore, to create the highest calibre of nurse, motivating students to maximise formative activity and feedback opportunities was an important part of practice learning. As stated above, the context of this research, using Gamification in an E portfolio to increase student nurse engagement in formative activities, was very different to earlier work carried out in this area. The nature of nursing and the culture of nursing students is also explored in chapter 2.

1.6 Research design

To see if Gamification could offer a solution to the lack of engagement, a research project was formulated. Due to financial constraints and a lack of definitive evidence that Gamification in this setting (nurse education) would work, a very low-cost Gamification intervention was developed. This comprised introducing a scoring system based on the timing, quantity and quality of the completion of formative and summative activities in the E portfolio. To try to assess that learning had occurred, the activity scores were compared with the overall summative mark attained by the students at the end of the placement module. The research aims and question and research methods that guided this research are provided in figure 1.

The research approach taken was primarily a quantitative Randomised Control Trial (RCT) with secondary qualitative follow-up group discussions. These methods were used to explore the research aims and questions. Chapter 5 presents the development of the conceptual framework that was used to support this project. This is followed by a full account of the underpinning philosophy, methodological paradigm, research methods, sampling strategies, strategies for data cleansing and data analysis.

Overall aim To establish whether introducing a scoring system into an E portfolio changes student nurses' performance in relation to their engagement with formative activities or learning.
Research question Does the introduction of a scoring system into an E portfolio interface change the student nurses' behaviour in relation to their engagement with formative activities and learning? **Sub-questions:** a. Does the introduction of a scoring system into an E portfolio interface influence the overall engagement as evidenced by the scores attained? b. Does the introduction of a scoring system into an E portfolio interface influence the number of students making entries? c. Does the introduction of a scoring system into an E portfolio interface influence the timeliness of the students' entries? d. Does the introduction of a scoring system into an E portfolio interface influence learning, as evidenced by the summative practice placement marks attained?
Research design Randomised Control Trial with supplementary discussion groups.
Data analysis – Descriptive and Inferential statistics. Identification of significant themes from the discussion groups.

Figure 1 Overview of the research design

1.7 Data analysis

The data and the results that were generated are presented in chapter 6. The data collected included both statistical and qualitative data. The statistical analysis undertaken used a measure of central tendency, T-test for 2 independent samples, comparison of two proportions, linear regression and visual inspection for correlation. The qualitative data were reviewed for common themes (Gibbs 2008).

1.8 Strengths, limitations and further research

Chapter 7 of the thesis presents a detailed discussion of the project, highlighting the strengths and limitations as well as areas for further research. It also highlights that there continues to be a dearth of research studies surrounding the effectiveness of Gamification within education settings. This supports the importance and relevance of this project to the growing body of research relating to Gamification using scoring systems, not only in education but also in nursing and within an E portfolio. The thesis then ends with a final summary and conclusion.

1.9 Summary

This introductory chapter has 'set the scene' as to why the move away from paper assessment of practice documentation to an online E portfolio was necessary. The background of the Author and her interest in Technology Enhanced Learning was highlighted and her role in the E portfolio project was clarified. It has provided the rationale for the need to increase student engagement and the reason why Gamification was a potential way in which to achieve this. The chapter has also explained the structure of the thesis and provided an overview of the content of the following chapters. In the next chapter, the background and context of the research is explained in more depth.

Chapter 2: Background context and retrospective baseline audit

2.1 Introduction

This thesis traverses the fields of nursing, nurse education, National Health Service (NHS) Healthcare Provision, practice learning, the introduction of an E portfolio and Gamification. To provide a sound context to the research project, this chapter explores each of these fields and presents the background against which this project was set.

The chapter commences with an account of the structure of the Pre-Registration Award, Bachelor of Nursing (BN), as it was delivered in 2016 in the researcher's institution. It highlights how several high-profile reports had cited failures in care within the NHS and how this scrutiny had thrown nursing and nurse education under the spotlight. Attention is then directed to how this has led to an increased emphasis on the importance of student nurses' practice learning. It also explains how the introduction of an E portfolio on an online platform had, for the first time, enabled academic staff to capture data on students' practice activities, The findings of a baseline audit of student nurses' engagement with formative and time-sensitive practice activity is then presented, accompanied by a rationale as to why there needed to be an increase in student engagement in practice learning The chapter concludes with a discussion on the concept of Gamification and the potential to use Gamification within a nursing student's E portfolio system in order to increase engagement.

2.2 The BN Award Programme

As much as nursing has evolved, so has nurse education. In 2013, nursing became an all-graduate profession. A typical student nurse undertakes a three-year undergraduate degree programme that has been approved by the Nursing and Midwifery Council (NMC 2013). The NMC is the profession's regulatory and statutory body. Under the requirements laid down by the NMC, the BN Award Programme must include a minimum of 4,600 hours, of which 50% of these hours must be undertaken as work-based learning in practice settings. In the practice settings, students must demonstrate the ability to meet a raft of competencies and proficiency standards. These are captured in the Standards for pre-registration (NMC 2010). In addition, in the researcher's university, 50% of the academic credit awarded to students on the BN programme is achieved by the grading of their practice at the end of the placement.

As such, learning in practice is a vital part of nurse education. In 2016/17, when this research project was undertaken, the BN Award Programme at the researcher's institution comprised several theory modules interspersed with six practice experience modules of ten to twelve weeks in duration.

2.3 An overview of the world of NHS Healthcare, nursing, and nurse education

The NHS Confederation published figures in 2015 demonstrating that the largest staff group employed by the NHS was nurses. Nurses are at the frontline of care, and research has demonstrated that good nursing care plays a vital role in reducing patient mortality and morbidity (Keogh 2013). However, when there are failings in patient care, it is often nurses and their preparation and education that comes under intense scrutiny. Between 2007 and 2013, there have been several high-level enquiries and reports written about failings of care for patients within the NHS.

In 2007, Mencap published the report, 'Death by Indifference', which highlighted 6 cases of people with a learning disability who died unnecessarily in NHS hospitals. On a much larger scale, the Mid Staffordshire NHS Foundation Trust Public Inquiry revealed multiple allegations of poor care and uncompassionate care between January 2005 and March 2009, with a final report being published in 2013 (Francis 2012). Because of these events, the quality of nurse education has been called into question, leading the Government to commission Lord Willis to scrutinise the current standards for education and training of nurses in the UK (Willis 2012). Willis sets out 34 recommendations for nurse education, with a key message that;

> **'Patient-centred care should be the golden thread that runs through all pre-registration nursing education and continuing professional development.' (Willis 2012, pg. 2)**

In addition, nurses were branded in the media as lacking in care and compassion. To counter this, in 2013 the '6 Cs' (comprising competence, care, compassion, communication, courage and commitment) were launched by the Chief Nursing Officer. The 6 Cs were the bedrock that informed the development of the 'Compassion in Practice, Nursing, Midwifery and Care Staff, Our Vision and Strategy' (DoH 2012). Practice learning on the shop floor was the most robust way of evidencing and assessing that nursing students had the qualities underpinning these values and skills. The Francis report (2012), Willis Report (2012), 6 Cs (Cummings 2103) and Five Years Forward (NHS England 2014) all highlighted the importance of practice learning within the nursing profession and in addition the need to 'raise the bar' in relation to pre-registration nursing

education. A significant development that followed was the revision and proposed expansion of the clinical practice skills for pre-registration nurses and the creation of a nursing associate role (NMC 2017).

In January 2018, when this thesis was written, the new standards for pre- registration nurse education were still in draft format. However, it was generally acknowledged that the final standards would increase the level and scope of practice of the newly qualified nurse at the point of registration. Therefore, the emphasis on practice learning and the ability to apply theory to real world practice is a crucial and central part of pre-registration nurse education (Antohe et al. 2016).

2.4 Practice learning

Many different strategies have been used to promote learning in practice. Firstly, all student nurses are allocated a qualified nurse to act as practice-based supervisor or mentor for the whole duration of the practice experience module. The NMC 'Standards to support learning and assessment in practice' requires student nurses to spend 50% of their time in practice, of which 40% should be spent working with their practice-based supervisor (NMC 2008). The role of the practice-based supervisor is very diverse. They act as a mentor, coach, clinical teacher, role model, surrogate university and NMC assessor. They provide 180-degree feedback to students on their performance from other members of the wider healthcare team and mark the students' performance (RCN 2017). Students are also encouraged to undertake several formative activities, such as reflection on specific aspects of their care and gaining service user feedback. In addition, students are encouraged to work alongside specialist nurses and other members of the inter-professional team. To pass a practice experience module, the student must complete the required pass / fail practice skills and an end summative grading. There is no penalty for non-completion or poor completion of the formative elements or activities, the impact of which is discussed in a later part of this chapter.

2.5 The impact of introducing an E portfolio

The recording of practice experience achievements, feedback and the completion of activities was previously captured in a paper portfolio. These activities included time-sensitive activities such as the student's initial interview and interim assessment. It was essential that these activities were undertaken on time. The rationale for this was that if the student had the interviews or the assessments too early, they would not have had time to show their full potential, and if the

assessment was too late, then the student could not act upon the feedback to improve their performance. In addition, it was expected that students would complete all the formative activities at least, once as a minimum. Due to the limited amount of time that the students' academic tutors had access to the paper portfolio, it was difficult to monitor each student's practice activity.

The introduction of the E portfolio has made close monitoring possible, as academic tutors can access their students' E portfolio at any time and from any computer that has internet access. The result of this has been several academic tutors reporting back that student formative assessments were being completed very late into the practice experience by the practice-based supervisor. Receiving formative feedback later than the halfway point of the practice experience disadvantaged the student, as they do not have sufficient practice placement time available to develop the deficient areas of their practice. In addition, academic tutors reported great variation in the completion of the formative activities, and that many students were not receiving feedback from service users. Given the recommendations from the Willis Report concerning patient-centred care, professionalism and respecting dignity and values of patients, poor or non-completion of practice-based activity strongly suggests that practice placement learning opportunities were not being maximised by all students.

2.6 Retrospective baseline audit

Initially, the variability in the degree of completion of the non-summative elements of the E portfolio was assumed to be due to the E portfolio being very new. However, in view of the continued feedback received from academic tutors, the Author undertook a retrospective audit. This formed part of the academic work in project evaluation, as the E portfolio needed to be verified as an effective vehicle to collect assessment of practice activities and marks. The baseline audit was carried out for two reasons: firstly, to ascertain factual evidence to support the need for an intervention, and secondly, to provide a baseline to measure the effectiveness of any intervention (Phye and Robinson 2005). Indeed, the findings of the audit were key drivers for this research project.

As previously stated, in the Author's institution, student nurses undertook 6 PE modules in a variety of practice environments during their three-year programme. The audit was carried out in June 2015 on the cohort of students who had undertaken PE 4. PE 4 was chosen as students were now familiar with the E portfolio, therefore ruling out poor or non-completion due to unfamiliarity. At that time, the E portfolio was being rolled out in successive waves to the

students and 120 students had completed PE 4, which at that time represented the greater number of students using the E portfolio for a single practice experience module.

According to the 'Central Limit Theorem', when attempting to get a representative sample from a population where the distribution is not known, a sample size of n = 30 will provide an appropriate sample, irrespective of the underlying distribution (Cohen et al. 2011). In addition, as there is always a small percentage of students who do not complete the placement, the intention was to get a good understanding of the range of completion or non-completion. In this audit, 60 E portfolios were selected to counter for non-completers and to ensure that saturation was achieved. The 60 E portfolios that were examined were randomly selected using the 'Rand' function in Excel. All the student identifier numbers were downloaded, the 'Rand' function was applied and the top 60 students on the list were used as the sample. One student in the sample had not completed the placement. This student's data were excluded from the audit.

When the E portfolio was built, the ability to see the dates of completion for entries was only visible when the placement was live. Once the placement had been completed, the only dates that could be viewed were the date the summative assessment was completed and the date the E portfolio was submitted. No specific reporting function had been built in to automatically download the required data. To get to the data, it was necessary to manually access the relational database and examine each individual student's portfolio using administrative access. It took approximately ten minutes per student to locate and extract the data.

The areas of the E portfolio that were examined are listed in tables 1 and 2. Each area should have at least one entry. Table 1 shows the number of students, who made at least one entry into each of these sections. The low number of students completing the sections on detailed drug administration and the record of drug administration are likely to be because they were told that these areas were optional until the final year. However, students are advised that they can practise this skill in the years leading up to the final year assessment. A significant finding is that only 22 (37%) students gained service user feedback on their performance. Whilst all of the E portfolios reviewed in the audit had the future development plans completed, only 26 (44%) students set midpoint objectives under the 'Completing Formative Learning Needs' area. Students are expected to have an initial interview within the first three days of commencing a placement and a review alongside a formative assessment at the mid-point.

Table 2 illustrates that 41 (69%) students' initial interviews were late, as were 34 (58%) of the formative assessments. In relation to the summative review, a late entry is likely to be due to the student having an extension. Two students (3%) received their summative review too early, which could be attributed to the students not having the full amount of time in which to develop their full potential.

Table 1 Number of students completing at least one of each formative activity

Formative activities.	Yes	No
Formative exercise	57 (97%)	2 (3%)
Completing formative learning needs	26 (44%)	33 (56%)
Completing future development plan	59 (100%)	0 (0%)
Record of an external visit completed	44 (75%)	15 (25%)
Desirable skill obtained and countersigned	23 (39%)	36 (61%)
Service user completed	22 (37%)	37 (63%)
Detailed drug administration completed	12 (20%)	47 (80%)
Record of drug administration	11 (19%)	48 (81%)

Table 2 Number of students completing time-sensitive activities on time

Time-sensitive activities	Yes, early	Yes, on time	Yes, late
Completing initial interview by 15th April	0	18 (31%)	41 (69%)
Completing formative assessment by 11th May	0	25 (42%)	34 (58%)
Completing summative review	2 (3%)	57 (97%)	0

2.7 Potential solutions to increase engagement

Given the findings of the initial audit, some form of intervention was needed that would increase student engagement in the above areas. One factor that was known to be significant in providing successful online learning is that of teacher presence. Indeed, teaching presence was strongly associated with student effort and motivation in the online learning environment (Lewis and Baker 2007, Wise et al. 2004). Given that the number of students engaging with the E portfolio per year was more than 1,800, this presented a challenge in terms of increased teacher time. Academics within the Faculty were already working at maximum capacity and it was highly unlikely that additional time would be found to support this element of learning. Therefore, the challenge was to find a way to provide a means of reducing the amount of teacher presence without reducing student motivation and engagement with the formative activities.

Putting in automatic blocks so that the students could not progress until the section was completed was not feasible, as the elements are not compulsory. For example, there are some settings, such as operating theatres, where obtaining patient feedback would be almost impossible. Another option was to send emails out as reminders to students. However, this work would have had to be done by academic tutors. The purpose of the E portfolio was to cut down on academic workload. In addition, feedback from students' representatives at the Staff-Student Liaison Committee had already indicated that students were overloaded with email traffic from the Faculty.

In the Technology Enhanced Learning sector there was a growing interest in the phenomenon of Gamification and its potential to influence behaviour. Much of this information was linked to the commercial sector. Early adopters of Gamification strategies, such as Nike, have had considerable success in securing the engagement of customers and increasing customer loyalty. Similar success stories have been reported from areas such as energy conservation, banking, and insurance and public health initiatives (Bunchball 2012, Palmer et al. 2013). Gamification has also been used in energy conservation programmes to promote energy savings by the public, by insurance companies to promote healthy lifestyle choices by their clients, and by a range of commercial ventures to introduce new processes to teams and individuals. This led to a speculation that Gamification may be useful to increase student engagement in educational activities (Lee and Hammer 2011, Kapp 2012). This is discussed further in chapter 3.

2.8 Summary

This chapter has explored the nature of nursing, nurse education and the need for ensuring that pre-registration programmes of study for nurses promote holistic, values-based, patient-centred care. Practice learning is vital to develop not just competency, but the ability to deliver high quality, individualised, compassionate care to service users. Learning in practice is a vital part of this process and accounts for 50% of the academic credit and time devoted to the BN Award Programme. Much of the learning in practice is formative and relies on feedback from a variety of healthcare professionals and service users. The retrospective baseline audit identified that not all students are maximising placement learning, especially feedback from service users. To increase the level of student engagement with the formative activities contained in the E portfolio, Gamification was proposed as a solution. However, the effectiveness of Gamification within an educational context was still in a state of equipoise. Chapter 3 provides an in-depth review of the emerging literature surrounding Gamification.

Chapter 3: E portfolios, Gamification, and education; a review of background literature.

3.1 Introduction

The aim of this project was 'to establish whether introducing a scoring system into an E portfolio changes student performance in relation to their engagement with formative activities or learning'. To provide context, this chapter provides an overview of the background literature relating to E portfolios, student engagement, learning and Gamification. Leading on from this, the overlap between theories of Gamification and theories underpinning key educational concepts, such as motivation, are compared. The potential use of scoring systems as a way of increasing student engagement with an E portfolio was proposed and the chapter concludes by highlighting the need to undertake a further focused literature review to critically evaluate the evidence supporting this proposal.

3.2 Inclusion of grey literature

A well as conventional sources, this chapter draws on the grey literature that explored the areas of student engagement, motivation, E portfolios and Gamification. The Luxemburg definition of grey literature defined it as 'That which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers (GreyNet International 2019). Therefore, grey literature adds a further dimension and breadth of understanding to the subject matters under exploration. In contrast, chapter four provides a critique of selected peer reviewed primary research. The main way in which the literature in this chapter was located was through internet searches using Google and Google Scholar and snowballing i.e. reviewing the reference lists of the sources located in order locate further relevant information (Conn et al. 2003).

3.3 Definition and uses of an E portfolio

Many definitions have been proposed to define the concept, scope, structure, significance, and purpose of an E portfolio. As the uses and purposes of E portfolios have developed over time, so

have the associated definitions. A definition offered by Hartnell-Young (2004, pg. 3) states that, 'Portfolios, as the name suggests, are mobile containers for artefacts in a range of media'. Similar definitions are also offered by Ahonen and Murto (2004) and Haywood and Tosh (2004). A common feature of these early attempts to define an E portfolio is that the focus is on the physical repository or space rather than the educational value of the E portfolio as a personalised learning tool. This is in keeping with the use of E portfolios at that time, which generally tended to be a collection of electronic documents or artefacts.

A later definition offered by Educause demonstrates a movement away from the concept of an E portfolio as an electronic repository of evidence and puts the learner and the learning process, rather than the technology, at the centre of the E portfolio. 'E-portfolios have emerged as a valuable online tool that learners, faculties and institutions can use to collect, store, update, and share information. E portfolios allow students to reflect on their learning, communicate with instructors, document credentials, and provide potential employers with examples of their work.' (Educause 2005) Whilst the definition refers to reflection and sharing with external stakeholders, it still lacks scope and structure in respect of professional development and lifelong learning.

An example offered by Cotterill (2007) states that, 'In general, an E portfolio is a purposeful collection of information and digital artefacts that demonstrates development or evidences learning outcomes, skills or competencies. The process of producing an E portfolio (writing, typing, recording, etc.) usually requires the synthesis of ideas, reflection on achievements, self-awareness, and forward planning; with the potential for educational, developmental, or other benefits. Specific types of E portfolios can be defined, in part, by their purpose (such as presentation, application, reflection, assessment and personal development planning), pedagogic design, and level of structure (intrinsic or extrinsic), duration (episodic or life-long) and other factors.' This extended definition reflects the broadening scope and purpose of portfolio learning and introduced factors such as pedagogic design and structure.

Cotterill's definition moves E portfolios away from the static notion of an online document storage system of prior learning towards being a tool for developing and facilitating learning. In 2012, a more succinct definition was put forward by the Joint Information Systems Committee (JISC): 'e-Portfolio tools typically offer an online personal space or repository of digital items combined with a means of presenting selected items to others, plus tools to support the processes involved, such as authoring, synthesising and presenting material for different purposes and audiences, capturing and reflecting on learning, setting targets and engaging in dialogue.'

(JISC 2012, pg. 3) This definition again reflects the complexity of E portfolios associated with learning and is the definition used in the research project to define an E portfolio.

3.4 E Portfolios in education and learning

Portfolio learning has increased in popularity over the last decade, with reference being made in the Dearing Report (Dearing 1997). The increase in the use of technology to support teaching and learning has seen the advent of E Portfolios. High level reports such as Leitch (DIUS 2006) and Burgess (Universities UK 2007, 2012) have identified skills as being crucial to the economic wellbeing of the UK. The drivers behind this increase include the identification of market-based skills gaps and the need to strengthen employability skills.

This has resulted in the subsequent growth in vocational and work-based learning programmes (Lester and Costley 2010). As stated above, originally E Portfolios were used as an electronic replacement for paper-based systems (Garrett and Jackson 2006). Such systems captured the assessment of competency and, as such, were skills based or task orientated (Rickards et al. 2008). The emergence of new devices, platforms and operating systems, combined with greater accessibility by students, academics and employers to the internet, has been accompanied by a diversification in the ways that E Portfolios are being used (Garrison and Vaughan 2012). This included showcasing progression and/or mastery of performance as a tool for promoting learning and showcasing future employability (Woodley and Sims 2011, Balaban et al. 2013).

3.5 Student engagement

Defining the term ‘student engagement’ has been the subject of much debate. However, what is certain is that increased student engagement has positive effects on outcomes. Work carried out by Trowler (2010) identified studies from the literature that found a correlation between increased engagement and specific outcomes. Examples included increases in critical thinking and the development of practical competence, and an increase in key transferable skills, including cognitive development (Kuh 2009 cited in Trowler 2010). Indeed, Trowler’s work recognised the volume of growing literature and studies that confirmed links between student engagement and improved outcomes. As such, engagement and increased attainment was no longer a point of debate. However, finding out what motivates students to engage is not so straightforward.

Motivation is often thought as being external, i.e. reward-based, or internal, i.e. coming directly from the individual.

3.6 Motivation and goal theory

Motivation can be defined as an internal state or condition that serves to activate or energise behaviour and give it direction (Huitt 2011). Motivating students to engage in learning is a key consideration for educators. Motivation affects learning and behaviour, as it determines how hard, or indeed whether, a student will work towards a goal, the length or sustainability of student effort over time, and the enthusiasm and energy that a student will devote to that activity. High levels of motivation can lead to students initiating their own learning and development. It has also been proposed that the process of motivation can increase cognitive processing (Vrielinga et al. 2012). By increasing attention, the way the mind processes external and internal events leads to information being held at a raised level of awareness, thereby fostering greater understanding and analysis. Three types of motivational drive are acknowledged in the literature. The first drive directs behaviours needed for survival. The second drive directs behaviours needed to gain rewards and/or avoid punishment. The third drive is when something is done for the pure satisfaction and enjoyment of doing the tasks. This third type of drive is attributed to the work of Harlow (1949) and is called intrinsic motivation. There are a plethora of motivational theories and models published within the literature to explain the biological and psychological bases of the different type of drives. In this review, those that have the most significance to learning are reviewed.

3.7 Extrinsic motivation

Early research into motivation focused on extrinsic motivators with outcomes being expressed in behavioural terms, albeit voluntary or involuntary. Such models include classical and operant conditioning. Classical conditioning is often associated with the work of Pavlov, whereby the repeated pairing of a neutral stimulus such as a bell to the taste of food (classed as the unconditioned stimulus) led to the dogs salivating, even when the bell rang, and no food was presented. The bell had become the conditioned stimulus and the salivation the (involuntary) conditioned response. Therefore, the dog has made an association between the bell and food.

The contribution of classical conditioning in higher education settings is very limited. However, features of operant conditioning are still widely used (Quinn and Hughes 2013).

Operant conditioning is when conditions for associative learning are created. In associative learning, an individual learns to associate a course of action with a positive or negative outcome (sometimes referred to as carrot or stick). The desired behaviours are rewarded, whilst undesirable behaviours are discouraged by some form of punishment. An example in education is the use of marks and awards to reward academic achievement (Conor et al. 2011). Extrinsic reinforcement has been criticised, as the impact of the reinforcers varies between individuals. For example, the level of an academic mark may be a key motivating factor for some individuals but not others. Over time, the use of the same reinforcer may become less effective at eliciting the required behavioural response. Furthermore, once the reinforcer has been withdrawn the behaviour may not be retained (Huit 2011).

3.8 Intrinsic motivation

Intrinsic motivational theories were developed to counter the limitations of extrinsic motivational theories. As contemporary views surrounding motivation developed, thinking began to focus on motivation as a cognitive process that also encompassed environmental and external factors, rather than purely behaviour manifested because of associated consequences (Barkley 2010). Pink (2009) highlights that work by Harlow (1949) and Deci (1969) led to the conclusion that there was an intrinsic motivational drive at work. This intrinsic or internal drive stemmed from the fact that human beings enjoy puzzles and problem solving because they thrive on the challenge. In addition, they found that when the tasks became more complex and required lateral thinking, then the reward-punishment model of motivation did not correctly predict outcomes. In situations requiring complex problem solving, the participants who were offered the greatest reward to achieve consistently underperformed when compared with participants offered lower rewards.

High levels of incentives seemed to narrow the focus of the participants, reducing lateral thinking and creativity that, in turn, reduced innovation and productivity. Therefore, whilst incentives work for straightforward tasks, they have a negative impact on tasks that require greater cognitive processing and flexible problem solving.

3.9 Expectancy theory

In 1964, Vroom produced his Expectancy Theory. Vroom postulated that there were three factors involved in motivation and that all three had to be present for motivation to occur (Vroom and Deci 1964). These were: a) Expectancy (E), which relates to whether the task is achievable; b) Instrumentation (I), what rewards would success bring; and c) Valance (V), the worth of the reward. The theory is captured in the equation: Motivation = E x I x V. This highlights that if one of the factors is low or absent, then motivation will be significantly reduced. This theory highlights that motivation is inextricably linked to the perceived values of the reward and that this may vary between individuals and individual contexts (Gyurko 2011).

Critics of Vroom's model suggest that it is too simplistic. For example, the premise that the greater the reward, the greater the motivation will be to attain the reward. As discussed, later work carried out by Pink (2009) and others has demonstrated that increasing the rewards can adversely affect performance (Harlow 1949 cited by Pink 2009).

3.10 Goal directed behaviour and goal theory

Goal orientation theory is a social-cognitive theory of achievement motivation. Indeed, it is proposed by Goraya and Hasan (2012) that most human behaviour is goal-directed towards meeting the individual's needs. This theory seeks to explain why people are motivated to learn, as opposed to how motivation occurs. Pintrich (2000) makes the distinction between three types of goals.

Mastery goals or learning goals are those associated with learning knowledge and skills acquisition to foster self-improvement. Performance goals or ego-involvement goals are those related to surpassing the attainment of the average student or succeeding with maximum gain for the minimal effort. Social goals are those which centre on interpersonal relationships with others. The third type of goals are approach-oriented and avoidance-oriented goals. Approach-oriented goals are where individuals are motivated to work towards achieving goals that will give them praise or recognition from others. Avoidance-oriented goals reflect negative motivation. The individual avoids moving towards these goals, as they fear being perceived as incompetent by others (Kaplan and Maehr 2007).

Students who adopt mastery-oriented goals will often spend longer on the task set, whilst those that choose performance goals appear to disengage at an earlier point, especially when the performance goals are not linked to outcomes (Vansteenkiste et al. 2010). Performance goals are also more closely associated with avoidance goals, as opposed to mastery goals that foster in-

depth engagement and heightened levels of cognitive processing. Individuals persist longer at academic tasks, they are more engaged with their work, and they develop and use more effective cognitive-processing strategies (Willingham 2007).

3.11 Self-regulated learning

Self-regulated learning (SRL) and performance is defined by Zimmerman and Schunk (2011, pg. 1), as the 'processes whereby learners personally activate and sustain cognitions, affects and behaviours that are systemically orientated towards the attainments of personal goals'. SRL involves a range of activities and strategies, such as: goal setting, focusing on instruction, information processing and retrieval, time management, accessing resources and evaluation and monitoring of progression. It also requires students to have positive emotions in relation to self-belief, pride, and self-reward (Schunk and Ertmer 2000).

A variety of models have been proposed to account for SRL, some of which focus on motivation, or goal setting, or a combination of these factors (Pintrich 2000, Wolters 2003, Zimmerman 2008). A common concept shared by all is that in self-regulation, learners instigate proactive processes and have high levels of self-belief in their ability to achieve. That is, the learner demonstrates self-observation, self-judgment, and self-reaction.

Figure 2 illustrates Zimmerman's model, which describes self-regulation as a cyclical model based upon social cognitive theory. The model highlights the interaction of personal, behavioural, and environmental factors.

Forethought is also referred to as 'the pre-action phase' and can be divided into task analysis and self-motivation belief. Task analysis commences when the learner is provided with the starting condition or the specific task to be achieved (Duckworth et al. 2009). The learner then turns this into a goal or a set of goals and considers strategies for achieving these. In common with goal theory, this stage is associated with the learner assessing their ability to successfully carry out the goals, including the resources required and the end rewards (Azevedo 2005). Specificity refers to the concrete or specific idea that the goals trigger. This is where self-evaluation of the task in hand, including an estimate of the amount of effort required to succeed, occurs. Proximity is where the learner differentiates the task into short and long-term goals and the sub-division of goals into stages over time. Difficulty relates to the challenge of the task or goals. Goals need to be sufficiently challenging but not too difficult (Vriding et al. 2012).

Self-motivation can be intrinsic or extrinsic. Intrinsic motivation can be defined as 'the doing of an activity for its inherent satisfaction, rather than for some separate consequences' (Deci and Ryan 2000). Extrinsic motivation is when the goals are associated with achieving externally set

outcomes. Self-efficacy is routed in both self-motivation and goal theory, and is associated with the effort, persistence, and perceived worth of any achievements.

The performance phase involves self-control and self-observation. These directly impact on the processes that occur during learning, especially those that affect action and attention. Learners identify metacognitive strategies and undertake an initial self-evaluation to review their progress, identify distractors and use motivational strategies from the forethought phase to promote on-going performance (Rienties et al. 2012).

The final part of the cyclic process is self-reflection upon performance, whereby the learner explores what went well and what did not. Using reflection, the learner retains strategies that worked well and revises strategies that did not work as planned and in doing so, prepares for future challenges. A summary of the self-regulatory processes is given in figure 2.

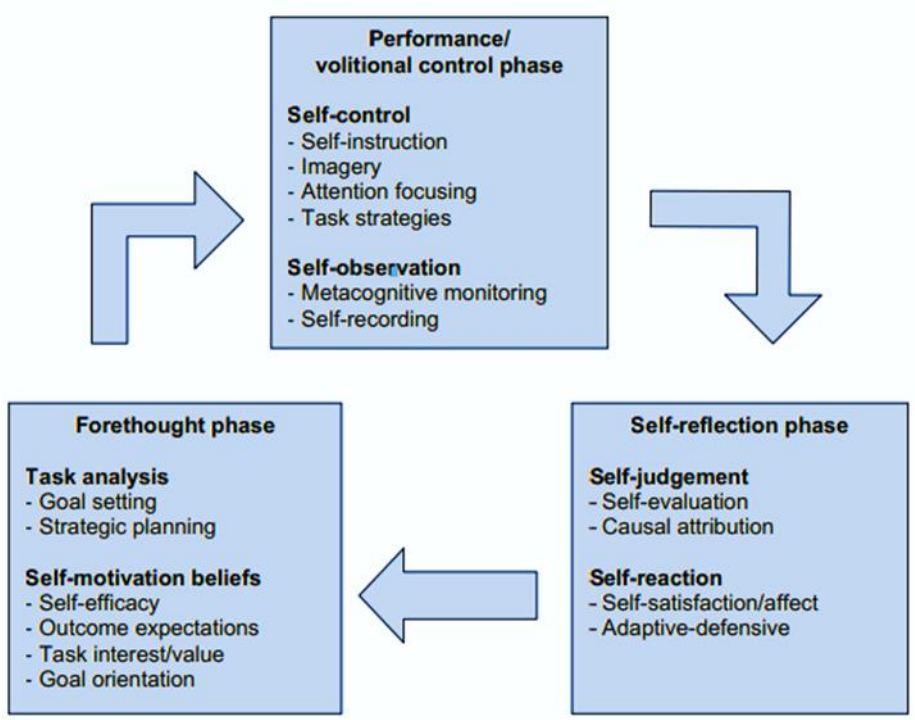


Figure 2 Self-regulatory processes of self-regulated learning (Zimmerman 2011)

Levels of self-regulation vary between learners. Factors that can influence self-regulation can be social, external, and internal. Social and external influences include how well the learning is supported through instruction, guidance, feedback, and observation of positive role modelling. Internal factors include the standards set by the learner themselves, as well as the self-belief in their own ability (Zimmerman and Risemberg 1997). Therefore, developing self-regulation in learners includes enabling them to develop metacognitive, evaluative, motivational, and reflective

strategies, which encompass the graduate attributes that student within HE institutions are required to attain (QAA 2013).

3.12 Theories of Gamification and learning

The concept of Gamification was born out of the online gaming industry, when it was first detected that individuals would spend hours on online games such as Candy Crush Saga and Farmville, often with no significant rewards other than gaining points and status (Kapp 2012). It is thought that the motivation to engage in such activity stemmed from the fun and challenging aspects of the game, rather than any monetary or material reward (Zicherman and Cunningham 2011). Achieving this level of engagement was attributed to tapping into the individual's extrinsic and intrinsic motivation, through instant feedback, non-material rewards, personal gratification, and the concept of levelling up, alongside the slick aesthetic look and feel to the overall the game (Schnell 2008, McGonical 2011, Bray 2012).

3.13 Defining Gamification

The term Gamification emerged in literature in 2008, with more frequent references being made to the term from 2010 onwards. Bray (2012, pg. 2) defines Gamification within the banking sector as the 'term for an approach to marketing and sales that employs the attributes of gaming to engage customers and change behaviours and expectations'. This definition is expanded upon by Palmer et al. (2012, pg. 54) who talk about Gamification as 'taking the essence of games/fun, play, transparency, design and challenge – and applying it to real-world objectives rather than pure entertainment'. Deterding et al.'s definition is the most succinct and widely quoted and is used to guide this project. This states that 'Gamification is the use of game design elements in non-game contexts.' (Deterding et al. 2011, pg. 1)

These definitions allude to the fact that Gamification involves a social engagement and/or goal directed behaviour. Far from being a frivolous pursuit, Gamification is gaining credence as a serious strategy to facilitate customer loyalty and retention, and to increase customer satisfaction in mainstream economic industries (Palmer et al. 2013).

3.14 Games and Gamification

Games involve the attainment of predetermined goals for rewards. In a well-constructed game, players can evidence prolonged engagement, complex problem solving and increased abilities to predict and anticipate the outcomes of their actions or the actions of others. Games that are well-

constructed evoke high levels of player motivation, with players entering a flow state similar to that described by Csikszentmihalyi and Moneta (1996), whereby the player is totally engrossed and fully focused on the activity and may persist with the activity for hours. This phenomenon accounts for the hours spent by gamers who are engrossed in games ranging from online games such as the World of Warcraft (Seeley Brown 2006), a team game involving fellow players, to solitary games such as crosswords and Sudoku. Candy Crush Saga is estimated to have more than 132 million players. Therefore, in most games the players play without the input of 'teacher presence' to assist with the continued emersion in game play.

The appeal of games is such that the scale of uptake of online games can run into millions of players. The number of users signing up to play online games, such as World of Warcraft, has earned these games the acronym of MMOG (Massive Multiplayer Online Games). Moreover, Trip Advisor is a gamified site that uses some of the principles of online games such as badges and recognition of the user's level of contribution to engage users. In 2017 TripAdvisor claimed to have had over 661 million reviews posted on their site (TripAdvisor 2017). As such, the potential to use the principles of games to engage people in specific activities was considered to be potentially huge.

3.15 Game mechanics, game dynamics and aesthetics – the building blocks of Gamification

The three main building blocks of verification are game mechanics, game dynamics and aesthetics. Game mechanics refers to the tools that are used within the gamified environment. This might include things as badges, electronic artefacts such as gems, cups, scoring systems and leaderboards (Bunchball 2012). Game dynamics is a term that refers to how the game mechanics are employed within the system. Examples include how many and when points are awarded, the updating of leaderboards to show elements of competition, unlocking of levels and using challenges to collect electronic artefacts such as jewels and cups (Zicherman & Cunningham 2011) Aesthetics refers to the enrichment of the gamified environment, such as the use of avatars, virtual reality settings and the overall look and feel of the online platform. Gamification can therefore take many forms and levels of sophistication (Kapp 2012, Kapp et al 2014)

The main factors that influence Gamification design are resources, including finance, access to appropriately trained staff and time. These factors need to be weighed up against the purpose that the gamified activities serve and the desired behavioural outcomes that are required (Burke 2014).

Therefore, Gamification in its simplest form could be purely the introduction of scoring system. In contrast, complex Gamification featured virtual realities using high fidelity graphics and animation, with associated quests and challenges for players or multiple players to contribute collaboratively towards solving (McGonigal 2012).

3.16 Gamification and education

Gamification of learning activities has been cited as one way of increasing and maintaining student motivation (Kapp 2012, Munteau 2011, Zicherman and Cunningham 2011). Currently, there is a growing interest in exploring Gamification as a way of making learning activities or tasks that students find uninteresting or too difficult seem more attractive (Domínguez et al. 2013). It is thought that it might increase engagement with formative activities, especially in online learning, where the level and quality of social activity and teacher presence can significantly vary (Baker 2010, Sun et al. 2008).

Higher education is predicated upon awards that are based upon the attainment of educational learning outcomes. The skills that students in HEIs are encouraged to develop are critical thinking, and an ability to innovate and adapt to new and novel situations, as well as becoming self-regulated and lifelong learners (Kapp 2012). Just like gamers, to achieve these skills and qualities, students need persistence, focus and determination and the ability to learn from experience. Indeed, in her editorial 'This Game Sucks', Smith-Robbins (2011) commented that higher education shares many similarities with games, such as rewards and levels, to such an extent that maybe higher education is already gamified, but just done so very badly. Whilst this comment is controversial, closer examination of games and the educational systems does reveal many similarities.

In games, players' persistence and effort is rewarded by points, virtual gifts, access to further resources and increased status. In the same way, students are rewarded by marks, award ceremonies and prizes for performance. In addition, in games when a player has mastered one level they are promoted to the next level (so called levelling up). In the same way, students who successfully complete an academic year level up and move to the next academic year (Lee and Hammer 2011). Therefore, gamified activities and environments could be used to tap into student motivation in ways similar to those proposed as underpinning education and learning. Parallels can be drawn between Gamification and student goal-directed behaviours and motivation, as well as student self-regulation.

3.17 Gamification and goal directed behaviours

In games, challenges and goal attainment form the core of game play. Players move through the game by addressing a series of challenges. At the end of the game is the penultimate challenge that takes the form of a mastery goal. However, along the way to achieving the end goal, players will encounter proximal goals that comprise a mix of social and performance goals (Dickey 2011, Groh 2012). Therefore, goal-directed behaviour and goal theory is fundamental to game play. As part of goal-directed behaviour, games are associated with problem solving and have been implicated as a means of developing Higher Order Thinking Skills (HOTS). This provides the potential for gamers to develop skills associated with self-regulated learning and metacognition (Kim at el 2009, Lee and Hammer 2011).

3.18 Gamification and motivation

Extrinsic and intrinsic motivation have already been discussed and both are thought to play a role in Gamification (Kapp 2012). Whether all or part of the motivational and student regulatory models are applicable to Gamification, in all or selective situations, is not clear However, as demonstrated in this section, there is growing support in the literature suggesting that in games, similar to the work of Pink, nearly all hierarchical models and broad theories of SDT reflect the components of autonomy, competency and relatedness in the upper levels of these models.

3.19 Gamification and self-regulated learning

As discussed earlier, self-regulated learning represents a complex form of deep student-centric learning that features aspiring to set goals, and social engagement with other participants, coupled with reflection and learning from experience. Self-regulated learning can be facilitated through the use of Gamification. However, in order to achieve self-regulated learning, the Gamification employed needs to incorporate multiple game mechanics and dynamics, include social community and feature high-fidelity graphics and animation. This type of Gamification requires a considerable use of resources, including time, money, Gamification experts and web/graphic designers.

Within the context of this research project such resources were not available. Therefore, it was recognised early on in this research project that developing complex gamified platforms and systems would not be possible. This did not imply that the principles of Gamification could not be

used to increase engagement, but rather that the scale of the Gamification intervention would need to be modest.

Scoring systems and leaderboards were considered to be one of the simplest Gamification game mechanics. The collection of points and a ranking creates conditions of reward and challenge (Biro 2014, Landers et al. 2014). The instant display of the students' scores in real time provides instant feedback. However, in 2014 there was very little robust research evidence to support that the use of scoring systems and leaderboards influences student performance (Christy and Fox 2014, Hamari et al. 2014). The next chapter presents the findings of a focused literature review that concentrated on critiquing the available evidence surrounding the use of scoring systems and leaderboards within education.

3.20 Conclusion

This chapter has explored the development and potential purposes and uses of the portfolios. It has also highlighted the fact that student engagement has been shown to be associated with increased student learning, the large impact of Gamification within the non-educational sector and highlighted the potential transferability of Gamification to educational settings. Commonalities between educational theory and Gamification theory were presented. It was acknowledged that the scope of implementing gamified systems varied considerably from the low-tech intervention such as a scoring board, to high-tech environments featuring high-fidelity virtual reality interfaces with the use of multiple Gamification strategies, including aspects of social engagement. Due to the limited resources that were supporting this research project, low-tech solutions were being explored to see whether these could promote student engagement with people-planning activities. The next chapter provides a focused review of the evidence available to support the use of such Gamification strategies.

Chapter 4: Focused literature review

4.1 Introduction

In the previous chapter, it was highlighted that there was little research evidence that explored the benefits and limitations of using Gamification within Higher Education and learning. Most studies within this area related to the educational use of simulation and video games. Given the research aim' To establish whether introducing a scoring system into an E portfolio changes student nurses' performance in relation to their engagement with formative activities or learning', the use of simulation of video games was deemed not relevant to the project. The grey literature associated with Gamification, motivation, engagement and Higher Education has already been discussed in chapter 3. The focus of this literature review was to establish what actual primary research evidence was available to support or refute links between Gamification, Higher Education and scoring systems in relation to student nurse engagement and learning. In addition, the review sought to explore where any Gamification strategies had been incorporated into an E portfolio.

4.2 Search strategy

As commented upon by Deterding et al. (2011), whilst the term Gamification first began appearing in the literature in 2008, the term did not gain widespread adoption within commerce until 2010. Therefore, the search criteria used in the literature review included peer-reviewed items published between 01.01.2010 – 31.12.2013, which was subsequently updated to cover the period 01.01.2014 – 01.01 2018.

4.3 Generation of the keywords

The aim of this project was 'To establish whether introducing a scoring system into an E portfolio changes student nurses' performance in relation to their engagement with formative activities or learning'. The PICO framework was used to generate the keywords. The acronym PICO stands for Population, Intervention Comparison, and Outcome and it is commonly used to develop a search strategy when searching literature (CASP 2018).

- Population - Student nurses
- Intervention – Gamification of an E portfolio
- Comparison - No Gamification
- Outcome - Engagement and learning

The keywords identified were student nurses, Gamification, E portfolio, engagement, and learning. These were truncated to student nurs*, gamifi* engag* and learn* to ensure that the scope of the search would include similar and related terms; E portfolio was run as 'online portfolio' and then 'e-portfolio'.

4.4 Identification of databases

A simple initial search was undertaken with each term using Delphis, which is a single interface that searches a range of databases. Each of the keywords was searched for individually with no limiters in place and the results were used to identify the databases returning the most articles. The reason for doing this was to ascertain which databases would be the most likely to return results when a later in-depth search was carried out.

The results of these searches identified that the top database for Gamification was SCOPUS. CINHAL and ScienceDirect returned the most results for student nurses. SCOPUS along with PsychINFO and ERIC were identified as being most relevant for learning and engagement.

SCOPUS is an international and extensive database of peer-reviewed articles, and conference proceedings. PsycINFO is a key database for psychology related publications. CINAHL is a database that covers literature relating to nursing, midwifery and allied health professionals. ERIC is a database that covers a range of publications including education and government documents. ScienceDirect covers the Elsevier publishing group that includes many nursing journals. ScienceDirect does not have a search engine that accepts Boolean Operators and limiters. Therefore, the full keywords rather than the truncated keywords were used to search this database. This meant that searches run in ScienceDirect were less discriminatory than other databases and, as predicted, the searches returned a large number of articles, many of which were not relevant to this study.

The results from these searches were then used to take forwards a series of more focused searches in order to find primary research relating to the following questions:

- How widely had Gamification been used with student nurses?
- How widely had Gamification been used within E portfolios?
- What evidence is there to support or refute that Gamification in the form of a scoring system increased engagement and /or learning?

4.5 How widely had Gamification been used with student nurses?

To address this first question, a search was carried out in all five databases using the term student nurs* AND gamif*. Where it was possible 'AND' was used as a Boolean Operator and the search limited to English language, peer review, research papers with the date range of 01.01.2010 – 31.12.2013, which was later updated to include 01.01. 2014 – 31.01.2018. The number of articles returned are presented in table 3.

Table 3 Results of the database searches using the keywords terms gamifi* AND student nurs*

Date range of search	**Search 1 (2010 – 2013)**	Search 2 (2014 – 2018)	Total
Database examined	CINAHL 0	CINAHL 3	3
Database examined	PsychINFO 0	PsychINFO 0	0
Database examined	SCOPUS 5	SCOPUS 20	25
Database examined	ScienceDirect 3	ScienceDirect 23	26
Database examined	ERIC 0	ERIC 0	0
Total	8	46	54
Duplicates removed		4	50

Given that only 50 articles were returned, the exclusion criteria were limited to 'not Gamification', 'not healthcare education' and 'not primary research'.

The 2010 – 2013 search only returned 8 articles. After reading the abstracts for these articles, 6 were discounted as they did not feature healthcare or Gamification. However, of the 2 remaining articles, 1 was not primary research and the article only briefly commented on Gamification in the context of virtual neonatal simulation (Pilcher 2013). The remaining article 'Meet Mohammed: Using simulation and technology to support learning ', by Lambert and Watkins (2013) featured a two-week study involving

simulation where students interacted with an online patient represented by an avatar. Whilst Gamification elements were present, Gamification was only mentioned briefly in the conclusion as an area that required further evaluation with no further explanation as to why this might be. The lack of literature was not surprising. At the time, this was in keeping with nursing, which, as a profession, had low levels of skills in the areas of computer use and information literacy (Button et al 2014). Therefore, apart from Lambert and Watkins (2013), no significant pieces of primary research emerged.

Over the duration of 2014 – 2018 Gamification began to gain traction in many difference academic fields (Koivisto and Hamari 2019). By January 2018, an additional 46 articles had been found. As stated earlier, SCOPUS and ScienceDirect do not discriminate very well and returned articles that are not relevant. After a review of the abstracts and titles of the remaining articles, 11 were not related to healthcare but to areas such as event management and financial markets; 13 were not related to the education of healthcare professionals and 3, whilst related to healthcare, focused on areas of software development such as Apps for health promotion. The full texts of the remaining 19 articles were reviewed to identify articles that featured primary research and literature reviews and discussion papers. A further 10 articles were discounted for the following reasons. 6 were discussion papers and not primary research, 3 were related to use by service users and the remaining article concentrated on system design and development.

This left 9 articles for analysis and synthesis (Ambrosio Manwhirter and Ford Garofalo 2016, Brull et al2017, Day-Black et al. 2015, El Tantawi et al.2016, Gallegos et al 2017, Lambert and Watkins 2013, Roche et al 2017, Staykova et al 2017 and Verkuylet al 2016). The PRIMSA diagram in figure 3 provides a visual representation of the search.

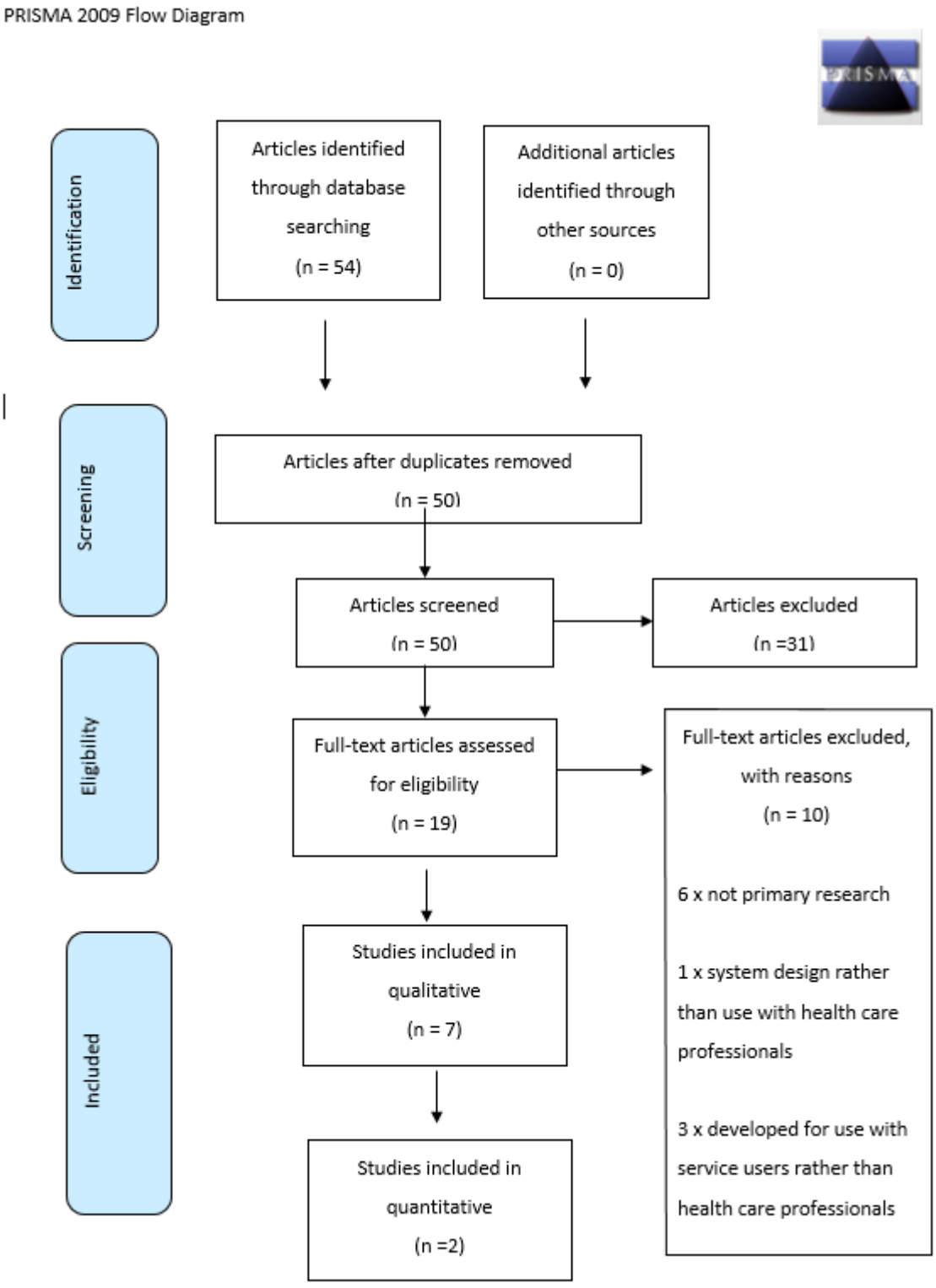


Figure 3 How widely has Gamification been used with student nurses - search strategy 2010 – 2018

Geographical spread and types of research

As can be seen in table 4 and from the discussion above, Gamification involving nursing and other health care professionals only really started to be reported upon from 2015 onwards. In relation to the geographical spread of the research being undertaken, this appears to be predominantly based within the USA. This is unsurprising as the USA is the leading country in relation to research outputs (SCImago (n.d.).

Table 4 Geographical spread and types of research

Article/ Conference paper	Country	Quantitative /qualitative/ mixed methods	Date
Lambert, N., Watkins, L. Meet Mohammed: Using simulation and technology to support learning (2013) Journal of Mental Health Training, Education and Practice, 8 (2), pp. 66-75.	England	Qualitative	2013
Day-Black, C. (2015) 'Gamification: An Innovative Teaching-Learning Strategy for the Digital Nursing Students in a Community Health Nursing Course', ABNF Journal, 26(4), pp. 90–94.	Maryland USA	Qualitative	2015
Ambrosio Mawhirter, D. and Ford Garofalo, P. (2016) 'Expect the Unexpected: Simulation Games as a Teaching Strategy', Clinical Simulation in Nursing, 12(4), pp. 132–136.	New York USA	Qualitative	2016
El Tantawi M., Sadaf, S. and Ahmadi, J. (2016) 'Using Gamification to develop academic writing skills in dental undergraduate students', EUROPEAN JOURNAL OF DENTAL EDUCATION, 22(1), pp. 15–22	Saudi Arabia	Quantitative	2016
Verkuyl, M., Atack, L., Mastrilli, P., Romaniuk, D. Virtual gaming to develop students' paediatric nursing skills: A usability test (2016) Nurse Education Today, 46, pp. 81-85.	Toronto Canada	Qualitative	2016
Cara Gallegos, Abigail J. Tesar, Kelley Connor, Kim Martz, the use of a game-based learning platform to engage nursing students: A descriptive, qualitative study, Nurse Education in Practice, Volume 27, 2017, Pages 101-106,	Boise USA	Qualitative	2017
Staykova, M.P., Stewart, D.Von , Staykova, D.I. Back to the Basics and Beyond: Comparing Traditional and Innovative Strategies for Teaching in Nursing Skills Laboratories (2017) Teaching and Learning in Nursing, 12 (2), pp. 152-157.	Virginia USA	Qualitative	2017
Brull, S., Finlayson, S., Kostelec, T., Macdonald, R., Krenzischeck, D. Using Gamificationto Improve Productivity and Increase Knowledge Retention during Orientation (2017) Journal of Nursing Administration, 47 (9), pp. 448-453.	Maryland USA	Quantitative	2017
Roche, C.C., Wingo, N.P., Willig, J.H. Kaizen: An innovative team learning experience for first-semester nursing students (2017) Journal of Nursing Education, 56 (2), p. 124	Alabama USA	Qualitative	2017

Each article in table 4 was reviewed using the CASP checklist in order to ascertain how robust the findings were. The CASP checklist addresses 3 areas 'Are the results of the study valid?', 'What are the results?' and 'Will the results help locally? 'with this latter point interpreted as how relevant were the results to the Author's study (CASP 2018). The CASP checklist for qualitative studies and cohort studies were used as a guide when reviewing the articles.

Simulation and online games

From the literature uncovered, Gamification seems to be used in nursing in two different ways. This is through the use of simulation (Ambrosio Manwhirter and Ford Garofalo 2016, El Tantawi et al. 2016, Lambert and Watkins 20 13, Staykova et al. 2017, and the use of online games (Brull et al. 2017, Day-Black et al. 2015, Gallegos et al 2017, Roche et al 2017, Staykova et al 2017 and Verkuylet al 2016).

Simulation

The work by Lambert and Watkins (2013) ran an online simulation that followed the admission and care of a patient with a mental health condition over a two-week period. The project used avatars to represent students and the patient in the online environment was created to reflect an acute mental health ward. The students were set challenges by being given additional clinical information regarding the patient's changing condition, which they needed to act upon. However, it is not clear if any other Gamification elements such as points or badges were employed. Whilst the authors indicate students found the experience engaging, they do not present any evidence of increased learning.

The work of Ambrosio Manwhirter and Ford Garofalo (2016) also used gamified simulation, but in contrast to that of Lambert and Watkins (2013) rather than using an avatar, the students participated in a real time gamified high-fidelity simulation exercises using a patient simulator. The subject matter concerned patient safety, communication and clinical emergencies such as resuscitation. The period of Gamification was much shorter with scenarios lasting between 1 to 15 minutes. Gamification was achieved through the award of scores. Again, this experience received positive evaluations with 100% of students expressing that the learning experience was beneficial, engaging and had increased their confidence in facing unexpected and emergency situations. In addition, 95% of students were able to identify areas where they required further study and experience. The study did not explore whether any increased learning had occurred. The study by Staykova et al. (2017) compared teaching clinical skills in a skills laboratory by a variety of different methods including scenarios and game-based learning. This mixed method study ran over a 15 week period whereby the different methods of delivery (traditional didactic, admission tickets, knowledge checks, I- clickers, games, role modelling, and scenario) were alternated. The games consisted of online quizzes as well as paper resources and the simulation comprised exercises such as online ECG recognition and virtual hospital assignments that used avatars to

represent patients. The students are asked to evaluate how effective they felt the different methods of delivery were. Interestingly, this study reported that students prefer innovative strategies for teaching as opposed to didactic approaches with simulation and physical skills demonstrations being rated higher than lectures. Therefore, gamified simulation has a role to play in nurse education alongside hands-on practical simulation.

Games

The work by Brull et al. (2017) featuring online games, did demonstrate increased knowledge retention during an orientation programme for qualified nursing staff. In this quasi experimental design, the participants were split into three different groups, but all received the same content, albeit delivered in a different way. One group was taught didactically in the classroom, the second group was asked to study online modules and the third group was exposed to the same content but in the gamified online learning environment comprising tasks, quests, and challenges. Participants in the gamified group received feedback through badges and points that were displayed or captured on leaderboards. Apart from one category, the results demonstrated that the participants completing the gamified content statistically outperformed their counterparts who were taught either didactically or through an online module. Brull et al. highlighted the need for more research to build a greater body of knowledge surrounding the use of Gamification. Roach et al. (2017) used an online game to try to improve student learning in relation to basic nursing concepts as well as promoting teamwork and communication. Out of 135 potential participants, 94 students volunteered to take part. The online package was presented to preregistration nursing students in a game format. Students joined the game in teams. Students could answer questions in teams and individuals were able to communicate with each other and between teams to generate competition. Feedback was by badges, points, and leaderboards. Feedback from students indicated they were motivated by peer pressure. They also commented positively about competition and that they bonded well within their teams. The aim of this study was to establish whether students would engage with the game and this outcome was upheld. The researchers did not evaluate whether increased learning had occurred.

These studies are in contrast to the work by Day-Black et al. (2015). In this study (n= 47) nursing students were introduced to 2 games, one called ‘Outbreak at Water’s Edge’, a Public Health Discovery Game and the second called ‘EnviroRisk’. However, the researchers were not able to track the students’ progression through the games and had to rely on the ‘honour ‘of the students to undertake this. A recognised limitation by the research team was that only 50% of the participants completed the evaluation form. The researchers claimed that the students’ experiences described in their study, showed an increase in student motivation to learn, but did not articulate how this was a measured. In addition, the study by

Gallegos et al. (2017) indicated that some nursing students disliked Gamification. In Gallegos et als' work, a research course was gamified using a 3D online platform and students were able to earn badges and gain points as well as their progress on leaderboards. The undergraduate student nurses in this study stated that they found the use of Gamification juvenile and not appropriate for research studies. They commented that they could see no point in gathering badges or rewards as they considered them to be valueless and without meaning. The study conducted by El Tantawi et al. (2016) was gamified in a different way to the previous studies. The aim of this study was to improve student academic writing and referencing skills. The students were asked to carry out role play as a research assistant, supporting dental researchers. Whilst the results demonstrated a statistically significant improvement in writing skills and a correlation between satisfaction with the experience, and improvement in writing skills. The qualitative feedback from students indicated that they did not want Gamification used in any further units of study.

The reasons for these negative reactions may be due to the way that Gamification was deployed. In Gallegos et al's. (2017) work, students commented that it would be more appropriate to include simulation rather than asking them to post articles and documents to the online learning platform. In the case of the work by El Tantawi et al. (2016), the sample seems to have included the whole cohort and students do not seem to have been given the opportunity to have opted out. Therefore, this could well account for the low motivation of the students that was reported by the research team. These cases illustrate that the implementation of Gamification may not always produce the desired results. For example, in their work, Verkuylet al (2016) developed a high-fidelity online game to develop paediatric nursing students' understanding of post-operative care. In this game, students were taken through the postoperative journey of a child via a series of video clips. After each video clip, they were asked to make a decision regarding the child's care. Once that decision was made, instant feedback was given to the students and students were encouraged to reflect on their decision-making processes. The quality of student evaluations indicated that the students found the game extremely valuable and that the situations at times felt real. They liked the feeling of being immersed in a real-life case study unfolding before them rather than reading scripted material from the book. Unlike the student feedback received by Gallegos et al. (2017) and El Tantawi et al. (2016), these students wanted more quests, challenges and gamified elements to be included. Therefore, from the literature examined it appears that the effects and impact of Gamification in nursing students can be unpredictable.

4.6 How widely had Gamification been used within E portfolios?

The search strategy that was used to explore Gamification usage with student nurses was repeated but this time using the keywords: gamifi* AND e-portfolio; gamifi* AND Online Portfolio. The number of articles returned is given in table 5. As can be seen, whilst nothing was returned from CINAHL, PsychINFO info or ERIC, a total of 57 articles was returned from the searches run in SCOPUS and ScienceDirect.

Table 5 Results of the database searches using the keywords gamifi* AND e-portfolio; gamifi* AND Online Portfolio

Date range of search	Search 1 (2010 – 2013)	Search 2 (2014 – 2018)	Total
Database examined	CINAHL 0	CINAHL 0	0
Database examined	PsychINFO 0	PsychINFO 0	0
Database examined	SCOPUS 6	SCOPUS 6	12
Database examined	ScienceDirect 2	ScienceDirect 43	45
Database examined	ERIC 0	ERIC 0	0
Returns	8	49	57
Duplicates removed	0	5	52

The 57 articles were initially reviewed by reading the title and the abstract. Again, only a small number of articles were returned, so the exclusion criteria used was limited to 'not gamified', 'not social media' and 'not children'.

5 duplicates were encountered and removed. As previously commented upon, ScienceDirect does not accurately discriminate and so many the articles returned were not relevant. Several related to banking and energy conservation, as well as child health, pre-school and junior school learning, nature conservation and start-up businesses using social media and MOOCs. As such a further 49 articles were excluded on the reading of the titles and abstracts.

3 article titles and abstracts directly referred to E portfolios (Abdul Wahab and Joy 2017, Kilroy 2017 and Mozelius et al and 2016). However, upon reading, the paper by Mozelius et al (2016), this related to overcoming language barriers when building E portfolios and online courses. Kilroy (2017) explored the adult learner's perception of the E portfolio as a job seeking tool. These two articles were not relevant and therefore also excluded.

Given the complete lack of relevant sources, the reference list from Abdul Wahab and Joy (2017) 'Raising engagement and motivation through gamified eportfolio in Kolej Profesional MARA (KPM), Malaysia: A Preliminary Survey' was scrutinized in an attempt to try to start snowballing for further literature and sources. A generic Google search was also undertaken to try to locate any additional literature including grey literature. One blog entry, 'Pairing E-Portfolios with Badges to Document Informal Learning, (Lloyd 2015) was located. The remaining returns were advertising services or Gamification reviews not involving e portfolios.

Like the researcher, Abdul Wahab and Joy (2015) and Lloyd (2015) identified a lack of engagement with E portfolios as problematic. Lloyd's blog summarized the work undertaken at the University of Notre Dame (France), when badges were introduced into an E portfolio. However, neither support their claims of lack of engagement with evidence or quantified the size of the problem. Lloyd's blog entry provided a useful summary of the Notre Dame project but does not indicate whether there was any increased student engagement. Despite searching the research outputs from the Notre Dame research group, no evaluative work associated with that specific project was found.

Abdul Wahab and Joy's work used a mixed methods approach to explore the feasibility of setting up an E portfolio in a developing country as well as investigating college students, (n= 174) gaming and internet usage habits. The study explored students' preferences for the structure of an e portfolio along with their suggestions for inclusion of Gamification elements. The work also illustrated that the students preferred the following Gamification features. 97% of the participants wanted points to be included along with badges (43%), leaderboards (41%) and status (59%). However, neither papers formally evaluated whether there was any increased engagement when using Gamification within an E portfolio. In addition, the sample in Abdul Wahab and Joy's work was 2/3rds young males, born between 1980 and 1994 (Gen Y). This latter point is explored further in the discussion chapter. The paucity of primary research involving the Gamification of E portfolios indicated that this was an area that warranted further investigation. The PRIMSA diagram in figure 4 provides a visual representation of the search.

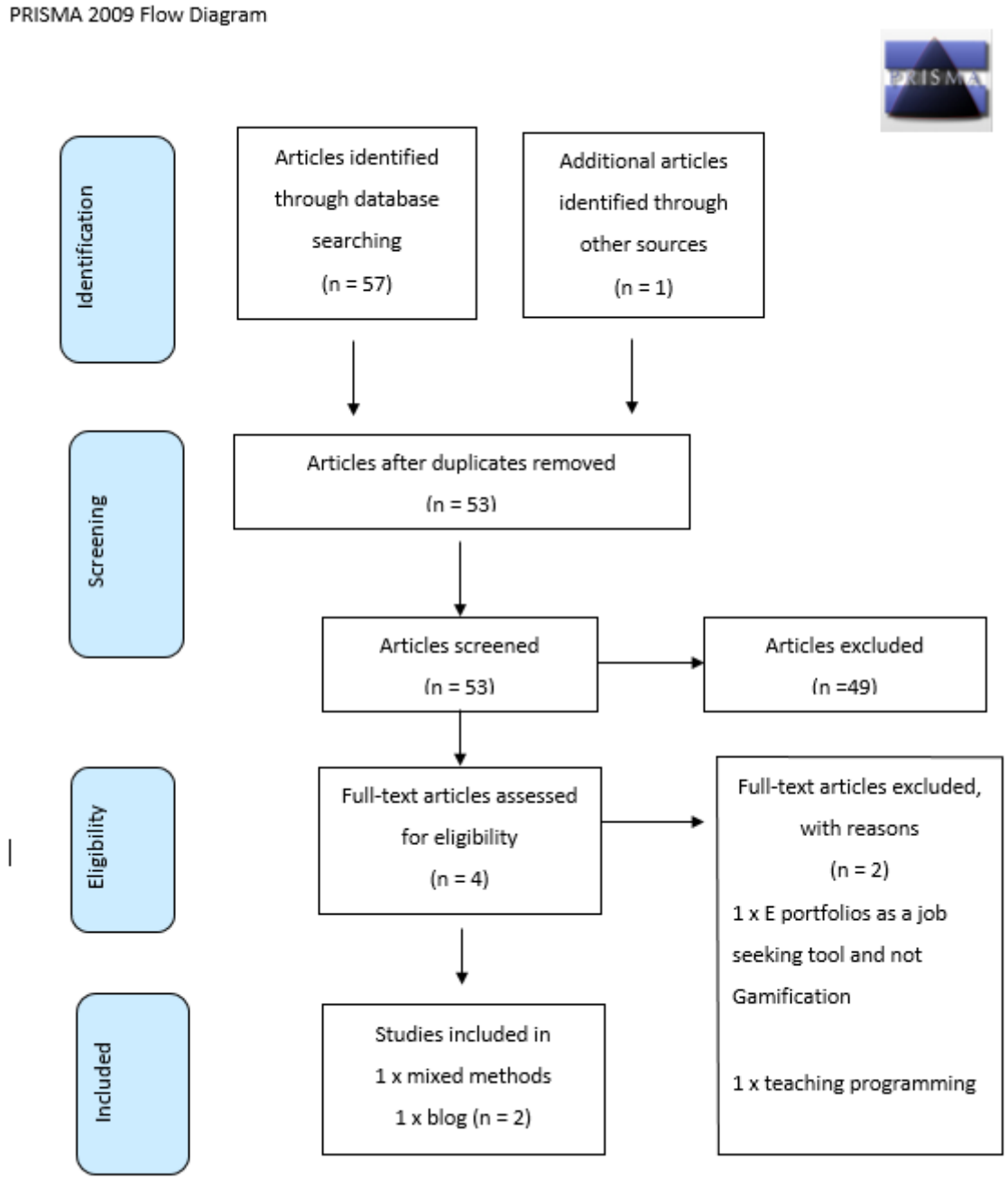


Figure 4 How widely has Gamification been used with E Portfolios - search strategy 2010 – 2018

4.7 What evidence is there to support of refute that Gamification in the form of a scoring system can increase engagement and /or learning?

The final search undertaken explored whether the literature supported, refuted or was inconclusive as to whether Gamification would increase engagement and/or learning. In this search the keywords gamifi* AND engag*; gamifi* AND learn* were used. Where it was possible 'AND' was used as a Boolean Operator and the search limited to English language, peer review, research papers with the date range of 01.01.2010 – 31.12.2013, which was later updated to include 01.01.2014 – 31.01.2018. The number of articles returned is presented in table 6.

Table 6 Results of the database searches using the keywords gamifi* AND engag*; gamifi* AND learn*

Date range of search	**Search 1 (2010 – 2013)**	**Search 2 (2014 – 2018)**	**Total**
Database examined	**CINAHL 3**	CINAHL 20	**23**
Database examined	PsychINFO 4	PsychINFO 49	**53**
Database examined	SCOPUS 17	SCOPUS 131	**148**
Database examined	ScienceDirect 9	ScienceDirect 121	**130**
Database examined	ERIC 2	ERIC 29	**31**
Total	**35**	**350**	**385**
Duplicates Removed	**2**	**89**	**294**

Removing the duplicates reduced the total number of articles to 294. Unlike the previous searches, this search produced a plethora of articles. In order to attain more focused results that were relevant to the research question, additional exclusion and inclusion criteria were used and are listed in table 7.

Table 7 Exclusion and inclusion criteria

Inclusion criteria	Exclusion criteria
Related to an HEI setting	Serious games and game theory
Nursing student	Primary and secondary education
Healthcare students	Video games
Application to work-based learning	Simulation
Gamification scoring systems	Virtual reality
Gamification, engagement, and motivation	Augmented reality
Gamification and E portfolios	Social media social networking
Primary research	Not Education

Inclusion criteria

As nursing programmes are run in universities as either undergraduate or postgraduate courses, it seemed logical to include Higher Education Intuitions (HEIs) as an inclusion criterion. Whilst this study was concerned with student nurses, the number of articles returned in the broad search was very low, especially considering duplicates had not been removed. Therefore, whilst nursing students were included, the inclusion criteria was widened to allow material that featured all healthcare students.

In 2018, 50% of the total duration of nursing courses in the UK is undertaken as work-based learning. Therefore, material that focused on work-based learning was thought to be worthy of examination.

In terms of Gamification, this study set out to find out whether using scoring systems is an effective method of Gamification. Therefore, Gamification scoring systems became an inclusion criterion. The same rationale applied to engagement and motivation behind Gamification. As this project was exploring the use of Gamification of an E portfolio, any findings by other researchers in this area could make a valuable contribution to this work and so was identified as a specific inclusion criterion.

Finally, as was illustrated in chapter 3, there is a growing amount of anecdotal and speculative articles on Gamification. Hamari et al. (2014) and Borges et al. (2014) undertook literature reviews relating to Gamification. Both commented on the lack of empirical studies. Therefore, an inclusion criterion was that the material located should be primary research.

Exclusion criteria

A number of exclusion criteria were also identified. The first of these were serious games and game theory. Serious games tend to be applied to game theory, a branch of mathematics that uses complex theory and modelling to predict outcomes of games. Neither of these two subject areas were deemed relevant to this project. Material that featured primary and secondary education was

excluded as the sample population and level of study would not be comparable to that of undergraduate students. In addition, material that was not related to formal education was also excluded. As this project involved Gamification of an E portfolio by introducing a scoring system, there was no intention to use social media or networking, video games, simulation, virtual reality or augmented reality. Therefore, material that had a heavy focus on these areas was excluded.

Whilst some articles fell into more than one of the areas for exclusion, of the 294 titles reviewed, 254 articles were excluded due to the following reasons. 103 articles were not related to education and featured areas such business, marketing, insurance, sales, keep fit, crowdsourcing and conservation, 12 focused on children or secondary education, 71 involved some form of social media or social networking, 14 focused on system design and development 24 featured video games , 12 featured virtual or augmented reality , 13 were not primary research and 5 were not related to Gamification.

After reviewing of the titles this reduced the number of studies for reading of the abstract and review of the full text to 40. Upon further reading a further 18 articles were excluded leaving 23 articles for critique. The reasons for exclusion were as follows: 5 were not primary research, 3 focused upon system design, 3 involved virtual reality, 2 involved video games, 4 were based on social media /networking and 1 was not related to HE. The remaining articles listed in table 8 were reviewed using the CASP checklists for qualitative studies and cohort studies (CASP 2018), and then collated to provide a synthesis of the main directions of the research that had been undertaken along with the main findings. The PRIMSA diagram in figure 5 provides a visual representation of the search. As it can be seen there was a distinct lack of qualitative research, which given that many of the studies were conducted with computer science and engineering students.

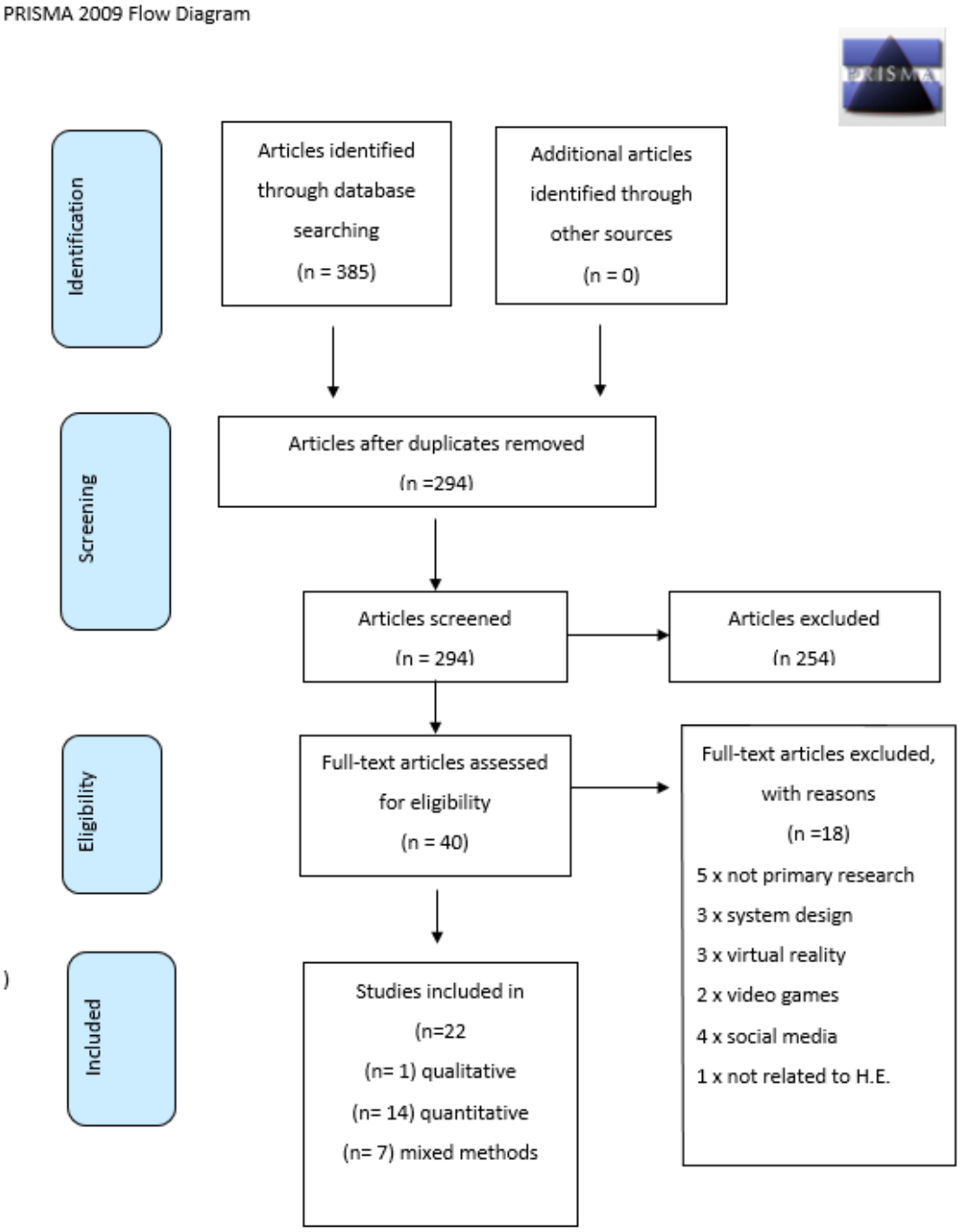


Figure 5. What evidence is there to support of refute that Gamification in the form of a scoring system can increase engagement and /or learning

Table 8 Geographical spread and types of research

Article/Conference paper	Country	Quantitative /qualitative/ mixed methods	Date
Barata G. et al. (2013) Engaging Engineering Students with Gamification. 5th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES):1-8.	Portugal	Quantitative	2013
Gehringer E and Peddycord B (2013) Grading by experience points: An example from computer ethics. Frontiers in Education Conference, 2013 IEEE, pp.1545-1550.	USA	Mixed methods	2013
Hakulinen L, et al. (2013) Empirical Study on the Effect of Achievement Badges in TRAKLA2 Online Learning Environment. Learning and Teaching in Computing and Engineering Conference.pp. 47-54	Finland	Quantitative	2013
Domínguez, A. et al. (2013) 'Gamifying learning experiences: Practical implications and outcomes', Computers & Education, 63, pp. 380–392	Spain	Mixed	2013
Caton, H. and Greenhill, D. (2014) 'Rewards and penalties: A Gamification approach for increasing attendance and engagement in an undergraduate computing module', International Journal of Game-Based Learning, 4(3), pp. 1–12	UK	Quantitative	2014
Banfield J and Wilkerson B (2014) Increasing Student Intrinsic Motivation and Self-Efficacy through Gamification Pedagogy. Contemporary Issues in Education Research 7 (4), pp. 291–298	USA	Quantitative	2014
Codish D, and Ravid G (2014) Academic course Gamification: The art of perceived playfulness. Interdisciplinary Journal of E-Learning and Learning, pp. 131–151	Israel	Quantitative	2014
Landers R, et al. (2014) Gamification of task performance with leaderboards: A goal setting experiment. *Computers in Human Behavior* 71 pp.508-515	USA	Quantitative	2014
Vaibhav A and Gupta P (2014) Gamification of MOOCs for increasing user engagement. Innovation and Technology in Education (MITE), 2014 IEEE International Conference. pp. 290 – 295.	India	Mixed	2014

Christy K and Fox J (2014) Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance Computers & Education. 78 pp. 66-77.	USA	Quantitative	2014
Ibáñez et al. (2014) Gamification for Engaging Computer Science Students in Learning Activities: A Case Study. IEEE Transactions on Learning Technologies 7(3) pp. 91-301	Spain	Quantitative	2014
Hanus, M. and Fox, J. (2015) 'Assessing the effects of Gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance', Computers & Education, 80, pp. 152–161	USA	Quantitative	2015
Hew, K. et al. (2016) 'Engaging Asian students through game mechanics: Findings from two experiment studies', Computers & Education, 92–93, pp. 221–236.	Hong Kong	Mixed	2015
Fotaris P. et al (2016). Climbing up the Leaderboard: An Empirical Study of Applying Gamification Techniques to a Computer Programming Class. Electronic Journal of e-Learning, 14(2) pp. 94-110.	UK	Mixed	2016
Attali, Y. and Arieli-Attali, M. (2015) 'Gamification in assessment: Do points affect test performance?', Computers & Education, 83, pp. 57–63	USA	Quantitative	2016
Poondej, C. and Lerdpornkulrat, T. (2016). The Development of Gamified Learning Activities to Increase Student Engagement in Learning. Australian Educational Computing, 31(2), pp. 1-16.	Thailand	Quantitative	2016
Hamari J (2017). Do badges increase user activity? A field experiment on the effects of Gamification Computers in Human Behavior, 71. pp. 469-478.	Multinational	Quantitative	2017
Stansbury, J. and Earnest, D. (2017) 'Meaningful Gamification in an industrial/organizational psychology course', Teaching of Psychology. 44 (1) pp. 38–45.	USA	Mixed	2017
Dias J (2017) Research Notes: Teaching operations research to undergraduate management students: The role of Gamification. *International Journal of Management Education* 15, pp. 98-111	Portugal	Mixed	2017
Hamari J (2017). Do badges increase user activity? A field experiment on the effects of Gamification Computers in Human Behavior, 71. pp. 469-478	Germany	Quantitative	2017
Çakıroğlu, et al. (2017)Gamifying an ICT course: Influences on engagement and academic	Turkey	Qualitative	2017

performance Computers in Human Behavior, Volume 69, pp 98-107			
Kyewski E and Krämer N (2018) To gamify or not to gamify? An experimental field study of the influence of badges on motivation, activity, and performance in an online learning course. *Computers & Education* 118, pp.25-37	Germany	Quantitative	2018

4.8 Gamification and engagement

A growing number of studies have reported Gamification as a way of increasing student engagement (Barata et al. 2013; Çakıroğlu et al. 2017; Caton and Greenhill 2014; Dias 2017; Domínguez et al. 2013; Gehringer and Peddycord 2013; Hamari 2017, Poondej and Lerdpornkulrat's (2018).

Barata et al.'s (2013) work with n = 77 engineering students used a scoring system, badges, a leaderboard and challenges in a multimedia content course, and detected increases in downloads and posts as well as an 11% increase in lecture attendance. Gehringer and Peddycord's (2013) work featured a sample size of n = 77 computer science students; of these, 25% of the participants in the gamified cohort were more actively engaged. Caton and Greenhill's (2014) study, involving n = 139 computer students, explored whether the use of an award/penalty framework improved attendance, engagement, and teamwork. An increase in engagement was detected, although no statistical analyses were presented. Similarly, Dominguez et al.'s (2013) study that involved n = 173 university students undertaking an introductory ICT course featuring scoring activities and badges also demonstrated a statistically significant increase in engagement in the online activities. Poondej and Lerdpornkulrat's (2018) work involved n = 577 undergraduate students in Thailand undertaking literacy skills classes, in a university located in Thailand. Half of the group was exposed to gamified activities and the remaining participants undertook the traditional course. The researcher reported that the participants in the gamified group again demonstrated a significantly higher level of engagement with the learning activities. However, Domínguez et al.'s (2013) work also highlighted that not all activities were equally engaged with. This point is discussed later in this chapter.

In more recent studies, Çakıroğlu et al. (2017) carried out a study with n = 37 undergraduate primary school teachers who were undertaking an introductory ITC course. The students who were exposed to the gamified version of the course, which used challenges, points,and leaderboards, demonstrated a statistically significant greater level of engagement than their counterparts completing the non-gamified version of the course. Dias' (2017) study involved n = 600 undergraduate management students studying operations research and featured points and leaderboards. This study reported statistical significance with a 20% increase in engagement. A larger 1 +1-year study by Hamari (2017), featuring n = 1579 users, used badges to gamify an online recycling/sharing economy. This study also revealed a statistically significant increase in engagement, with users in the gamified condition posting more proposals, carrying out more transactions and generally using the service in a more active way.

Works by Hakulinen et al. (2013) and Kyewski and Krämer (2018) did not detect any statistically significant increase in engagement. Hakulinen et al.'s work on the 'Effect of Achievement Badges in TRAKLA2 Online Learning Environment' featured a sizable population, (n = 281) Whilst the gamified group outperformed the non-gamified group, the findings did not demonstrate any statistical significance. More recently, albeit a smaller study (n = 126) of shorter duration (5 weeks), Kyewski et al.'s work that researched the influence of badges in a variety of online learning courses did not demonstrate any increase in engagement and, in contrast to other studies, statistically demonstrated that intrinsic motivation declined over time. Fotaris et al. (2016) also drew attention to a potential novelty factor in their study of leaderboards as a Gamification mechanic. Hamari (2017) put forward that the increase and decrease in engagement may also be part of this novelty effect and drew attention to the lack of empirical research into novelty factors and Gamification.

4.9 Gamification and Motivation

Canon and Greenhill's (2014) work using a reward and penalty framework, found that Gamification motivated students to undertake tasks that they previously were resistant to. Similar findings were found in studies by Barata et al. (2013), Hakulinen et al. (2013), Banfield and Wilkerson (2014), Ibanez et al. (2014) and Vaibhav and Gupta (2014). These latter studies did not incorporate a penalty element, thereby reinforcing that the effect was most likely driven by positive Gamification strategies rather than punitive ones.

By contrast, several of the research studies also demonstrated that the participants' responses to a gamified activity were not necessarily uniform. Codish and Ravid (2104) reported that different

personality types influenced motivation when using leaderboards as a form of game mechanic. In particular, they noted that leaderboards were better at motivating introverts rather than extroverts. However, in their study the scoring system and leaderboards were asynchronous and so feedback was not instantaneous, which the participants found frustrating. The study by Dominguez et al. (2013) also found that motivation was variable, with some participants commenting that they disliked the challenge elements. Gehringer and Peddycord (2013) found that participants disengaged if the collection of points or scores involved additional work that they considered unnecessary.

The study carried out by Anders et al. (2014) suggested that the motivation behind the use of leaderboards could be linked to that of goal theory. However, they emphasised that too narrowly defined goals could limit the scope of learning. Another finding from this study was that the participants had to see the purpose of the activity to be motivated. These findings are also common to goal theory and adult learning where participants make a subconscious assessment as to whether a task is attainable and worthwhile doing (Ryan and Deci 2012). An interesting observation was made by Dominguez et al. (2014), who commented on the phenomena of flow as depicted by Csikszentmihalyi (2008), as a necessary state for deep immersion in games and gamified activities. Dominguez highlighted that it was very difficult to achieve a flow state within educational Gamification without the introduction of materials such as video leading towards more edutainment than Gamification. However, they did acknowledge that Gamification activities could be motivational, irrespective of participants not achieving a flow state. Whilst there was evidence indicating that, in certain circumstances, Gamification using scoring systems can be used to motivate individuals to carry out activities or tasks, the impact of Gamification and learning remains less clear.

Landers et al. (2014) postulated that goal-directed theory could explain the motivation behind increased engagement with gamified activities, due to goal commitment moderating the relationship between scores and task performance. As discussed, some studies revealed that Gamification does not always increase engagement. As seen in the studies by Christy and Fox (2014), Dominguez el al. (2014) and Hakulinen et al. (2013), Gamification does not generate behavioural changes in a uniform or predictable way.

Goal commitment is mediated by the likelihood of a successful outcome versus the cognitive load in achieving the successful outcome (Landers et al. 2014). It therefore follows that the participants would choose to focus on activities that required the lesser effort on their part, but still be relevant to their overall formative activities. As found by Sailer et al. (2017), Gamification can be used to generate and fulfil competency need satisfaction, which is one of the three needs related to self-determination theory. These needs are said to be universal, innate, and psychological, and include the need for competence, autonomy and psychological relatedness (Ryan and Deci 2017). In addition, Ibanez et al. (2014) found that students went on working in a gamified interface even after they had exceeded the given goals. These findings support intrinsic motivation.

4.10 Gamification and learning

Of the eleven studies examined, seven reported outcomes related to learning. Caton and Greenhill (2014) demonstrated an increase in academic performance by detecting that there were more 2.1-degree classification marks achieved through their reward penalty framework. However, the statistical relevance of this was not tested. Ibanez et al. (2014) set out to measure whether Gamification changed academic performance. They found that that gamified activities led to a 'moderate' increase in learning. Similarly, Dominguez et al. (2013) also found an increase in academic attainment in the gamified group, despite there being some disparity between the degree of attainment between practical and theoretical tasks. Conversely, the work by Barata et al. (2013) and that of Hakulinen et al. (2013) found no correlation between marks and Gamification. Attali and Arieli-Attali (2015) looked at the effect of awarding points to participants across the age range when completing math's tests. Whilst the speed increased under Gamification, no significant results were found to suggest any increase in learning. However, the authors did comment that the gamified intervention was very short. The work of Hew et al. (2016) reached similar findings when using points, badges and leaderboards to increase engagement and learning in Asian students. Engagement increased significantly, but knowledge acquisition and learning did not. Non-significant statistical findings were also detected by Stansbury and Earnest (2017) and by Kyewski et al. (2018). This contrasted with the findings of studies such as those undertaken by Çakıroğlu et al. (2017), Dias (2017), and Yildirim (2017), all of whom found statistically significant increases in academic attainment and/or scores.

Çakıroğlu et al.'s (2017) study with undergraduate pre-service primary school teachers has already been discussed under engagement, as has the work of Dias (2017), who used badges and

leaderboards with undergraduate management students. A study by Yildirim (2017) with n = 97 undergraduate math's students used a heavily gamified online platform featuring challenges, rewards, badges, and leaderboards. Pre- and post-tests scores were compared and revealed a statistically significant increase in scores of the group exposed to the gamified course. Therefore, it seems that whether Gamification consistently leads to increased learning or academic attainment is still unclear and warrants further research.

4.11 Gamification and scoring systems

Landers et al's. (2014) study concluded that leaderboards were an effective Gamification mechanism for increasing motivation and engagement. Dominguez et al. (2013) supported this assumption and highlighted that leaderboards were an effective way of providing instant feedback to participants. In the research undertaken by Gehringer and Peddycord (2013), one of the main criticisms from the participants was the slow speed at which they received feedback in a gamified system that relied on manual feedback. Poondej and Lerdpornkulrat's (2018) study used badges, points, and leaderboards and concluded that these game mechanics were a valuable part of increasing student engagement.

Therefore, the use of an automated leaderboard or scoring system could be seen to be a way of overcoming this limitation. In addition, Christy and Fox (2014) explored the use of leaderboards in relation to the concept of gender associated stereotypic threat. The interesting finding from this result was that gender mix, i.e. whether a group was dominated by high-performance men and women, could impact on performance. However, the study was very limited insofar as it was conducted in a simulated environment, only reviewed math's performance and was conducted over a short timeframe with only one exposure to a leaderboard. Furthermore, Codish and Ravid (2014) found that leaderboards were more effective with introvert personalities than extrovert personalities. When these findings are combined, it would appear that leaderboards do not always produce consistent behaviours when used with a different personality and gender types. This is explored further in chapter 7.

4.12 Conclusion

In summary, the main limitation of the studies that have been explored is that the majority involve research undertaken with computer and engineering students. This limits the transferability of the findings to students studying subjects such as the arts, history, and healthcare. In addition, traditionally the students undertaking courses in engineering and computing tend to be males and the evidence does highlight the potential influence of behaviours toward Gamification based on gender. The evidence suggests that Gamification does increase motivation and engagement, but this effect is not uniform across a student cohort. In addition, gender, the type of tasks set, the way feedback is presented and the speed that any feedback is received, appears to play a role in whether students engage. Goal- directed theory has been proposed as a model to explain student behaviours in relation to gamified systems. The evidence to support Gamification as a way of increasing learning was mixed. So far, no literature has been found that reviews the use of a gamified approach within an E Portfolio setting, which is the basis of this research proposal. In addition, the emerging gender findings will be particularly relevant due to the high ratio of females to males within the nursing profession. The next chapter uses the findings of this review to consider and develop the methodology that was used to create this research project.

Chapter 5: Methodology

5.1 Introduction

Following the review of literature, the overall aim of this research was generated. The aim was to gather data that could be critically reviewed to determine whether the introduction of a scoring system into an E portfolio interface changed student nurses' behaviour in relation to their engagement with formative activities and whether this impacted on the participants' learning as determined by their marks. In order to achieve this aim, it was essential to ensure that there was alignment between the philosophy of the chosen paradigms and the sampling strategies, methods of data collection and the approaches to the data analysis that were adopted (Coolican 2014). As such, this chapter provides a critical review of the choices made when the research design was constructed. This chapter commences with a review of the theoretical framework that supported the project, followed by a consideration of the philosophical stances that were adopted to generate the methodology. The sampling strategy, methods and instruments of data collection, data cleaning and data analysis are then justified along with discussion surrounding ethics and the overall strengths and limitations of the methodological approach.

5.2 Theoretical framework

The theoretical framework that supports this work is provided in figure 6. The purpose of the theoretical framework was to provide a logically thought out structure that robustly supports the research methodology and methods (Miles and Huberman 1994). The baseline audit of current practice and critical review of evidence were the starting points in the development of this theoretical framework. These have already been explained and justified within chapter 2, in the background section. The review of literature was carried out to investigate what research had already been carried out relating to the use of Gamification in an E portfolio that was being used by nursing students. The literature review was presented in chapter 3. This identified that whilst there was growing interest in Gamification and education, very little of this pertained to nursing students and to E portfolios. As such, this highlighted that there was a gap in the literature.
The further steps are detailed within this chapter. However, an overview is provided here for clarity. The next step in developing the theoretical framework was to critically reflect as to what

were the most appropriate research methods to robustly support research into Gamification of a nursing E portfolio and to measure the impact on engagement and/or learning. Defining the metrics for engagement and learning formed the initial thinking. Engagement could be measured by counting the number of entries made by student nurses and the timing of these entries in the E portfolio. Learning could be assessed by examining the students' marks in practice. This therefore suggested that hypotheses could be generated and tested using the positivist paradigm and, as such, the research methodology began to emerge.

This moved the development of the framework into its third stage of development, that of the research methods and testing of the data collection tools. Given the lack of available existing evidence, a systemic review was not possible, therefore an RCT was proposed. Given the limitations of RCTs, in that that they do not provide insight into the psychological aspects of human behaviour, group discussions were also added to the research methods (Creswell and Plano-Clark 2011). The data analysis therefore comprised quantitative and qualitative data. The final step was to confirm that the framework was transferable to other settings. This is discussed under strengths and limitations, located at the end of this chapter.

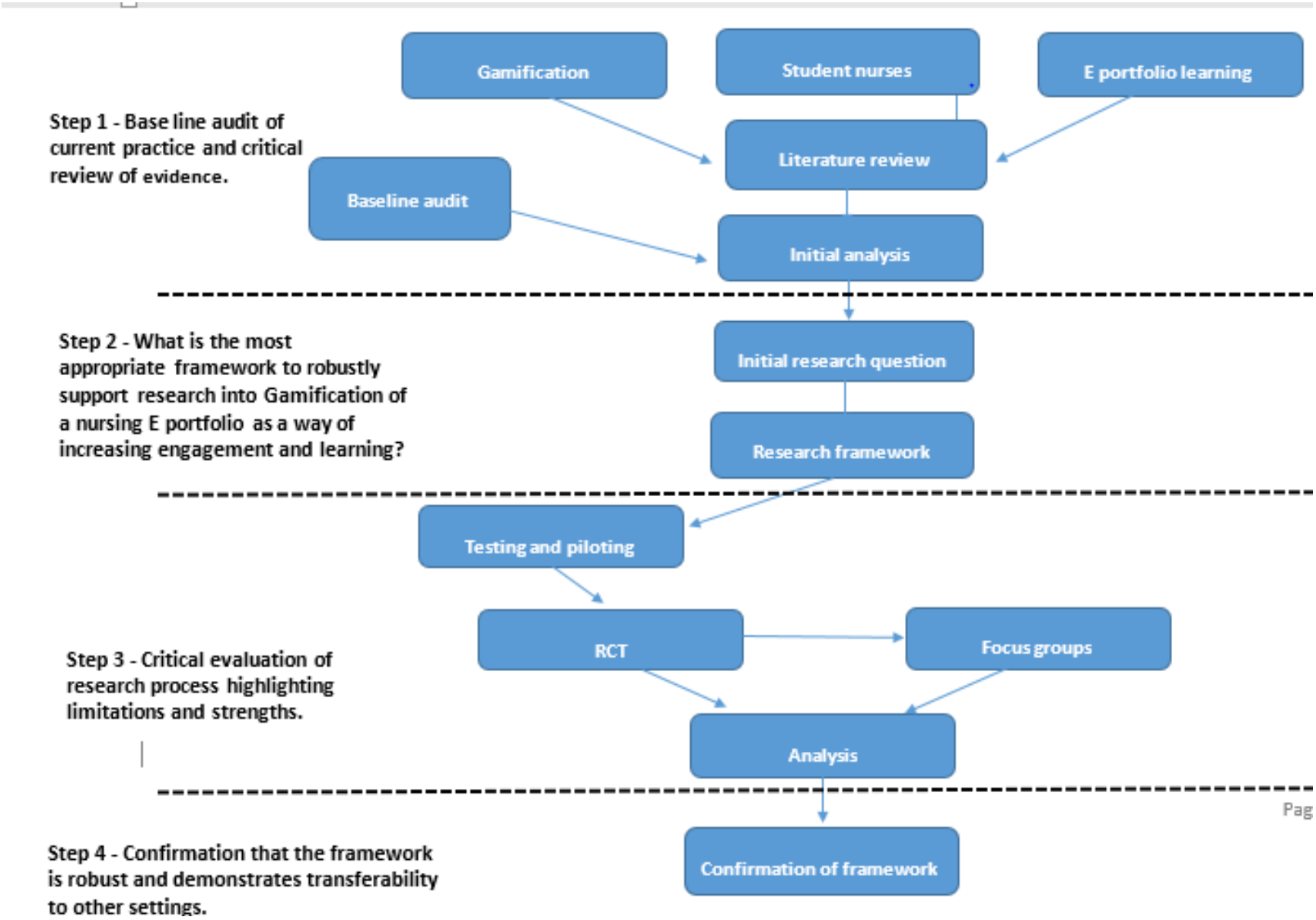


Figure 6 Theoretical framework to support this research project

5.3 Epistemology and methodology

Creswell (2011) draws attention to the four worldviews used in research. These are 1) postpositivist, 2) constructivism, 3) advocacy and participation and 4) pragmatist.
1) Postpositivist is concerned with deduction and empirical observation and measurement in order to confirm theories about the natural world. In contrast to positivism, which looked for absolute truth, acknowledges that research is imperfect and therefore seeks not to prove a hypothesis but the failure to reject a hypothesis. Examples of postpositivist research methods are typically quantitative and include randomised controlled trials and quasi-experimental designs.
2)Constructivism is more concerned with theory generation than theory confirmation. This worldview is interpretivist and qualitative as it seeks to explore historical and social constructs through the lived experiences of the participants. Examples of constructivism research methods are focus groups and participant observation.
3) The worldview of advocacy and participation is often politically driven and explores aspects such as empowerment and patriarchy by collaborating with marginalised groups to invoke social change. The research methods are collaborative in nature such as focus groups.
4) Lastly, the pragmatist worldview considers that the research problem is the most central issue to be resolved. Rather than adopting a purist worldview philosophy, pragmatists argue that using a mix of quantitative and qualitative research methods, the combined results will provide insights towards finding a practical solution (Johnson and Onwuegbuzie 2003, Petersen and Gencel 2013).

The epistemological viewpoint or theory of knowledge that guided this research was the pragmatist worldview. This research project aimed to objectively review whether gamifying the interface of an E portfolio increased student nurse engagement and attainment and, therefore changes in observed behaviour. Any findings needed to be generalised to a cohort of approximately 400 students. The aim to “objectively review “fitted with the methods of the postpositivist, whilst the aim to understand "changes in observed behaviour" fitted well with the methods of the constructivist. Therefore, using research methods from both the postpositivist and constructivist worldviews was deemed to be the best way to collect the fullest amount of data by which to address the research question.

In the absence of sufficient primary research to carry out a systemic review, RCTs, when done well, are considered to be the gold standard method for carrying out research within the positivistic paradigm (Cohen and Manion 2011). This is because RCTs typically feature large numbers of participants, randomisation and, where possible, blinding. These features help to

maintain the objectivity of the research and minimise bias, as well as producing a large amount of data that can be subjected to statistical testing. The outcomes of the statistical testing can be used to support or reject the starting hypotheses (Muijs 2011).

However, research undertaken within the postpositivist worldview does have recognised limitations. The postpositivist world view is only concerned with physical phenomena within the environment that are stable across time and that can be directly observed and measured. It does not take account of things that cannot be directly observed and measured, such as emotions and feelings, and, as such, only provides a way of describing phenomena through one-directional causal links at a superficial level (Bryman 2016). The use of the constructivist worldview methods was used to provide additional data that would give more insight and complement the postpositivist research method and data that would be uncovered using an RCT. (Creswell and Plano-Clark 2011).

Constructivist worldview research methods were used to try to understand why the participants acted in the way that they did and if present, why any variations in behaviour occurred. Within this worldview the processes of observation and induction are used to gather qualitative data by methods such as in-depth interviews, focus groups, and questionnaires, to explain how and why changes in behaviour occur (Gibbs 2008). As such, the research methods capture data on social processes that postpositivist quantitative methods cannot (Cohen and Manion 2011).

A number of constructivist research methods could have been used to gather this information. Questionnaires were discounted as the students were constantly asked to completed questionnaires for module evaluation, placement evaluation and the National Student Survey (NSS). At the time of this study, all questionnaires that were targeted to this student group were receiving low response rates. Hence questionnaires were discounted. Individual interviews were considered but discounted in favour of focus groups. Focus groups would allow for a focused discussion between the individuals as to their thoughts, feelings, and experiences of using the gamified interface. It was decided that due to the highly focused nature of the subject, individual interviews would not generate as much data as an interactive discussion between participants (Bryman 2016). The focus groups were complementary insofar as they allowed greater understanding and insight into the changes in behaviour. However, the limitation of the focus groups was that they could not quantify the size of any change. This was compensated for by the RCT. It also allowed for methodological triangulation to be undertaken that directly increased the validity of the findings (Trochim et al. 2015).

5.4 Overall aim, research questions and hypotheses

As stated earlier, the overall aim of this research project was to establish whether introducing a scoring system into an E portfolio changed student performance in relation to their engagement with formative activities or learning. The primary research question and sub-questions are listed below.

Research question and hypotheses

The primary research question that this research project attempted to address was:

> **'Does the introduction of a scoring system into an E portfolio interface change the student nurses' behaviour in relation to their engagement with formative activities and learning?'**

From this main question a series of sub-questions and hypothesis were generated. The sub-questions are detailed in table 9 and the hypothesis in table 10. Sub-questions a, b, and c were measured using both the RCTs and focus group methods. Sub-question d was measured using the RCT data and not the focus group data. In order to address sub-questions, a number of null and alternative hypotheses were generated. As the literature was inconsistent in supporting the effectiveness of Gamification to promote engagement as well as learning, two-tailed hypotheses were deployed.

Table 9 Summary of the sub-questions used within this research project

a.	Does the introduction of a scoring system into an E portfolio interface influence the overall engagement as evidenced by the scores attained?
b.	Does the introduction of a scoring system into an E portfolio interface influence the number of students making entries?
c.	Does the introduction of a scoring system into an E portfolio interface influence timeliness of the students' entries?
d.	Does the introduction of a scoring system into an E portfolio interface influence the learning as evidenced by the marks attained?

Table 10 Hypotheses generated for testing

Hypothesis 1 – overall scores H10 There will be no significant statistical difference in the scores attained by student nurses who are exposed to the scoring system when compared with the student nurses in the control group, who cannot see the scoring system. H11 There will be a significant statistical difference in the scores attained by student nurses who are exposed to the scoring system compared with the student nurses in the control group, who cannot see the scoring system. Hypothesis 2 – timing of entries H20 There will be no significant statistical difference in the timing of the entries made by the student nurses who are exposed to the scoring system compared with the student nurses in the control group, who cannot see the scoring system. H21 There will be a significant statistical difference in the timing of the entries made by the student nurses who are exposed to the scoring system compared with the student nurses in the control group, who cannot see the scoring system. Hypothesis 3 – the number of students making entries H30 There will be no significant statistical difference in the number of students making entries when the student nurses who are exposed to the scoring system are compared with the student nurses in the control group, who cannot see the scoring system. H31 There will be a significant statistical difference in the number of students making entries when the student nurses who are exposed to the scoring system are compared with the student nurses in the control group, who cannot see the scoring system. Hypothesis 4 – overall marks H40 There will be no significant statistical difference in the marks attained by student nurses who are exposed to the scoring system when compared with the student nurses in the control group, who cannot see the scoring system. H41 There will be a significant statistical difference in the marks attained by student nurses who are exposed to the scoring system compared with the student nurses in the control group, who cannot see the scoring system.

5.5 Randomised Control Trial – primary research method

RCTs are considered to be the method of choice when undertaking positivistic research to compare the outcomes of an intervention (Kendall 2004). The two main methodological components of an RCT are the comparisons between a control and experimental (intervention)

group, and the random allocation of participants to either a control or experimental group. Through randomisation, the RCT design attempts to equalise or reduce all variables between the groups, so that any measured differences between the groups can be attributed to the intervention (Hutchinson and Styles 2010). In order to firmly ensure that an RCT was the correct method, the following question were subjected to introspection. This process is captured in figure 7.

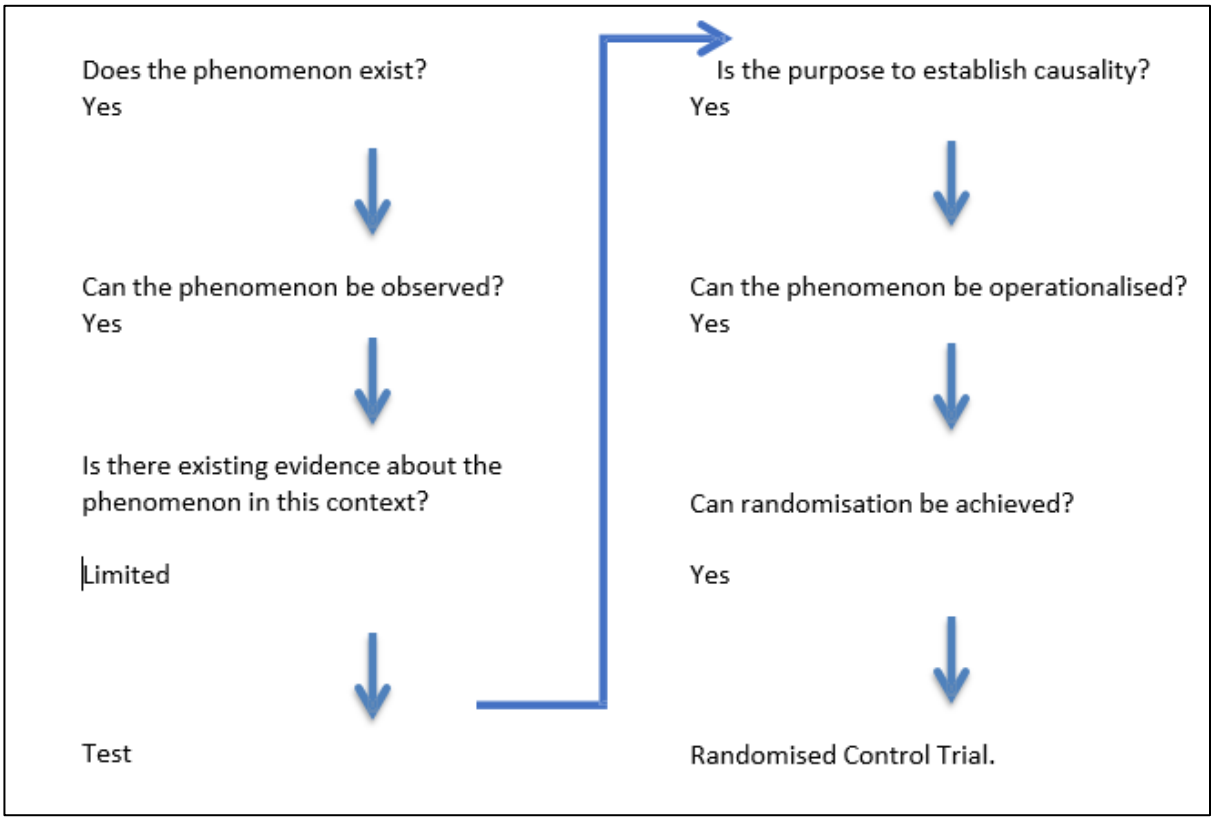


Figure 7 Internal thought processes used to qualify the use of an RTC

5.6 Randomised Control Trial design

The type of RCT used in this study was a parallel two-armed RCT as shown in figure 8. A parallel RCT is the simplest of RCT designs and involves comparisons between a control group and an experimental group (Akobeng 2005, Torgerson and Torgerson 2008). Within the experimental group, the independent variable that is manipulated is the introduction of a scoring system; the dependent variable is the students' reaction in relation to their engagement with the E portfolio after exposure to the scoring system. The control group operates under normal conditions with no manipulation. This creates the condition whereby the differences between the two groups can be measured.

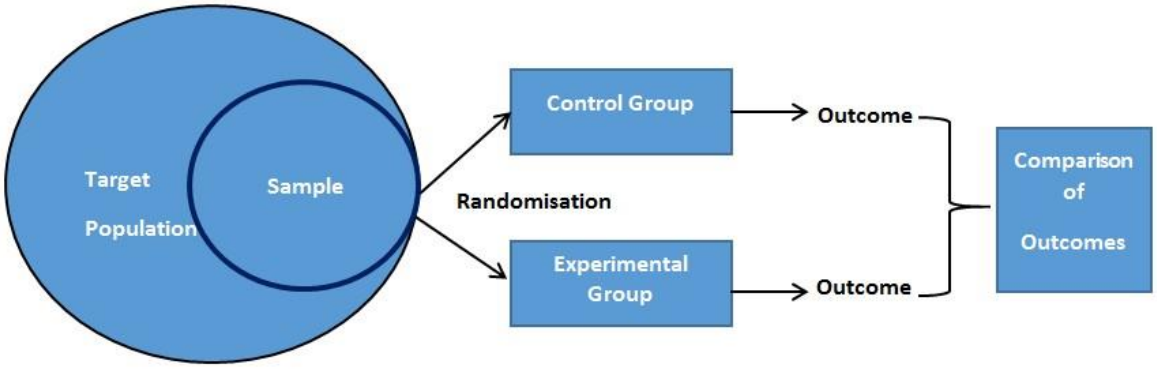


Figure 8 Parallel RCT design (adapted from Akobeng (2005))

5.7 Developing the data collections tools used in Practice Experiences 3, 4 and 5

The development of the scoring system was undertaken in collaboration with the E portfolio provider. The funding for the development came from an internal university 'Education Enhancement Fund'. The total cost of the build was 7.5K and took approximately eight weeks. A programmer working for the E portfolio provider implemented coding that enabled the consented students' data from the E portfolio database to be gathered into a discreet programme and converted into scores. The scoring matrix was provided by the researcher. This is provided in table 11. As can be seen, the weighting score allocation was equal across all of the formative activities so that no one activity was promoted over another.

Table 11 eAoPP scoring matrix and dates

Task	**Student points**					**Bonus mentor points**			
Timed events	Not done	Early	On time	Late		Not done	Early	On time	Late
Completing my professional development	0	3	3	1		n/a	n/a	n/a	n/a
Completing my initial interview	n/a	3	3	1		n/a	3	3	0
Completing my formative assessment	0	1	3	1		0	0	3	0
Completing my formative learning needs	n/a	n/a	n/a	n/a		0	0	3	0
Tasks	**P3 dates 7th Sept – 1st Nov**					**P4 dates 4th April – 29th May**			
Timed events	**On time**					**On time**			
Completing my professional development	10th Sept					7th April			
Completing my initial interview	10th Sept					7th April			
Completing my formative assessment	1st – 8th October					28th April – 5th May			
Completing my formative learning needs	1st – 8th October					28th April – 5th May			

Points gained by number of entries	**Point allocation**
Each formative exercise completed	3 points for each one completed and signed off by mentor
Service user feedback record	3 points for each one completed
Desirable skills	3 points for each one signed off by mentor, zero if not signed off by mentor
Record of external and practice visits	3 points for each record completed by the student
Each detailed drug administration completed	3 points for each one signed off by mentor, zero if not signed off by mentor
Each record of drug administration	3 points for each one signed off by mentor, zero if not signed off by mentor

The programmer also revised the student view of the E portfolio interface. This included showing the participant's score on the E portfolio screen, hyperlinking the score displayed to open a new window revealing the breakdown of how the scores were obtained. This window also displayed a link to a PDF document entitled 'How to improve your score', so that the participant could clearly see how points were allocated. The participant's score could only be seen in the student interface. It was not visible in the practice educator or tutor view, in order to maintain consistency with the participants in the control group. In addition, this was felt to be important in case the score attained by the student influenced the practice educator's grading of that student.

In order to make sure that the system worked, it was tested by the developer and then with Postgraduate Diploma in Nursing students. These were students who were undertaking a practice placement using the same E portfolio system as the intended target group of BN students. The pilot ran from 3rd to 31st August 2015. The students were asked to volunteer to test the scoring system by the Postgraduate Programme Lead. However, only six students volunteered.

The test needed to run when the postgraduate students were in practice placement and conclude before the start of the first RCT, so that any amendments could be made. Due to some delays in the development, there was only a four-week window available to carry out testing. Therefore, there was insufficient time to recruit more students.

However, given the fact that the developers had extensively tested the system, the risk of a small pilot not revealing any data collection problems was considered to be minimal. In addition, as the data was downloaded at the end of each placement, any deficiencies would have been detected and noted very early on in the study. The pilot was therefore more valuable to assess the look and feel of a scoring interface.

At the end of testing, feedback was canvassed through email correspondence. Two students provided feedback. This indicated that the display was rather dull and that the linear layout of the score breakdown was cumbersome. In addition, the students wanted to know what size scores they should be aiming towards. Figure 9 provides screenshots of a fictitious test account, illustrating the original design of the interface.

Figure 9 The student view of the original gamified E portfolio screen

Based on this feedback the following changes were made. Colour was added to the background of the score so that it would stand out on the screen. In addition, the colour changed as the participant's score increased. Target scores were introduced for the mid-point and for the end of the placement. The interface that showed how the scores had been calculated was revamped into a more user-friendly format. Figure 10 shows the revised student view of the gamified E portfolio screen used in PE3.

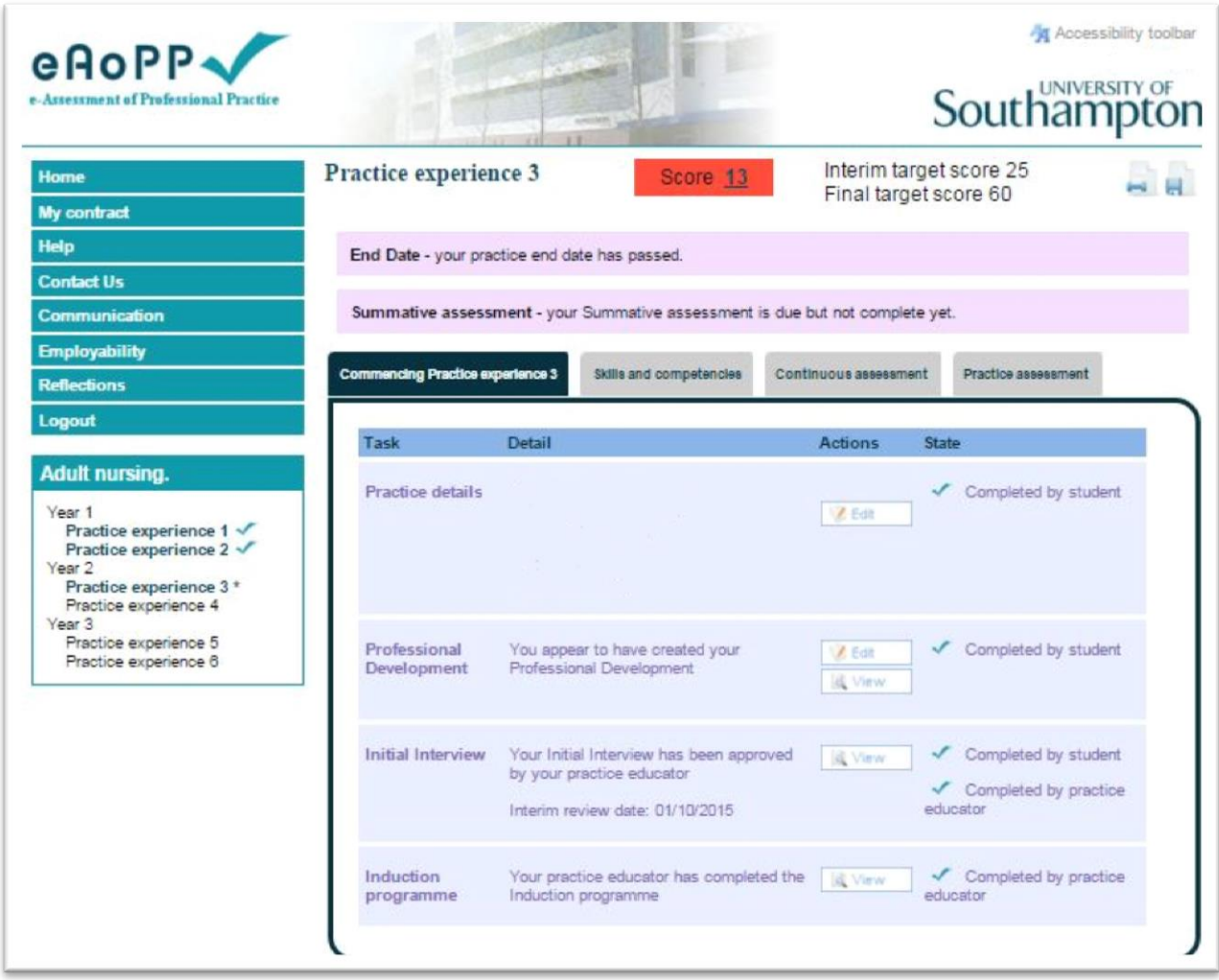


Figure 10 Revised student view of the gamified E portfolio screen used in PE3

Testing also provided an opportunity to review how the data was downloaded. Originally, each pathway had to be downloaded separately for group a and then group b. This required that eight separate data sets be downloaded. In order to simplify this, the download process was amended to include a download of all students in group a and then group b respectively.

The intention was to increase the degree of Gamification in PE4 to explore whether providing a competitive element changed behaviour. This was achieved by implementing a strapline to the E portfolio interface that told the participant where their score sat when compared with the rest of

the group. This information was updated overnight. In addition, the scores attained by the participants would be reset at the end of each practice experience module, i.e., PE3 and PE4. However, due to a miscommunication the scores were not reset, and the additional Gamification strategy was not implemented until halfway through PE4. As such, it was decided to continue the project into PE5. In PE5 the participants in the experimental group were able to see their position in the group, their own score, and their cumulative score from the beginning to the end of PE 5. This is displayed in figure11.

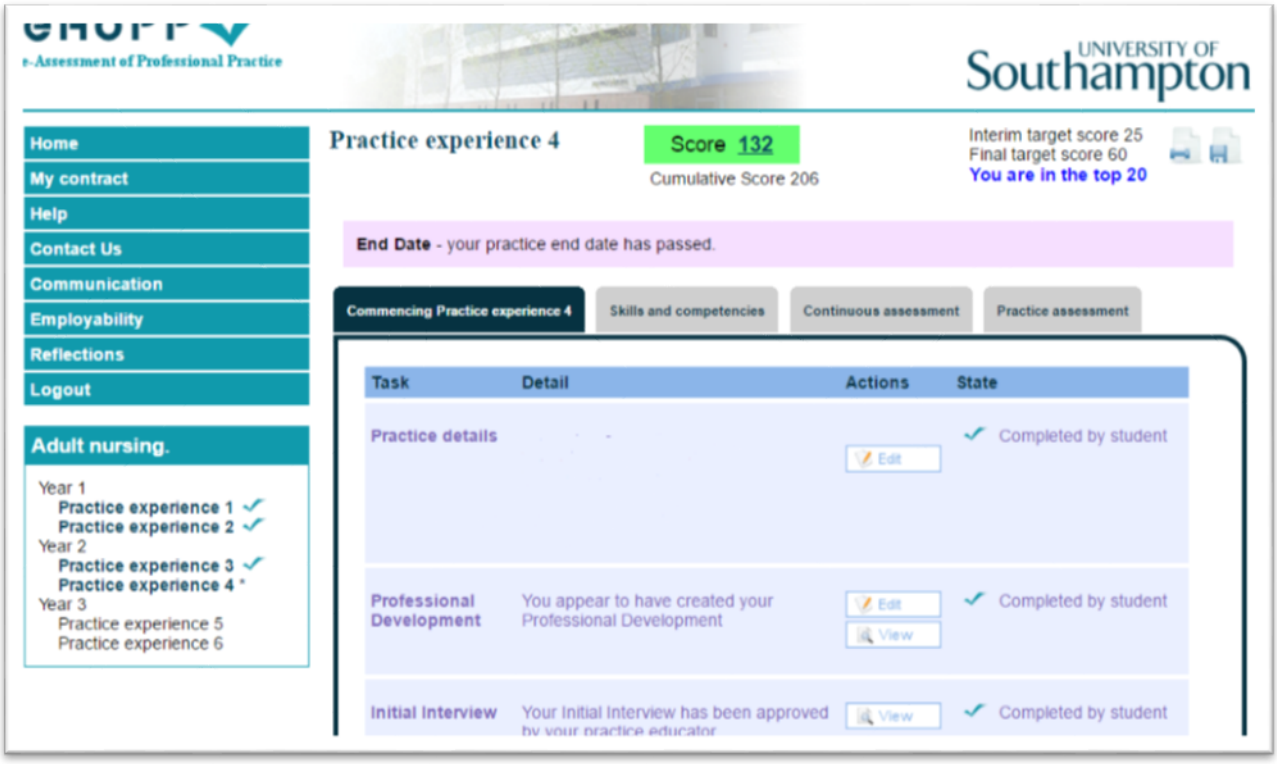


Figure 11 Student view of the E portfolio screen used in part of PE4 and PE5 including the increased level Gamification

5.8 Sample size

The sample was drawn from the 2014/15 BN pre-registration student intake. The total target population size at the start of the research project was 355 students. A key consideration was to obtain a sample of sufficient size that the any findings could be interrogated using inferential statistics (Coolican 2014). The sample size was calculated using the software package 'G Power'. As can be seen from figure 12, the total sample size needed to calculate the difference between

two independent means with a power of 0.8 and significance level of 0.05% was determined as n = 52.

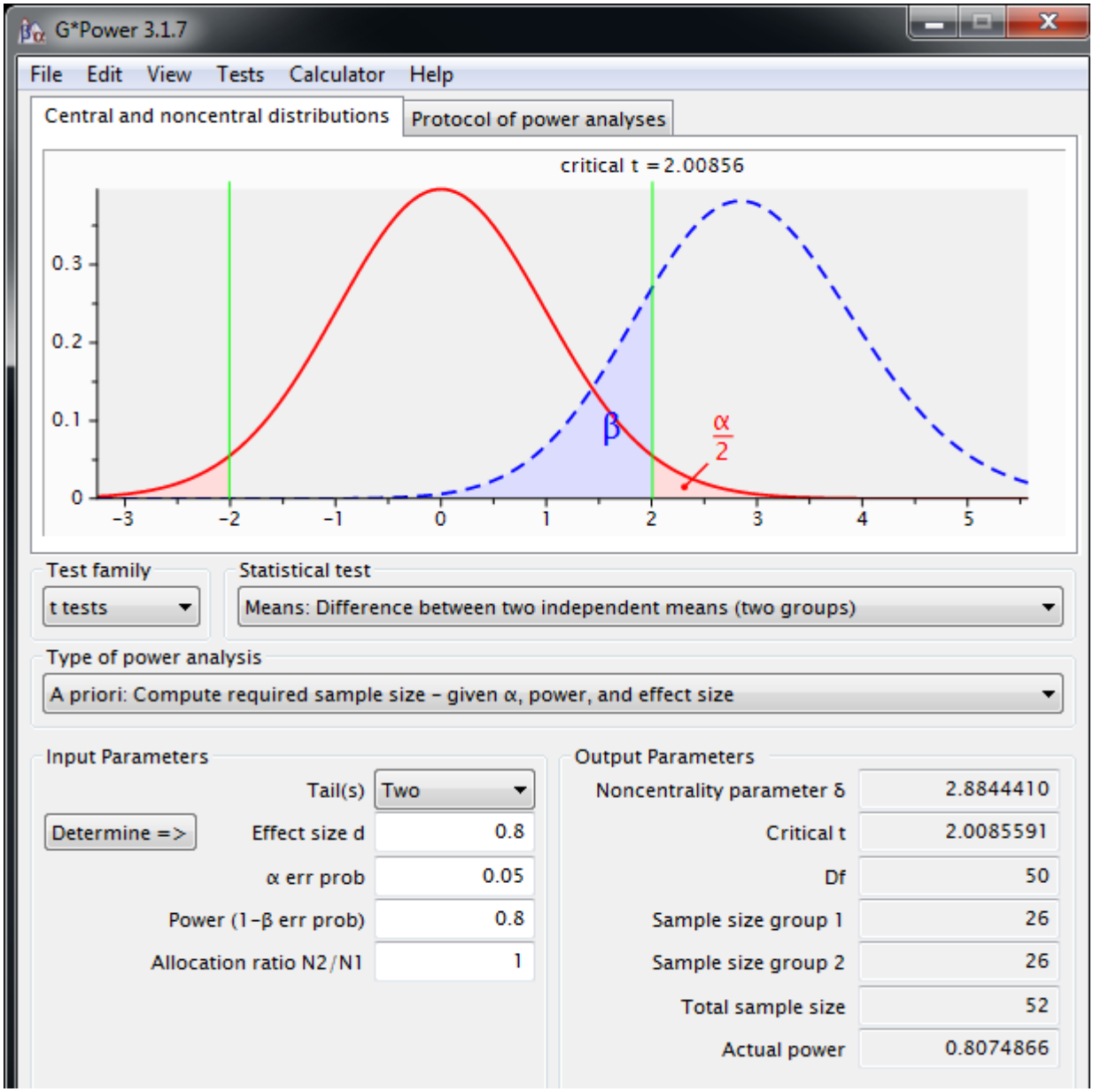


Figure 12 Screenshot of the G Power sample size calculation

5.9 Gaining access

Before proceeding with recruitment, ethical approval was sought. This is discussed later on in this chapter. In addition, permission from the Head of Academic Unit, who had overall responsibility and accountability for students and their programme of study, to access the students and their data was gained. The programme lead was also consulted as a matter of courtesy and good practice. Following attainment of these permissions, recruitment to the study began.

5.10 Recruitment

Recruitment commenced in July 2015 and continued until 1st September 2015. Details about the study and an invitation to participate were emailed to all students in the 2014 BN cohort. The Author then followed up the email request in person by visiting the students whilst they were in small-group workshops. The reason for visiting the students was so that the researcher could outline the purpose of the research, the role of the participants and to answer any questions. Consent forms and participant information sheets were distributed to the students. The students were informed that participation was completely voluntary and that students who were interested should each complete a consent form and hand this to the tutor who was leading the workshop. The Author then left, so that the students did not feel pressurised into agreeing to participate.

The study initially recruited 210 participants and therefore had clearly recruited over and above the minimum sample size of n = 52. The large sample size was encouraging as this helped to ensure a high level of external validity. External validity refers to the extent to which the results can be generalisable to the target population (Trochim et al. 2015). A large sample size provided a greater probability that the sample was representative of the target population and provided reassurances that the likelihood of any attrition would not impact too greatly on the ability to generate meaningful inferential statistics.

5.11 Inclusion and exclusion criteria

The inclusion criteria were all BN students in the 2014 cohort, who were undertaking PE3 using the E portfolio and, had consented to take part in the project. The exclusion criteria were students undertaking PE3 from other cohorts and students who had the start of PE3 delayed.

5.12 Randomisation and stratification

In order to start building internal validity and to counter subject selection bias, a randomised stratified sampling method was adopted (Torgerson and Torgerson 2008).

Internal validity is the term given to whether the data collected (the dependant variables of scores and marks) is due to the effect of the independent variable (Gamification). As both groups had similar programme experiences, the impact of any changes in student performance due to changes to the curriculum would have been reflected by both the control and the experimental group. Randomisation therefore provided a mechanism for countering any unknown or additional unpredicted extraneous variables that might have affected the scores and marks attained (Cohen and Manion 2011). This factor along with the consistency in the conduct of the research approach ensured that internal validity was maximised as far as it was possible to do so.

The randomisation process was accomplished by using the 'RAND' function in Excel. The 'RAND' function was used to give each participant a random number between 0 and 1. The sort, filter and expand selection was then applied to the random number column to sort the values from the lowest to highest. The list was then split in two equal halves so that 50% of the participants were placed in one list and 50% were placed in the second list.

As outlined in chapter 2, the BN preregistration student intake comprises four pathways: child nursing, mental health nursing, adult nursing, and dual field nursing (a combination of adult /child or adult/mental health). Whilst the students were studying different areas of nursing, it should be noted that the placement duration, formative activities, and summative grading in practice were identical for all students. Students undertaking the BN also showed a variation in age and gender. For example, the Mental Health pathway attracts more males than the other pathways. Also, whilst a significant proportion (n = 266 or 75%) of students were under the age of 25 when they commenced the BN programme, it also attracted mature students. In many cases the mature students were employed as healthcare assistants for a minimum of two years and then funded to complete the BN.

Therefore, the target population from which the sample was drawn contained distinct sub groups of pathway, age, and gender. Once randomisation had taken place, the two groups were scrutinised, and reallocations were made to ensure that these sub groups are equally represented in the control and experimental group (Kendall 2004). The rationale for doing so was to ensure that there was equal representation of all sub groups in the control and the experimental group, so that the finding was not due to an over-representation of any of the sub groups within the control or experimental group.

Whilst reallocating participants by the discreet variables of gender and field was straightforward, age is a continuous variable and not as straightforward. It was decided to define a mature participant in this project as having been born after 1/1/1990. The age of 25 years was selected,

as this is when the last part of the developing brain , the pre-frontal cortex reaches maturity. The pre-frontal cortex is thought to control judgement and play a role in rational thought . Therefore, it is considered that adulthood is not fully reached until the age of approximately 25 (Arain et al 2013).

Table 12 provides an overview of the sample and the stratification at the start of the project. The lists of the Students Identifiers were sent over to the programmer, who then pushed the lists two weeks before each PE commenced. The decision as to which group was allocated to the control or the experimental group was left with the programmer. The Author was not told which group was allocated to the control or gamified/experimental group until after all three RCTs had concluded.

Table 12 Composition of Group a and Group b

Strata	Number of participants allocated	
Group	a	b
Child	10	10
Mental Health	14	12
Dual Field	4	4
Adult	77	79
Female	97	97
Male	8	8
D.O.B before 1/1/1990	82	84
D.O.B after 1/1/1990	23	21
Overall sample size (n)	n = 105	n = 105

5.13 Conducting the three RCTs

The first RCT began in September 2015 when the BN pre-registration module, PE3 started. The RCT was repeated in PE4. In the original research design, however, two errors occurred. A miscommunication between the Author and the programmer meant that the scores were not reset at the beginning of PE4 and only a cumulative score was showing on the gamified participants' interface. This was discovered by the Author when a mid-report was generated from the E portfolio database to check that the data was being correctly collected. This action revealed that the database was not generating the participants' individual scores for PE4. After speaking to the programmer, it became apparent that the participants' scores had not been reset at the end of PE3 and that the increase in the level of Gamification had also not been implemented. It was decided to leave the cumulative scores and to add the individual scores along with the increased level of Gamification in the middle of PE4. In addition, after gaining ethical approval and participant consent, a further RCT was run over the duration of PE5 featuring the increased Gamification, placement score and cumulative score. The timeline is provided in table 13.

Table 13 Timeline – Start and finish dates of practice experience 3, 4 and 5

Module	Start date	Completion date	Duration
PE 3	05/09/2015	30/10/2015	8 weeks
PE 4	04/04/2016	27/05/2016	8 weeks
PE 5	07/12/2016	20/01/2017	9 weeks (plus 2 weeks annual leave)

5.14 Data collection

Halfway through PE3, PE4 and PE5, the Author ran reports for groups a) and b). This provided an interim breakdown of the scores. Checking this report was essential to ensure that the database was collecting the correct information. The access to these reports was gained via the admin interface of the E portfolio and did not involve going into the participants' actual E portfolios. Therefore, blinding was maintained. An updated report was also run at the end of each PE. These areas are expanded upon in chapter 6.

5.15 Data analysis

The following data analysis strategy was used. The approach to the initial stage of the analysis was used to assess whether Gamification increased the overall scores of the participants when compared to the non-gamified participants' scores. It also enabled any relationship between the participants' scores and marks to be explored.

The scores and then the marks from each group were summarised and compared with each other using measures of central tendency. This was done for the individual placements and the placements combined, and so enabled an initial view of the spread and distribution of each of the data sets to be gauged. The definitions of measure of central tendency, dispersion, and associated statistical terms used in this section are given in table 14.

Table 14 Definitions of measure of central tendency, dispersion, and associated terms

n	The total number of values in the data set
Mean	The value attained when all the numbers in the data set are added together and divided by n
Median	The central value in the data set
Range	The difference between the highest and lowest values in a data set
Interquartile range (IQR)	The difference between the highest and lowest values in a data set after the lower 25% and upper 25% of the data points have been removed
Minimum	The lowest value in a data set
Maximum	The highest value in a data set
Standard (Std.) Deviation	The measure of the dispersion of a data set from its mean
Skewness	The measure of asymmetry for the normal distribution

Following on from this, the scores and marks were each then subjected to testing using inferential statistics.

The purposes of the testing linked back to the set hypotheses. Therefore, the aim of statistical testing was to:

a. Determine the differences between the means of group a and b in relation to scores and marks;
b. Determine the difference in the proportion of the mean between group a and b in relation to participants who completed at least one formative activity or completed a time-sensitive event within the given timescale;
c. Determine any relationship between the gamified and non-gamified cohorts, in relation to score and mark, including whether factors such as age, field or gender were having any impact on any relationship that was detected.

The data collected from the RCTs was both interval and ratio in nature. Figure 13 shows the decision tree that was used to guide the statistical testing.

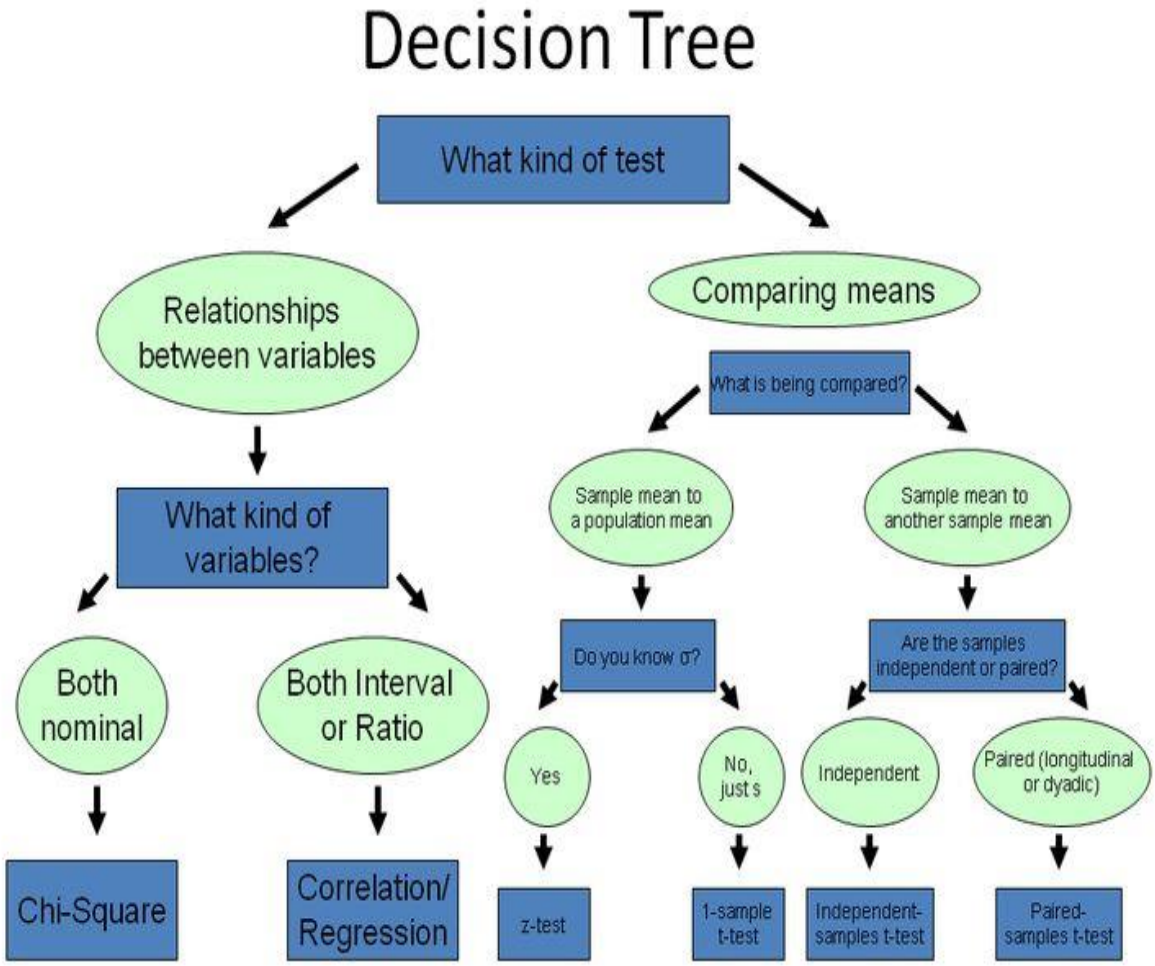


Figure 13 Decision tree to guide selection of statistical tests

(Source https://www.pinterest.co.uk/pin/533887730809876046/?lp=true)

5.16 Blinding

Blinding of participants and researchers is common practice in an RCT design as it reduces the occurrence of any unintentional bias caused by the participants and the researcher (Akobeng 2005). In this study, due to the nature of the intervention, i.e. exposure or non-exposure to a scoring system, it was obvious to the participants when they logged into PE3 as to whether they were in the control or experimental group. Therefore, the participants could not be blinded. However, the participants were not able to identify the other students in the study and these details were not revealed at any time during the RCT studies. The reason for this was to try to prevent cross-contamination between and within the control and experimental groups.

In order to minimise researcher bias, the researcher was blinded for the duration of the RCTs and subsequent data analysis. This was achieved as follows:

For each field an Excel sheet was created that reflected the stratification and contained only the student ID and field. Two weeks before the start of PE3, the Excel sheets were passed to the E portfolio provider who then allocated one sheet from each field to the gamified (experimental) interface and the second group to the non-gamified (control) interface. The E portfolio provider then randomly assigned the letters a and b to the experimental and the control groups. At the end of each practice placement the student data was downloaded into two Excel files, labelled group a and group b. The identity of each group (i.e. experimental or control) was not made available until after the final analysis at the end of PE5. The researcher had no contact with the participants during the RCT studies.

5.17 Maximising validity and minimising bias

Throughout the previous sections, the steps that have been taken to reduce bias and maximise validity have been discussed. The use of a randomised sampling technique and partial blinding were intended to help reduce sampling bias and researcher bias from distorting the study findings and increase internal validity. Randomisation was used in an attempt to increase both the internal and external validity (Torgersen and Torgersen 2010). Stratification of the sample was intended to reduce the impact of any sampling anomalies on the results. Repeating the experiment in PE4 and PE5 also demonstrated that the findings can be replicated. This again enhanced the internal and external validity of the study (Akobeng 2005).

The use of a two-armed RCT, where the control and experimental group activity run parallel to each other, further enhanced internal validity as the measurements were made under the same external conditions, so reducing the impact of any potential confounding variables. This, along with stratified randomised sampling, strengthened population validity, i.e. the extent to which the results of a study can be generalised from the specific sample that was studied to a larger group of subjects (Kendall 2004, Torgersen and Torgersen 2010).

Ecological validity or the extent to which the results of an experiment can be generalised from the research environmental conditions to real life was high. This was because the participants were using the E portfolio as they would in the everyday context of their practice placement, and not undertaking any different type of activity. The conditions were therefore real- world and authentic. Population and ecological validity forms the foundations of construct validity. Therefore, this study demonstrated high construct validity (Coolican 2014).

A final type of validity that was considered was statistical conclusion validity (Torgenson and Torgenson 2010). In order to maximise statistical validity, parametric analyses were performed to a 95% confidence level and a statistical test power of 80%. These parameters were standardly

used to ensure that the chances of detecting an effect were as high as possible (power) whilst the likelihood of rejecting a null hypothesis, when there is an effect, is minimised. Therefore, this provided a 5% or less chance that a type 1 error would occur, i.e. incorrect rejection of a true null hypothesis. As can be seen in figure 12, the sample size recruited exceeded the number of participants needed to detect statistically significant differences between the groups, although a type 1 or type 2 error could not be totally eradicated (Coolican 2014).

5.18 Focus Groups – secondary research method

At the end of PE5 the RCT data was downloaded from the E portfolio database. The data was examined to establish the range of the participants' scores for group a and group b. The blinding was also removed, which revealed that group a was the experimental group and group b was the control group.

A sample of the participants from group a, the experimental group, were selected to gain further feedback on their experiences. A purposeful sampling strategy was used to select participants from across the mark range to take part in focus groups. Twelve potential participants were identified and invited by the researcher (via email), to attend a focus group. Four participants were those who had the four top scores in the range, a further four were those who had the lowest scores in the range and the final four were those who had scores in the middle of the range .

The reason for sampling in this way was to gain insight into participations with varying level of engagement. In addition, Bryman (2016) indicates that for a focus group to work well, between eight and ten participants are needed. This would enable participants to bounce ideas off each other, adding to the richness of the data produced.

The focus group meetings were scheduled to be held on the university campus. The date for the focus group meeting was set to ensure that timetable clashes were avoided and that the participants were on the university campus on that day.

However, out of the twelve participants invited to take part, only five responded. Unfortunately, two of the five dropped out, one due to transport problems and one due to sickness. Of the three participants who did attend, two were from the top scoring range and one was from the middle scoring range. Rather than run the focus groups with very low numbers and an unbalanced sample in terms of scores, the initial ideas for the focus groups were abandoned.

Instead a secondary recruitment strategy was used to try to increase the number of attendees. This involved inviting all the participants from group a to attend one of three focus group sessions. A further six participants responded making eleven in total. However, only three participants attended the first focus group , three more attended the second focus group and only

one participant attended the third focus group . Due to the lack of participants, the focus groups took the form of two group discussions and one individual discussion. The lack of participants who took part in the focus group was a considerable limitation which is discussed further in chapter 7.

5.19 Focus group methods

Prior to commencing this study, a number of key questions were generated in order to give the intended focus groups structure (Parahoo 2006). The questions were peer-reviewed by three academics to ensure that the questions were not leading, ambiguous or confusing. Amendments were made, and the final questions are given in Appendix A.

Twelve questions were formatted with the purpose of getting a broad understanding of the participants feelings about the gamified interface. This included how the participants felt about seeing a score on their screen, whether this changed their behaviour in any way and whether they noticed the increase in the level of Gamification from the midpoint of PE4. The questions also explored the motivation of the participants to engage with the E portfolio activities and which activities they engaged with most frequently and why. The participants were asked what could be done to increase their level of engagement further and what they saw the purpose of the E portfolio to be. Finally, the participants were asked to give any other feedback that they thought would be useful to the project.

These questions were used to loosely guide the group and individual discussions. Whilst it was intended that each focus group lasted 30 minutes as detailed below, in reality the group discussions lasted approximately fifteen minutes and individual discussion ten minutes, as the length of time needed to explore how the participants felt the scoring system influenced their behaviours was much shorter than the predicated 30 minutes.

Planned structure for the focus groups was:

- 5 minutes welcome and purpose of the focus group, review of the consent forms, ground rules, data usage, protection, and storage
- 20 minutes to explore how the participants felt the scoring system influenced their behaviours
- 5 minutes to gather any last thoughts, to debrief and close the session.

5.20 Data collection and analysis

The data from the group and individual discussions were captured by a note taker. The note taker had an extensive background in capturing qualitative data from both focus groups and individual interviews. Furthermore, they were familiar with the researchers work from previous

collaborations. A simple manual coding of the transcripts was undertaken to identify key themes (Gibbs 2008). This was carried out using Bryman's four stages of coding

Analysis Stage 1 first read through

Stage 2: Read again

Stage 3: Code the text

Stage 4: Relate general theoretical ideas to the text (Bryman 2016)

Chapter 6.provides further details as to how the coding was developed and the results of the group and individual discussions

5.21 Ethical considerations

The evidence surrounding the use of Gamification, as a way of improving student engagement in Higher Education, was extremely limited (Codish and Ravid 2014). It was not known if the intervention would increase or decrease the frequency or the quality of student engagement. As such, the study was exploring a phenomenon that was in a position of equipoise.

The study received full ethical approval in relation to recruitment, procedural processes, data storage and destruction from the Faculty of Physical and Applied Sciences (ERGO/FPSE/13446). The ethics submission documentation is provided in Appendix B. In addition, support was given from the Faculty of Health Sciences. The researcher was not involved in the teaching or practice assessment of the participants and was not an academic tutor for any of the participants. The researcher was only known to the participants through the recruitment process. This avoided any potential for the researcher to unwittingly coerce any students into taking part in the study.

5.22 Confidentiality and anonymity

All participant data was held in an electronic format in accordance with University Policy on research data retention as well as the Data Protection Act 1998. All paper documentation, such as consent forms and email addresses, was scanned and uploaded to the University's secure research storage area. The original paperwork was shredded. The student ID number was the only identifying characteristic associated with the quantitative data collected in the RCT. This was needed since, if a participant had decided to withdraw from the study, it would have allowed the data to be located and removed. Direct quotes from the participants were used during the group and individual discussions data analysis. The researcher ensured that no information that would reveal the identity of the participants was included. This ensured the anonymity of the participants.

5.23 Critical evaluation of the strengths and limitations of the research methodology

RCTs can be prone to several types of flaws. These include sampling errors, problems with the reliability and validity of the data collection tools, data contamination and unintentional (Hawthorne effect) or perverse behaviours of the participants. The measures taken to try to prevent or minimise these have been embedded into the study design and expanded upon in the earlier sections of this report.

The strength of this work was the combined use of an RCT and group/individual discussions. This allowed methodological triangulation, which can deepen the understanding gained from a research project, as well as enabling the findings from each method to be used to validate each other (Creswell and Plano-Clark 2011). The duration of the study (3 x 8 to 10-week periods) was longer than the duration of previous studies reviewed in chapter 4. Using only one Gamification mechanic, a scoring system, enabled the results to be very specific to the use of a scoring system. Therefore, the methods adopted in this project and the need for controlled trials over longer periods was in keeping with the recommendations for future research, as highlighted by Hamari et al. (2014).

As the study was being carried out with a very specific student group in one faculty, the findings were limited in terms of transferability. A factor that needed to be considered was that the participants were likely to know each other and so cross-contamination between the groups could not be fully controlled. Whilst stratified randomised sampling was carried out, this might not have prevented the students discussing the project with each other, which might have led to contamination of the control group.

5.24 Summary

In conclusion, this chapter has provided details of the philosophical concepts and theoretical framework methodology that were used to support the development and conduct of this project. It has rationalised the use of the research methods and tools as well as the approach to data analysis. The limitations and ability to generalise any findings from this project have also been explored. The next chapter provides details of the data collected from the RCTs and the group and individual discussions.

Chapter 6: Results and data analysis

6.1 Introduction

This chapter provides a detailed account of the data collected, the methods used to analyse the data and the results generated. It commences by revisiting the research questions and subsequent hypotheses that were generated. The results from the RCTs are presented first. The methods of data collection, verification and data cleansing are discussed, followed by an overall summary of the demographic compositions of each group and the impact of attrition. The measure of central tendency and dispersion are then reviewed before attention is turned to the results generated using inferential statistics. The review of inferential statistics includes justification of the choice of data analysis test used. The analysis of the findings of the group and individual discussions are then explored, along with the rationale for the choice of data analysis tool. The chapter then concludes with an overall summary of the key findings and their potential significance.

6.2 Review of the research questions and hypotheses

The primary research question that this research project attempted to address was, 'Does the introduction of a scoring system into an E portfolio interface change the student nurses' behaviour in relation to their engagement with formative activities and learning?' From this main question a series of sub-questions was generated:

- Does the introduction of a scoring system into an E portfolio interface influence the overall engagement as evidenced by the scores attained?
- Does the introduction of a scoring system into an E portfolio interface influence the number of students making entries?
- Does the introduction of a scoring system into an E portfolio interface influence timeliness of the students' entries?
- Does the introduction of a scoring system into an E portfolio interface influence the learning as evidenced by the marks attained?

Sub-questions a, b, and c were explored using both the RCTs and group and individual discussions methods. Sub-question d was examined by interrogating the marks produced by the eAoPP database. In order to address sub-questions a, b, c, and d, a number of null and alternative hypothesis were generated. These were presented in chapter 5 table 10.

6.3 Data collected from the RCTs

The data was extracted from the portfolio database into an Excel spreadsheet. The areas that data were collected from are summarised in table 15. As it can be seen, the data fell into three categories: 1) marks and scores, 2) the number of activities undertaken by the participants, and 3) the completion of time-sensitive events. These categories form the key areas for analysis. The rationale for collecting this specific data has already been discussed in chapter 5.

Table 15 Data collected from the participants' E portfolios

Marks and scores
The mark attained for each of the 3 placements by the student
The Gamification score attained for each of the 3 placements by the student
The mean mark of the student for all 3 placements combined
The mean Gamification score of the student for all 3 placements combined
Data entries made
The number of service user feedback forms collected by the student
The number of external visits completed by the student
The number of desirable skills attained by the student
The number of detailed drug records completed by the student
The number of drug administration rounds completed by the student
Recording of completion of time-sensitive events
The time when the completion of the professional development was undertaken by the student
The timeliness of the completion of the initial interview as undertaken by the student
The timeliness of the completion of the initial interview as undertaken by the mentor
The timeliness of the completion of the formative interview as undertaken by the student
The timeliness of the completion of the formative interview as undertaken by the mentor

6.4 Checking the accuracy of data capture.

Shortly after the conclusion of PE3, the breakdown and composition of 30 participants' scores (15 from group a and 15 from group b) were compared against the data contained in the 'data view' section in the admin interface in the E portfolio. This is a different part of the E portfolio system to where the reports of the scores for each group were downloaded for analysis (see screenshot in Appendix C). The reason for doing this was to ensure that these reports that were generated by the E portfolio database were accurately capturing the required data. The implications of the

gamified system not accurately capturing the participants' scores would invalidate any findings and would have required that the study be halted.

In order to ensure that the data collected was representative across the whole range of scores, the top, middle and bottom scoring participants from both groups who undertook PE3 were reviewed. Adopting this approach meant that high and low outliers were included to check that high scores were not due to duplicate records being created in the background of the eAoPP database or low scores occurring due to loss of data.

6.5 Data cleansing strategy

Following the conclusion of PE5, the data was prepared for analysis. Firstly, the data for both groups was visually scrutinised by the researcher to identify any anomalies, such as outliers and missing data. It was observed that in PE4, four participants had data missing from the professional development section. The Gamification process required that the lists of the participants in each group be 'pushed' two weeks before the PE started. Upon further investigation within the portfolio database, it was discovered that the missing data was because the students had completed this section several weeks before PE4 began and therefore before the Gamification data had been pushed.

These participants' data sets were included as they featured amongst the middle to highest scoring participants. Not having a score for the professional development exercise only reduced the overall score by three points and hence the impact was considered to be negligible.

After the data had been inspected for anomalies and the missing entries due to early activities of a participant had been accounted for, a data cleansing strategy was applied. This involved identifying any other incomplete data sets that were due to reasons such as a participant failing to complete or start a PE. Once a participant's data was removed, the participant was not readmitted to the study. The reason for this was that they would not have had an equivalent experience to the other participants, which could be a confounding variable that reduced the reliability of the findings.

6.6 Stratification and the impact of attrition

As stated in the methodology chapter, the sampling groups were generated using random selection. Final manual adjustments were then made to try to ensure that subgroups of age, gender and nursing field were equally represented in both groups. Table 16 provides a summary

of the demographic spread at the start of PE3 and the impact of subsequent attrition from the study in PE4 and PE5.

Table 16 Summary of the stratification in each placement following attrition

Strata	Categories	Initial stratification		Number of participants who completed each practice experience					
				PE 3A	PE 3B	PE 4A	PE 4B	PE 5A	PE 5B
Gender	**Female**	97 (92%)	97 (92%)	87 (92%)	94 (93%)	85 (91%)	91 (93%)	75 (91%)	80 (92%)
	Male	8 (8%)	8 (8%)	8 (8%)	7 (7%)	8 (9%)	7 (7%)	7 (9%)	7 (8%)
Branch	**Adult**	77 (73%)	79 (75%)	69 (73%)	75 (74%)	67 (72%)	73 (75%)	57 (70%)	63 (72%)
	Mental Health	14 (13%)	12 (11%)	13 (14%)	11 (11%)	13 (14%)	11 (11%)	12 (14%)	11 (13%)
	Child	10 (10%)	10 (10%)	9 (9%)	10 (10%)	9 (10%)	10 (10%)	9 (11%)	10 (12%)
	Dual Field	4 (4%)	4 (4%)	4 (4%)	5 (5%)	4 (4%)	4 (4%)	4 (5%)	3 (3%)
Age	**D.O.B before 1/1/1990**	23 (22%)	21 (20%)	18 (19%)	19 (19%)	17 (18%)	18 (18%)	15 (18%)	15 (17%)
	D.O.B after 1/1/1990	82 (78%)	84 (80%)	77 (81%)	82 (81%)	76 (82%)	80 (82%)	67 (82%)	72 (83%)
	Sample size (n)	105	105	95	101	93	98	82	87

As it can be seen, attrition reduced the overall sample size from n = 105 participants in group a and n = 105 participants in group b, to n = 82 participants in group a and n = 87 participants in group b. Therefore, the number of participants lost from each sample was 23 from group a and 18 from group b. Given that the number of participants required for each cohort to be subjected to inferential statistics still exceeded the calculated sample size (figure 12), the effect of attrition was limited and did not impede the ability to carry out inferential statistical analysis.

In terms of the effect of attrition on stratification, this also remained minimal. As illustrated in table 16, the initial stratification produced two groups with similar representation in relation to

gender, field, and age. By the end of PE5 the gender representation in group a was slightly reduced. In group b the number of female participants decreased, as did their average representation within the sample. With regard to stratification in relation to field, group a experienced a loss of twenty participants from the adult field, two participants from the mental health field, one participant from the child field and no participants from the dual fields. Group b experienced similar drops, except for the adult field where there was a smaller loss of sixteen students. With regard to age, the greatest attrition rate for both group a and group b was seen in participants whose date of birth was after 01/01/1990. However, given that the majority of the participants fell within this category, this had little impact on the percentage representation of this subgroup within group a or group b.

Given the stability of the stratification within the samples, it was possible to undertake statistical analysis to explore whether any one of these strata performed better than the others. This is discussed further in the latter part of this chapter under Regression.

6.7 Measure of central tendency and measure of dispersion

Initially, the data was summarised using the mean as the measure of central tendency and the standard deviation as the measure of dispersion.

The variables included in this analysis were the participants' Gamification scores and the marks achieved in each PE and the mean Gamification scores and marks for all three PEs combined. The reason for choosing these specific variables was that the variables represented summary outcome measures. If Gamification had improved engagement and/or learning, then a difference would be found when comparing the means of these variables. Therefore, it was anticipated that the analysis of these summary outcome measures would indicate whether there was a statistically significant change in student performance when exposed to the Gamification condition.

6.8 Measure of central tendency

In order to ascertain the effect that the presence of outliers made on the reliability of the mean as a measure of central tendency, the mean was calculated twice. This was done firstly with the outliers included and then with the outliers removed. These results are displayed in tables 17, 18, 19 and 20.

In relation to the scores, before the removal of the outliers, the difference between the mean values for group a and b demonstrated that group a consistently outperformed group b, with the highest percentage difference of 18.9% in PE3 (table 17). Once the outliers had been removed, the data indicated that group a continued to outperform group b, albeit to a lesser extent (table

18). The highest percentage difference of 16.1% was in PE4. As would be expected, the removal of the outliers reduced the range, standard deviation and skewness for both group a and group b in all PEs.

In relation to the marks, the findings were very similar, with group a outperforming group b before and after the removal of the outliers. However, the degree to which group a outperformed group b did not exceed 2.2% (PE3) with the outliers in (table 19). Once the outliers were removed, it increased to 2.3% in PEs3, 4 and 5 (table20). As previously discussed, because there was a limit to the amount of marks that could be awarded for each PE, the impact on the removal of outliers on the range, standard deviation and skewness for both group a and group b in all PEs was minimal.

Table 17 Measure of central tendency – Gamification scores

	PE3 Group a	PE3 Group b	Difference	PE4 Group a	PE4 Group b	Difference	PE5 Group a	PE5 Group b	Difference	All PEs Group a	All PEs Group b	Difference
n =	95	101		93	98		82	87		95	101	
Mean	83.7	70.4	13.3 (18.89%)	84.1	73.5	10.6 (14.42%)	88.9	75.1	13.8 (18.38%)	84.9	73.5	11.4 (15.51%)
Range	243	159		152	153		193	148		133	104	
Minimum value	28	16		29	16		46	20		43	23	
Maximum value	271	175		181	169		239	168		176	127	
SD	36.3	29.5		34.4	33.3		38.7	30.3		26.7	23.8	
Skewness	2.0	1.1		0.9	0.8		1.7	0.3		1.1	0.23	

Table 18 Measure of central tendency outliers removed – scores

Scores – outliers removed	PE3 Score group a	PE3 Score group b	Difference	PE4 Score group a	PE4 Score group b	Difference	PE5 Score group a	PE5 Score group b	Difference	PE3,4 & 5 Score group a	PE3,4 & 5 Score group b	Difference
n =	89	97		92	96		79	86		92	101	
Mean	77.1	66.7	10.4(15.59%)	83.0	71.5	11.5 (16.08%)	82.7	78.0	4.7 (6.03%)	82.3	73.5	8.8 (11.97%)
Range	112.0	105.0		141.0	132.0		118.0	126.0		100.3	104.3	
Minimum	28.0	16.0		29.0	16.0		46.0	20.0		43.0	22.7	
Maximum	140.0	121.0		170.0	148.0		164.0	146.0		143.3	127.0	
Std. Deviation	24.7	23.6		33.0	30.7		28.0	28.8		22.7	23.8	
Skewness	.7	.3		.8	.6		.9	.1		.6	.2	

Table 19 Measure of central tendency – marks

	PE3 Group a	PE3 Group b	Difference	PE4 Group a	PE4 Group b	Difference	PE5 Group a	PE5 Group b	Difference	All PEs Group a	All PEs Group b	Difference
n =	95	101		93	98		82	87		95	101	
Mean	68.6	67.1	1.5 (2.24%)	68.2	67.3	0.9 (1.34%)	71.6	71.5	0.1 (0.14%)	69.5	68.3	1.2 (1.76%)
Range	43	41		43	41		36	45		35	42	
Minimum value	42	44		42	44		49	40		50	43	
Maximum value	85	85		85	85		85	85		85	85	
SD	7.8	8.5		7.6	8.4		7.6	8.2		5.4	7.3	
Skewness	-0.5	-0.1		-0.6	-0.1		0.3	0.9		-0.8	-0.5	

Table 20 Measure of central tendency outliers removed – marks

Marks – outliers removed	PE3 Mark group a	PE3 Mark group b	Difference	PE4 Mark group a	PE4 Mark group b	Difference	PE5 Mark group a	PE5 Mark group b	Difference	PE3, 4 & 5 Mark group a	PE3, 4 & 5 Mark group a	Difference
n =	93	98		91	95		78	85		91	100	
Mean	69.0	67.7	1.3 (1.92%)	68.7	68.0	0.7 (1.03%)	72.5	72.2	0.3 (0.42%)	70.2	68.6	1.6 (2.33%)
Range	33.0	33.0		33.0	33.0		27.0	30.0		25.0	33.0	
Minimum	52.0	52.0		52.0	52.0		58.0	55.0		60.0	52.0	
Maximum	85.0	85.0		85.0	85.0		85.0	85.0		85.0	85.0	
Std. Deviation	7.1	7.8		6.9	7.7		6.4	7.1		4.3	6.9	
Skewness	0.0	0.2		-0.1	0.2		0.5	-0.2		0.5	-0.2	

6.9 Measure of dispersion

The output data from SPSS is summarised in figures 14, 15. 16 and 17 and tables 17 and 18. As can be seen in tables 17 and 18, the dispersal of the data is much greater for the scores than for the marks. For example, with the scores for PEs 3, 4 and 5 combined, the standard deviation for group a and b is 22.7 and 23.8 respectively, whereas the marks for this combined PE have a standard deviation for group a of 4.3 and b of 6.9. The reason for this is that the maximum mark a student could attain in any PE is 85% and the minimum pass mark was 40%. In relation to the scores, there was no cap on the maximum on the amount of points that the participant could attain. Therefore, the potential range for the spread of data in relation to marks was much smaller than for scores. When the standard deviation for groups a and b were compared against each other, it was seen that the figures were very similar (see example above), which indicated that the spread of scores and the spread of marks was similarly distributed between groups a and b. This similarity in distribution can clearly be seen in the histograms in figures 14, 15, 16 and 17 and in the histograms for each individual PE provided in Appendix D.

The bell curves on the histograms also illustrate where the normal distribution would have fallen. As can be seen in the histograms of the scores, both the individual and combined PEs demonstrated a right or positive skew. Inspection of the histograms for the marks indicated the presence of a left or negative skew. A skew in the data can indicate the presence of outliers. Outliers were classified as any points that when multiplied by 1.5 give value that falls outside the interquartile range (IQR). The significance of extreme outliers is that the reliability of the mean as a measure of central tendency can be distorted. Therefore, all data sets were further interrogated to identify any outliers. The results are provided in Appendix D.

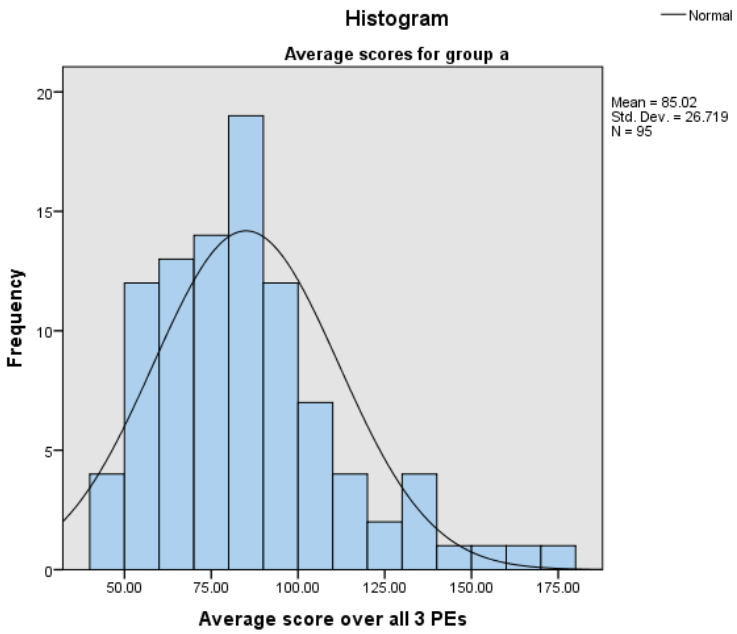


Figure 15 Average scores achieved by group a over all 3 PEs

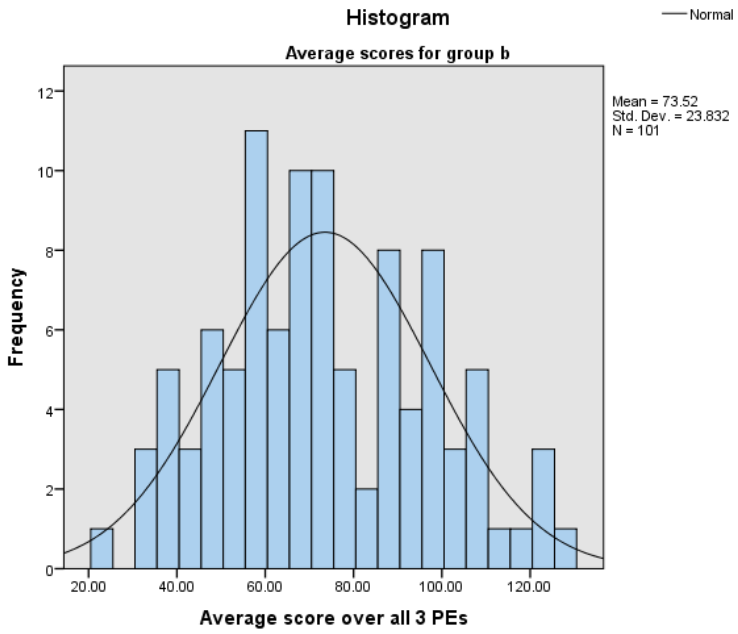
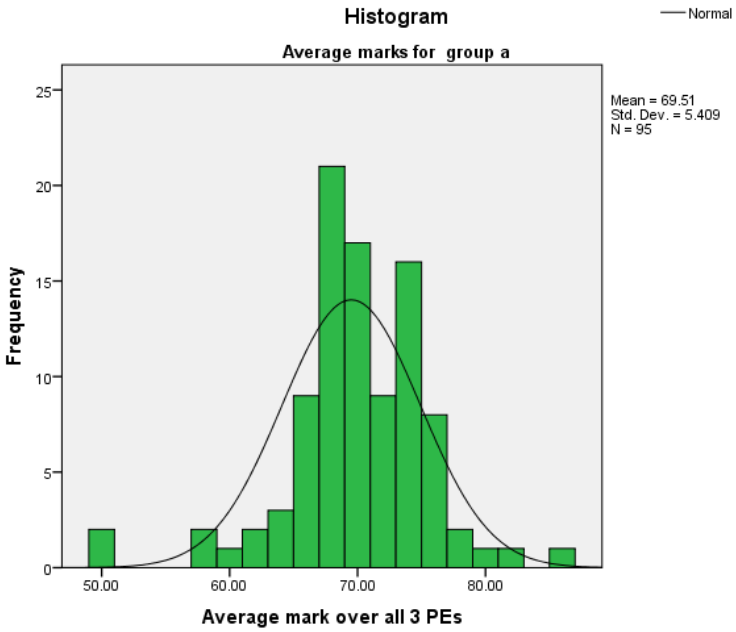


Figure 14 Average scores achieved by group b over all 3 PEs



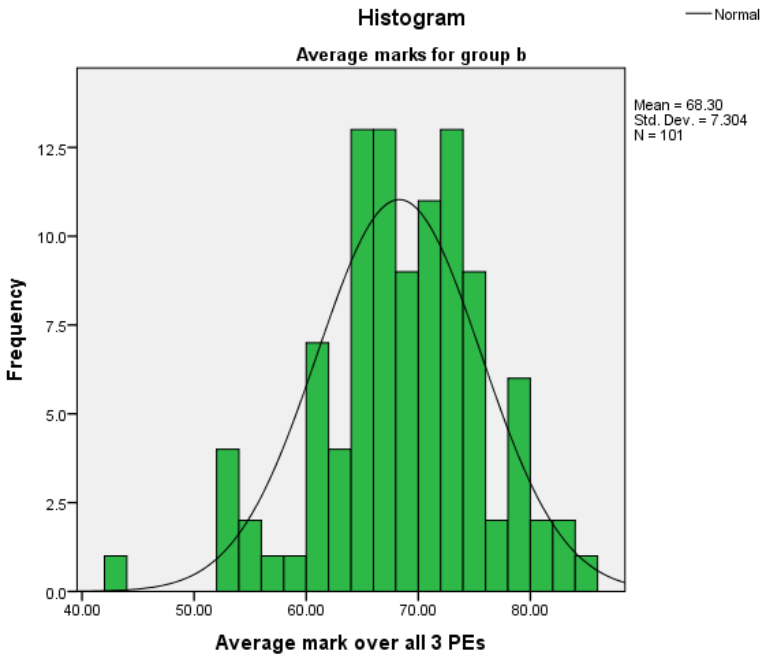


Figure 17 Average marks achieved by group a over all 3 PEs erage marks achieved by group b over all 3 PEs

In order to explore whether the differences found between groups a and b were statistically significant, the data was then subjected to a T-test for two independent samples**.** This is discussed in the next section.

6.10 T-test for two independent samples

A T-test for two independent samples (t-test) was used to compare the means of group a and b in order to estimate the effect of Gamification on group a and see if there was any statistically significant difference between the mean values of group a and b. In keeping with general convention, the confidence interval was set at 95% level and the significance level was set at 0.05. As previously discussed, the two distributions of the data for the marks and scores were not perfectly normal. Therefore, the first step in the analysis was to review the values generated in SPSS for Levene's Test for Equality of Variances. Levene's test highlights whether the use of parametric tests, such as the t-test, is appropriate by determining if the two data sets have about the same or different amounts of variability between the data. If the significance returned by the Levene's test is greater than 0.05, it is generally acceptable to assume equal variances are present. If this assumption is not met, then the significance value listed under the 'Equal variances not assumed' is used.

The results of the t-tests are given in tables 21, 22 ,23 and 24. With one exception, the analysis of the means of the scores and marks demonstrated equal variance in all PEs. The exception to this was the mean mark for PEs3, 4 and 5 with the outliers included (table 22). Despite the assumption of equal variance, in order to confer rigour, the t-test was run with the outliers included and then repeated with the outliers removed.

Table 21 Independent samples test for the mean of scores – outliers included

		Levene's Test for Equality of Variances. Sig.	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
PE3 score	Equal variances assumed	.355	.005	4.02656	22.60918
	Equal variances not assumed		.006	3.96317	22.67258
PE4 score	Equal variances assumed	.757	.032	.93842	20.27115
	Equal variances not assumed		.032	.93005	20.27952
PE5 score	Equal variances assumed	.201	.067	-.71385	20.32922
	Equal variances not assumed		.070	-.79685	20.41221
Mean score	Equal variances assumed	.762	.002	4.37250	18.62010
	Equal variances not assumed		.002	4.34612	18.64648

Table 22 Independent samples test for the mean of scores – outliers excluded

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PE3 score	Equal variances assumed	.230	.632	2.942	184	.004	10.42442	3.54358	3.43315	17.41569
	Equal variances not assumed			2.936	180.947	.004	10.42442	3.55024	3.41922	17.42962
PE4 score	Equal variances assumed	.337	.562	2.478	186	.014	11.521	4.648	2.350	20.691
	Equal variances not assumed			2.475	183.537	.014	11.521	4.656	2.335	20.706
PE5 score	Equal variances assumed	.055	.814	1.066	163	.288	4.729	4.436	-4.030	13.488
	Equal variances not assumed			1.067	162.469	.287	4.729	4.431	-4.020	13.478
PE3,4 & 5 score	Equal variances assumed	.005	.946	2.010	187	.046	8.46058	4.20930	.15676	16.76440
	Equal variances not assumed			2.008	185.729	.046	8.46058	4.21261	.14986	16.77130

Table 23 Independent samples test for the mean of marks – outliers included

		Levene's Test for Equality of Variances	Sig. (2-tailed)	95% Confidence Interval of the Difference	
		Sig.		Lower	Upper
PE3 mark	Equal variances assumed	.557	.228	-.89120	3.72101
	Equal variances not assumed		.227	-.88562	3.71543
PE4 mark	Equal variances assumed	.469	.464	-1.44407	3.15550
	Equal variances not assumed		.463	-1.43793	3.14936
PE5 mark	Equal variances assumed	.492	.978	-2.37648	2.44236
	Equal variances not assumed		.978	-2.37103	2.43691
Mean mark	Equal variances assumed	.004	.192	-.61149	3.02796
	Equal variances not assumed		.188	-.59584	3.01231

Table 24 Independent samples test for the mean of marks – outliers excluded

	Levene's Test for Equality of Variances Sig		Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
PE3 mark	Equal variances assumed	.480	.230	-.83099	3.44214
	Equal variances not assumed		.228	-.82555	3.43670
PE4 mark	Equal variances assumed	.428	.501	-1.39412	2.84097
	Equal variances not assumed		.500	-1.38870	2.83555
PE5 mark	Equal variances assumed	.364	.742	-1.74908	2.44953
	Equal variances not assumed		.741	-1.74022	2.44068
PE3, 4 & 5 mark	Equal variances assumed	.346	.470	-1.41282	3.04852
	Equal variances not assumed		.469	-1.40668	3.04239

t-test results and scores

As can be seen in tables 21 and 22, the t-test revealed significant differences between group a and group b for PE3 and PE4 as well as for the mean of the PEs. The only PE that did not show statistical significance was PE5, where a p value of 0.067 was returned. When the t-test was run with the outliers removed, significant findings were again produced for PE3, PE4 and for the mean of the PEs. Again, PE5 was not found to be statistically significant.

t- test results and marks

Tables 23 and 24 provide the results of the t-tests for the marks for each PE and the three PEs combined. It can be seen from these tables that no statistically significant differences between groups a and b were detected. This included the analyses that were undertaken with the inclusion and exclusion of outliers.

6.11 Comparison of the proportion of the means

An area of interest was whether Gamification would increase the number of students attempting an activity at least once. Where participants had completed the formative activity more than once, this was still simply scored a single success. The reason for this was that the opportunities to complete formative activities varied between clinical practice areas and so might return misleading results.

In order to assess this aspect, a comparison of the proportion of the means was conducted. This was undertaken using a user-written Excel file validated again STATA version 14.0. The formative activities that were included in the scoring system are listed in tables 15, 25 and 26.

As can be seen from table 25, group a consistently outperformed group b with the exception of PE5, where both groups performed equally in relation to service user feedback and drug rounds. The statistical analysis of this data is given in table 26. This revealed that there were statistically significant differences between group a and b for the following activities. These were in the attainment of desirable skills in PE3, the external visits, detailed drug documentation and drug rounds in PE4. In addition, in PE5 the P value for desirable skills was 0.052, which when rounded up made this a statistically significant finding.

Table 25 Number and percentage of participants completing one or more formative activities

		External visits per PE			Desirable skills per PE			Service user feedback per PE			Detailed drug documentation per PE			Drug round per PE		
		PE3	PE4	PE5	PE3	PE4	PE5	PE3	PE4	PE5	PE3	PE4	PE5	PE3	PE4	PE5
a	yes	90 (95%)	87 (94%)	74 (90%)	83 (87%)	76 (82%)	71 (87%)	60 (63%)	49 (53%)	38 (46%)	57 (60%)	68 (73%)	71 (87%)	69 (73%)	70 (75%)	69 (84%)
	no	5 (5%)	6 (6%)	8 (10%)	12 (13%)	17 (18%)	11 (13%)	35 (37%)	44 (47%)	44 (54%)	38 (40%)	25 (27%)	11 (13%)	26 (27%)	23 (25%)	13 (16%)
	Total	n = 95	n = 93	n = 82	n = 95	n = 93	n = 82	n = 95	n = 93	n = 82	n = 95	n = 93	n = 82	n = 95	n = 93	n = 82
b	yes	88 (87%)	78 (80%)	72 (83%)	77 (76%)	75 (77%)	65 (75%)	52 (51%)	40 (41%)	40 (46%)	58 (57%)	56 (57%)	73 (84%)	67 (66%)	59 (60%)	73 (84%)
	no	13 (13%)	20 (20%)		24 (24%)	23 (23%)	22 (25%)	49 (49%)	58 (59%)	47 (54%)	43 (43%)	42 (43%)	14 (16%)	34 (34%)	39 (40%)	14 (16%)
	Total	n = 101	n = 98	n = 87	n = 101	n = 98	n = 87	n = 101	n = 98	n = 87	n = 101	n = 98	n = 87	n = 101	n = 98	n = 87

Table 26 P values attained from the comparison of two proportions (values highlighted in pink are statistically significant)

PE	External visits P value	Desirable skills P value	Service user feedback P value	Detailed drug documentation P value	Drug rounds P value
PE3	0.065	0.044	0.099	0.715	0.339
PE4	0.005	0.378	0.100	0.021	0.024
PE5	0.156	0.052	0.962	0.624	0.966

6.12 Gamification and time-sensitive events

To establish whether Gamification increased the timeliness of the students' entries, the Gamification interface was set up so that late entries or entries made too early were recorded as a 1, and entries made on time were recorded as 3. The results attained are provided in tables 27, 28, 29, 30 and 31.

The comparison of two proportions was used to detect any statistically significance differences between group a and b in relation to the on-time scores. The results are provided in table 32.

Table 27 Comparison of the timeliness of students' entries – Professional development

	Professional development					
Completed	PE3 Group a n = 95	PE3 Group b n = 101	PE4 Group a n = 93	PE4 Group b n = 98	PE5 Group a n = 82	PE5 Group b n = 87
On time	41 (43%)	56 (55%)	39 (42%)	44(45%)	24 (29%)	37 (43%)
Too early or late	54 (57%)	45 (45%)	54 (58%)	54(55%)	58 (71%)	50 (57%)

Table 28 Comparison of the timeliness of students' entries – Initial assessment student

	Initial assessment student					
Completed	PE3 Group a n = 95	PE3 Group b n = 101	PE4 Group a n = 93	PE4 Group b n = 98	PE5 Group a n = 82	PE5 Group b n = 87
	71 (75%)	74 (73%)	55 (59%)	65 (66%)	46 (56%)	63 (72%)
	24 (25%)	27 (27%)	38 (41%)	33 (34%)	36 (44%)	24 (28%)

Table 29 Comparison of the timeliness of students' entries – Initial assessment mentor

	Initial assessment mentor					
Completed	PE3 Group a n = 95	PE3 Group b n = 101	PE4 Group a n = 93	PE4 Group b n = 98	PE5 Group a n = 82	PE5 Group b n = 87
	75 (79%)	78 (77%)	71 (76%)	85 (87%)	69 (84%)	79 (91%)
	20 (21%)	23 (23%)	22 (24%)	13 (13%)	13 (16%)	8 (9%)

Table 30 Formative assessment student

	Formative assessment student					
Completed	PE3 Group a n = 95	PE3 Group b n = 101	PE4 Group a n = 93	PE4 Group b n = 98	PE5 Group a n = 82	PE5 Group b n = 87
	52 (53%)	54 (53%)	51 (55%)	60 (61%)	68 (83%)	67 (77%)
	45 (47%)	47 (47%)	42 (45%)	38 (39%)	14 (17%)	20 (23%)

Table 31 Formative assessment mentor

	Formative assessment Mentor					
Completed	PE3 Group a n = 95	PE3 Group b n = 101	PE4 Group a n = 93	PE4 Group b n = 98	PE5 Group a n = 82	PE5 Group b n = 87
	60 (63%)	60 (59%)	59 (63%)	61 (62%)	74 (90%)	78 (90%)
	35 (37%)	41 (41%)	34 (37%)	37 (38%)	8 (10%)	9 (10%)

Table 32 R P values attained from the comparison of two proportions (values highlighted in pink for entries completed on time.

PE	Professional development P value	Initial assessment student P value	Initial assessment mentor P value	Formative assessment Student P value	Formative assessment Mentor P value
PE3	0.086	0.815	0.771	0.907	0.590
PE4	0.680	0.304	0.064	0.371	0.864
PE5	0.073	0.027	0.190	0.338	0.899

6.13 Analysis of correlation between marks and scores with age, field, and gender

The final statistical tests used linear regression to explore whether there was any correlation between marks and scores when examined in relation to age, field, and gender. The breakdown of the data into these three categories is provided in tables 33, 34, 35, 36, 37 and 38. Scatter diagrams were also constructed to visually inspect the data to identify whether any positive or negative correlations were present. These are located within appendix D.

Scores and gender

It can be seen from table 33 that both males and females in group a outperformed their counterparts in group b. However, the degree to which males and females in group a outperformed group b was very different. In PE5, the difference between males in group a and b was 68.1%, whilst the maximum difference between females in groups a and b was found in PE3 and was 18.3%. These differences between the performance of males and females could indicate an intervention effect within the male participants. This effect is explored further using linear regression.

Table 33 Comparison of scores by gender

GENDER	Female		Male	
PE	n	Mean score	n	Mean score
PE3 a	N =87	83.5	n = 8	85.3
PE3 b	n = 94	70.6	n = 7	66.6
Difference %		18.27%		28.08%
PE4 a	N = 85	83.8	n = 8	86.5
PE4 b	n = 91	74.3	n = 7	71.6
Difference		12.79%		20.81%
PE5 a	N = 76	87.7	n = 7	89.6
PE5 b	n = 80	81.3	n = 7	53.3
Difference		7.87%		68.11%
Mean PE 3,4 & 5 a	N = 87	84.8	n = 8	86.8
Mean PE 3,4 & 5 b	n = 94	74.5	n = 7	60.8
Difference		13.83%		42.76%

Scores and age

Table 34 provides the data collected when the mean scores were summarised by age. As can be seen, participants in group a outperformed their counterparts in group b in both the 'under 25 years age group' and the 'over 25 years age group'. When the over performances for each group were compared, the differences between the size of the out performance for the under and over 25-years-old age groups maximum difference was detected in PE3,4, and 5 and was 6%. Visual inspection of the scatter diagram (see appendix D) did not demonstrate the presence of any correlation. The effect of age was explored further when the linear regression modelling was undertaken.

Table 34 Comparison of scores by age

AGE	Under 25 years of age		Over 25 years of age	
PE	n	Mean score	n	Mean score
PE3 a	n = 64	81.2	n = 31	88.9
PE3 b	n = 76	69.0	n = 25	74.6
% Difference		17.68%		19.17%
PE4 a	n = 63	84.1	n = 30	84.0
PE4 b	n = 74	74.3	n = 24	70.9
% Difference		13.19%		18.48%
PE5 a	n = 53	90.7	n = 28	85.3
PE5 b	n = 67	80.5	n = 20	74.1
% Difference		12.67%		15.11%
Mean PE 3,4 & 5 a	n = 64	84.1	n = 31	86.7
Mean PE 3,4 & 5 b	n = 76	73.9	n = 25	72.4
% Difference		13.80%		19.75%

Scores and field

Table 35 gives the data attained when the means were analysed for groups a and b and then separately split into the different fields of nursing. As can be seen, participants in group a outperformed their counterparts in group b in every field. However, due to the large size variation between the different fields, comparison by percentages was not considered to provide an accurate summary method for this data. Within the adult field, which featured larger numbers than the other fields (and equal is 142), it could clearly be seen that the over performance of adult field participants ranged between 14.1 and 8.5% with an overall mean of 11.4%. The mental health field participants, n = 24, and the child field participants, n = 19, were similar sizes. Comparison between these two fields demonstrated that overall child field outperformed mental health field by 9.4%. In relation to the dual field students, n = 9, the smaller number in that field led to percentage inflation in relation to the other fields when comparing their performance. The impact of field, if any, is considered further under linear regression modelling.

As can be seen from the mean of all PEs, the child and dual field students performed similarly, both outperforming mental health and adult field participants. Participants in the adult field gave the lowest performance (11%) in relation to the mean score for all PEs. However, given that the number of participants in the child and dual fields was much smaller than for adult and mental health, small numbers of attrition within these fields would have the potential to cause large percentage changes, making it difficult to accurately predict the relationship between Gamification and field.

Table 35 Comparison of scores by field

Mean score by field	AD	MH	CH	DF	Total of means
PE3 a	81.6 n = 69	84 n = 13	105.6 n = 9	68.8 n = 4	340.0
PE3 b	71.5 n = 75	60.4 n = 11	78.1 n = 10	60.6 n = 5	270.6
% Difference	14.13%	39.07%	35.21%	13.53%	
PE4 a	84 n = 67	80.5 n = 13	93.6 n = 9	76 n = 4	334.1
PE4 b	77.4 n = 73	70.0 n = 11	65.2 n = 10	52.3 n = 4	264.9
% Difference	8.53%	15%	43.56%	45.32%	
PE5 a	92.8 n = 57	71.7 n = 12	93.0 n = 9	74.8 n = 4	332.3
PE5 b	84.7 n = 63	61.8 n = 11	73.6 n = 10	41.3 n = 3	261.4
% Difference	9.56%	16.02%	26.36%	81.11%	
Mean PE 3,4 & 5 a	85.2 n = 69	78.7 n = 13	97.4 n = 9	73.2 n = 4	334.5
Mean PE 3,4 & 5 b	76.5 n = 73	62.8 n = 11	72.3 n = 10	54.6 n = 5	266.2
% Difference	11.37%	25.32%	34.72%	34.07%	

Mark and gender

It can be seen from table 36that when the mean mark for females was compared between groups a and b, the difference ranged from 1 to 2%. By contrast, the difference in the mean mark between the males in group a and b ranged from -7 to 10%. When the mean PE 3, 4 and 5 is compared, these differences become much smaller with males in group a outperforming their counterparts in group b by 1.7 %, and females in group a outperforming their counterparts in group b by 3%. As discussed earlier with the comparison of scores and fields, the number of male participants was very small and therefore small changes in either mark or attrition would have a large influence on the PE means. As such, the means and percentages were not truly representative of the measure of central tendency. The overall difference between group a and group b in the combined PEs is very low, indicating that the presence of a gamified interface does not affect the participant's subsequent mark.

Table 36 Comparison of marks by gender

GENDER	Mean mark			
PE	**n**	**F**	**n**	**M**
PE3 a	n = 87	68.4	n = 8	69.4
PE3 b	n = 94	67.4	n = 7	63.0
% Difference		1.48%		10.16%
PE4 a	n = 85	68.2	n = 8	67.6
PE4 b	n = 91	67.6	n = 7	63.0
% Difference		0.89%		7.30%
PE5 a	n = 76	71.8	n = 7	69.0
PE5 b	n = 80	71.3	n = 7	74.0
% Difference		0.70%		-6.76%
Mean PE 3,4 & 5 a	n = 87	69.5	n = 8	68.9
Mean PE 3,4 & 5 b	n = 94	68.4	n = 7	66.7
% Difference		1.61%		3.30%

Mark and age

Table 37 presents the percentage differences attained when the data is analysed in relation to participants under the age of 25 years old and over the age of 25 years old. The data demonstrated that there is a very small percentage change between group a and group b in both the under and over 25 age groups. Group a 'over 25 years of age group' underperformed when compared with group b by approximately 1%. Conversely group a of 'under 25 years of age group' overperformed by a maximum of 3% (PE3). When all PEs are compared, the difference between group a and group b under 25s was 2%. Similarly, in the over 25 years group the difference between groups a and b was 0.0%. Therefore, age did not play a factor in how the participants responded to the gamified interface in relation to mark.

Table 37 Comparison of marks by age

Age	Mean mark Under 25 years old		Mean mark Over 25 years old	
PE	**n**		**n**	
PE3 a	n = 64	68.5	n = 31	68.5
PE3 b	n = 76	66.5	n = 25	68.9
% Difference		3.01%		-0.58%
PE4 a	n = 63	68	n = 30	68.5
PE4 b	n = 74	66.7	n = 24	69.3
% Difference		1.95%		-1.15%
PE5 a	n = 53	72.4	n = 28	70.1
PE5 b	n = 67	71.7	n = 20	70.9
% Difference		0.98%		-1.13%
Mean PE3,4 & 5 a	n = 64	69.6	n = 31	69.2
Mean PE3,4 & 5 b	n = 76	68.0	n = 25	69.2
% Difference		2.35%		0.0%

Mark and field

As with score, the mean marks were scrutinised in relation to field. These results are given in table 38. In the adult field the differences between groups a and b were less than 1%. In the mental health field, group a outperformed group b, apart from PE5 where group a underperformed group b by 2.7%. The child field demonstrated a 13.5% difference between groups a and b in PE3; however, the differences between the groups in PE5 were lower, with an overall mean of 5.4%. In relation to the dual field participants, apart from PE3, group a outperformed group b. However, when the mean of all PEs combined was examined, adult and dual fields demonstrated a less than 1% difference between groups a and b. In mental health the difference between groups a and b was 1.9%. The child field demonstrated a 5.4% difference between group a and b and so showed the largest variation between the fields.

Branch		AD	MH	CH	DF	Total of means
PE3	a	68.3 n = 69	69.3 n = 13	71.7 n = 9	61.8 n = 4	271.1
	b	67.9 n = 75	65 n = 11	63.2 n = 10	63.2 n = 5	259.3
Difference		-0.59%	6.62%	13.45%	-2.22%	
PE4	a	68.6 n = 67	66.7 n = 13	66.8 n = 9	68.8 n = 4	270.9
	b	68.2 n = 73	65 n = 11	66.6 n = 10	68.3 n = 4	268.1
Difference		0.59%	2.62%	0.30%	0.73%	
PE5	a	71.2 n = 57	72.5 n = 12	70.9 n = 9	76.5 n = 4	291.1
	b	71.4 n = 63	74.5 n = 11	68.9 n = 10	73.3 n = 3	288.1
Difference		-0.28%	-2.68%	2.9%	4.37%	
Mean all PEs	a	69.4 n = 69	69.5 n = 13	69.8 n = 9	68.9 n = 4	289.9
	b	68.8 n = 73	68.2 n = 11	66.2 n = 10	68.3 n = 5	270.4
Difference		0.87%	1.91%	5.44%	0.88%	

Table 38 Comparison of marks by field

6.14 Multiple linear regression

Multiple linear regression was carried out in SPSS in order to see if there was any relationship between Gamification and score and between Gamification and mark. As field, gender and age were identified as variables that may affect the outcome of the scores and marks attained, these predictors were added into the regression. The reason for this was to control for these factors and so improve the model produced in SPSS. The following results were obtained:

Table 39 Mean score model summary (adjusted R Square value .059)

	Unstandardised Coefficients B		95.0% Confidence Interval for B	
		Sig.	Lower Bound	Upper Bound
(Constant)	95.014	.000	65.823	124.204
Gender	3.997	.671	-14.546	22.539
Age	-.089	.786	-.733	.556
Group	-10.529	.005	-17.909	-3.149
Branch=Mental health	-9.208	.107	-20.431	2.015
Branch=child	3.430	.577	-8.676	15.536
Branch=Dual Field	-17.812	.041	-34.895	-.730
interaction	-15.158	.264	-41.820	11.504

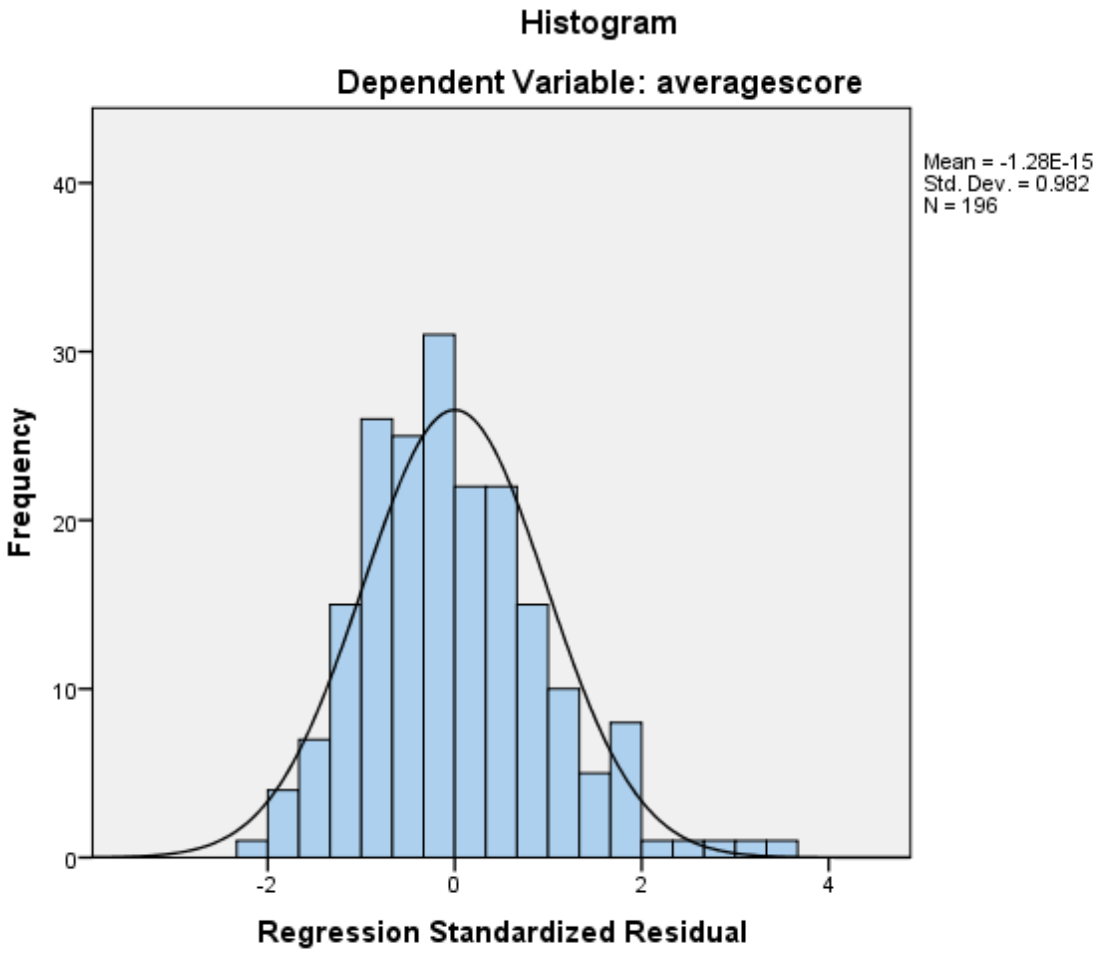


Figure 18 Histogram showing spread of the standardised residuals for average score

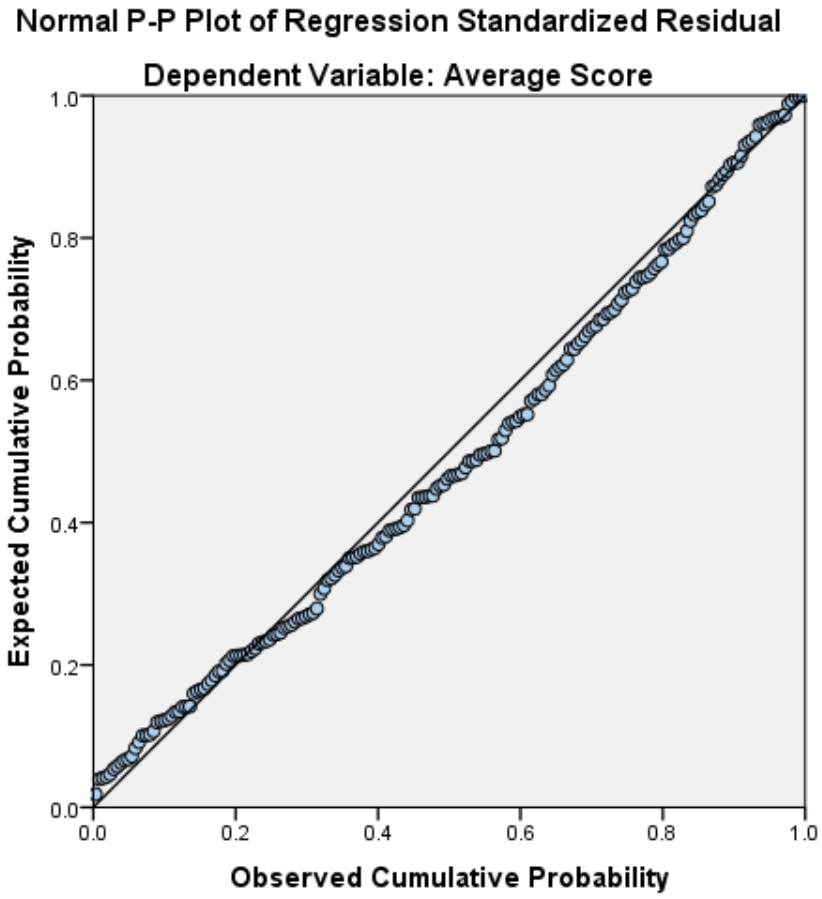


Figure 19 Plot of observed cumulative probability against expected cumulative probability for score

The analysis of data generated from running the regression analysis is captured in table 39 and figures 18 and 19. The adjusted R Square value is .059. As can be seen from table 39, the strata of group and of dual field generated significant findings, with P values of 0.005 and 0.041 respectively.

Visual inspection of the regression standard residuals in figure 19 is suggestive of a normal distribution. This is also confirmed by the plot of observed cumulative probability against expected cumulative probability, with the residuals of the observed cumulative probability falling very close to the expected values.

The lower and upper bound confidence intervals for group, which are -17.909 and -3.149 respectively, show that the difference in the mean scores attained by group a and b was approximately 10.5 for all fields. The participants from the dual field had lower and upper bound confidence intervals of -34.895 and 0.730 and on average scored 17 points higher than the other fields combined.

Multiple linear regression for mark

Table 40 Mean Mark Model Summary (adjusted R Square value -.081)

	Unstandardised Coefficients B	Significance	95.0% confidence interval for B	
			Lower Bound	Upper Bound
(Constant)	71.902	.000	64.307	79.497
Gender	-.816	.739	-5.641	4.009
Age	-.010	.904	-.178	.157
Group	-1.093	.263	-3.014	.827
Branch=Mental health	.055	.970	-2.865	2.976
Branch=child	-1.848	.249	-4.997	1.302
Branch=Dual Field	-.602	.790	-5.047	3.842
interaction	-1.200	.733	-8.138	5.737

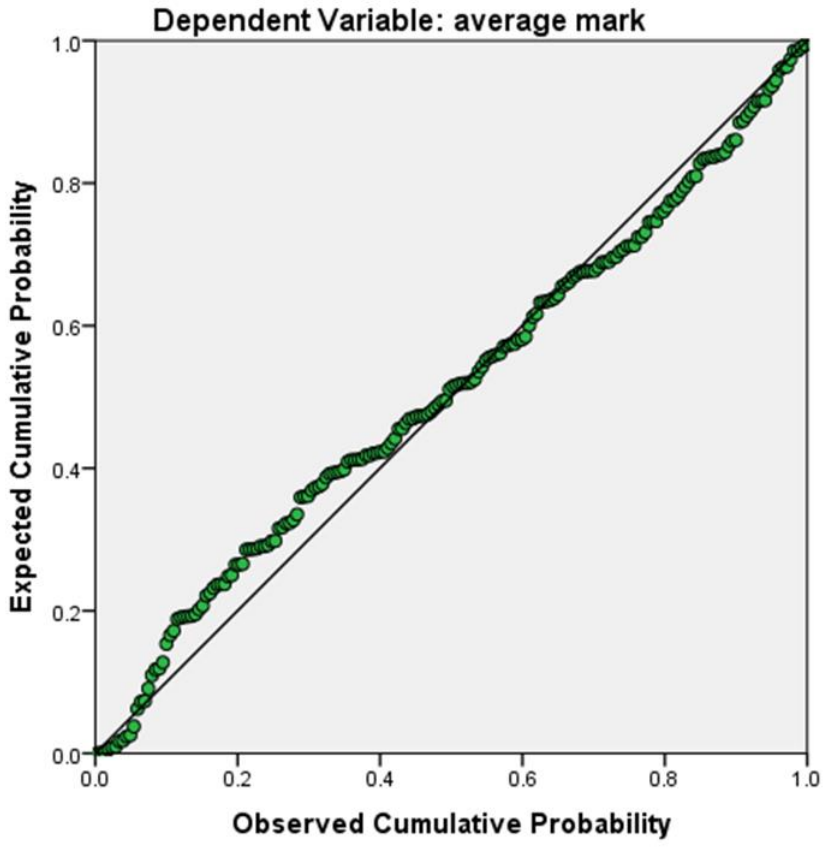


Figure 20 Plot of observed cumulative probability against expected cumulative probability for mark

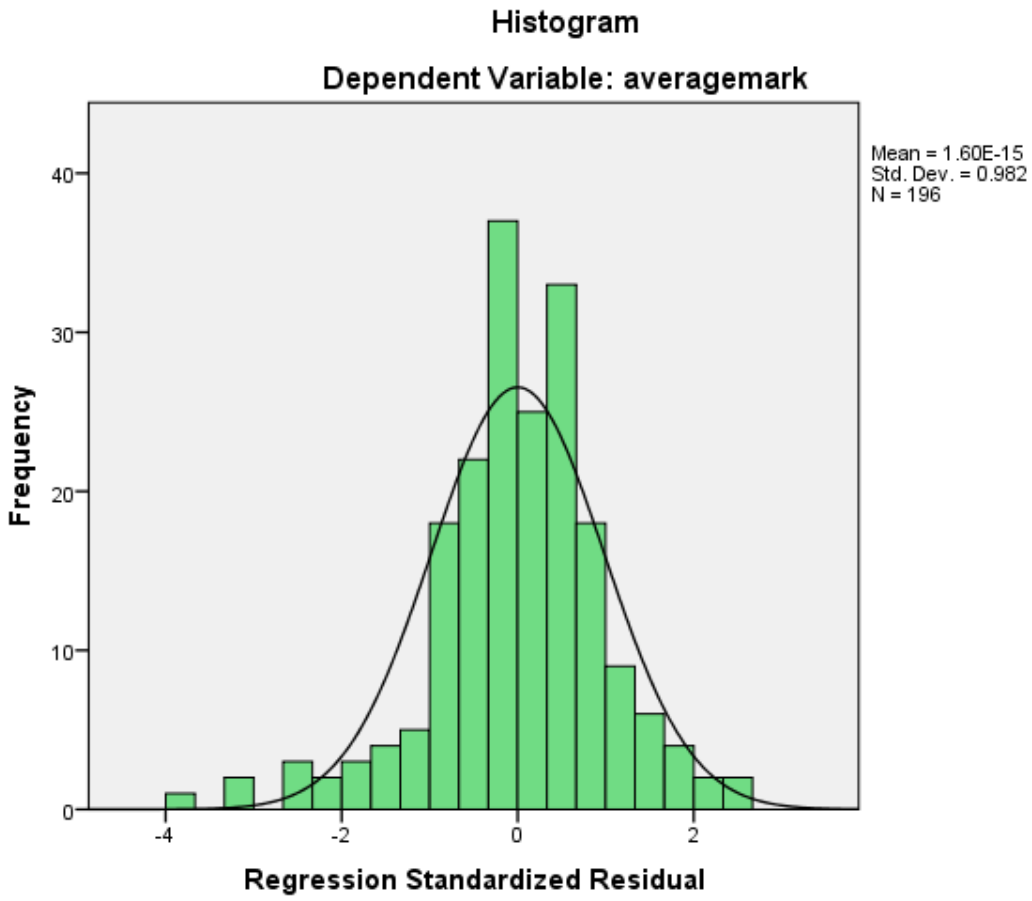


Figure 21 Histogram showing spread of the standardised residuals for average mark

The analysis of data generated from running the regression for mark is captured in table 40 and figures 20 and 21. The adjusted R Square value was -0.081. The closer the value of the adjusted R Square is to 1, the better the fit of the data against the predicted regression model. As can be seen from table 40, there are no significant findings as the P values exceed 0.05 in all PEs. Visual inspection of the regression standard residuals in figure 20 was suggestive of a normal distribution. This is also confirmed by the plot of observed cumulative probability against expected cumulative probability, with the residuals of the observed cumulative probability falling very close to the expected values. The lower and upper bound confidence intervals for the group, which are -3.014 and 0 .827 respectively, show that the difference in the mean marks attained by group a and b is very small, i.e. 3 marks.

6.15 Group and individual discussions

As stated in chapter 5 section 5.18, the focus groups were scheduled to take place two weeks after the end of PE5. The response rate to the initial call for participants was very low and so a second call was sent out. Two focus groups were held each featuring three participants and one individual discussion featuring one participant. The demographic information concerning participants is provided below. This is followed by the narrative that provides a summary of the

group and individual discussions including some of the quotes made by the participants. The narrative illustrates how the codes and key themes were generated. Figure 22 provides an overall summary of the codes

6.16 Participants

Discussion group 1 was attended by three participants. All participants were under 25 and from the adult field of nursing. The two female participants were ranked within the top ten scoring students. The male participant fell within the middle range of the scores. Group discussion 2 was attended by three further participants. All three participants were female under 25 and from the adult field of nursing. They fell within the middle range of the scores. Participant 7 who attended alone, who took part in the individual discussion, was under 25, female, from the adult field of nursing and whose score fell within the lower scoring section of students. The same question schedule was used although participant 7 did tend to go off track talking about other aspects of the E portfolio and its functionality that did not directly contribute towards the purpose of the research. Due to the low level of participation it is unlikely that any form of data saturation was achieved, and as, such the data produced from the discussion groups and interview needed to be .interpreted with care as they may not actually reflect the experience of the wider sample. A limitation therefore was that all of the participants were from the adult nursing and there was no representation from child, mental health or the dual field branches.

6.17 Thematic analysis

The transcripts from each group and individual discussions were reviewed and manually coded and the codes were then combined to generate themes. Overview of the thematic analysis and the codes and sub themes that emerged are given in figure 22.

Motivational levels

As discussed in chapter 3 and chapter 4 motivation can be both intrinsic and extrinsic. In addition, the introduction of Gamification does not always lead to increased motivation and has been cited as a demotivator in certain studies (Fang et al. 2013). As discussed below, the participants in the discussion groups and the interview provided data indicating both motivating and demotivating factors.

Increase in motivation amongst participants (codes IM1, 1M2, 1M3)

Two of the participants said that as they saw the scores increase, they were motivated to get their scores up (IM1, IM2). Participant 1 said,

"Whilst it seems silly, I just wanted to keep my score up to get into the in the top 5 and I got all excited when it did". (IM1, IM2, IM3)

Participant 1 also commented that if their score dipped, they made extra effort to bring the score back up (IM1, IM2). At the same time as saying that, the participant was gesticulating wildly with their hands.

It is interesting to note that these participants fell into top scoring ranges. Given that only the participants could see their score and the position this would suggest evidence of intrinsic motivation rather than extrinsic motivation. Scoring systems that produce an extrinsic motivation effect can provide bragging rights, which in this case the reward is an increase in positional power. When asked what they thought about the activities contained within the E portfolio, participant 1 said,

"They make you reflect on what you're doing in your practice, which is a good thing". (IM1)

This again indicates a link back to intrinsic motivation as it could be suggested that the participant's internal reward was not the score, but their increased contribution and development of their own professional practice. In addition, participant 2 said that they liked to look back at previous placements and this enabled them to see how far they had progressed since they started the course (IM3). When asked about their thoughts when they saw the score on the screen, the participants commented that this made them conscious if they were behind. Participant 4 commented that the score.

"Did incentivise me to work harder" (IM1, IM2)

This quote continues to support the theme of internal intrinsic motivation, as the participant for no other reward and seeing their score go up, continued to undertake practice activity.
However not all the data collected indicated an increase in motivation.

Decrease in motivation amongst participants (codes DM1, DM2, and DM3)

Participant 3 commented that whilst it was satisfying to see the score go up, they were not particularly enthused to work towards making it higher (IM1). Participant 7 stated that they;

"Felt they were on track, as long as there were 50 students below them" (IM1)

Participant 2 also said that they knew that some of their colleagues;

"Could not be bothered" (DM1).

There could be several reasons for participant 2 providing getting this response. Participant 2's score fell into the top range of scores. The other participant she was discussing her score with might have scored much lower and rather than admit this just declared that they were not bothered. Alternatively, it may be that this participant generally was not motivated by the scoring system.

This is an interesting fact as the participants also commented that they often worked in isolation from other students in the group, so there was no opportunity to swap information and for them to discuss their scores (DM2, DM3). However, participant 2's comments suggest that there was some discussion between participants about the scoring system. How this might have impacted on study overall is not clear.

The evidence above demonstrates that some participants felt quite ambivalent about the scoring system and were not engaging. This could be due to the anonymity of the other participants. It is difficult to know whether participants knowing each other's identity as well as rank in scoring system would have had a greater motivational effect. One thing that clearly came out of the discussions was a lack of recognition or reward. All of participants commented on this. As participant 1 stated, there was:

"No real acknowledgements of success" (DM2).

They did notice their ranking displayed on the top of the home page.

This response illustrates that the impact of introducing a scoring system produces individual variable results.

Competition amongst participants (codes C1, C2)

Another area that is been widely cited in the literature is that social pressure and competition often led to increase engagement in gamified systems. All of the participants were asked if they were competitive in nature and all apart from participant 1 responded that they were mildly competitive but not overtly so. Participant 1 declared that she was more competitive with herself than in activities that involve other people such as sports. This again supports the ideal of intrinsic motivation. When asked about competition and seeing the progress of other participants, participant 4 thought that it would be better to see their score against the mean score rather than their ranking within the cohort.

Participant 3 in the group stated that it*;*

"Brought in a competitive element and shows personal achievement" (C1, C2).

However, as stated earlier participant 3 had stated that whilst it was satisfying to see the score go up, they were not particularly enthused to work towards making it higher. This information seems to suggest that some of the participants would have responded if there was more direct such as knowing the identities and scores of the other participants. This indicates that Gamification strategies targeted at increasing external motivation may have led to greater levels of engagement.

When asked which activities they tend to focus upon most, the participants were unanimous in saying medicines management, giving the reason that this was the easiest way of increasing their scores (C1). This correlated with the statistical data discussed earlier in this chapter and brought up an interesting concept of the participants learning to game the system in order to increase their scores.

Intuitiveness of the scoring system (Codes ITS1, ITS2, ITS3, ITS4)

Another reported problem with introducing Gamification into learning systems is that users become disengaged due to technical difficulties, overly complex systems and lack of information as to how to navigate the sites. All participants agreed that when they first saw the scores on the screen, they were initially uncertain as to what they were for or meant, and then they remembered that they were in the study. Apart from participant 7, the remaining participants quickly learnt how to interrogate the score (ITS2, ITS4).

Participant 5 did see the colour change, which they commented on as:

"I noticed that and thought it was pretty cool" (ITS4)

Participant 1 2 and 3 did not noticed the colour changes in the score as the scores increased. Therefore, using colour changes to demonstrate levels of attainment could be deemed not to be an effective Gamification adjunct in this case.

Participant 6 in this group was one of the few who had undertaken the professional development exercise very early and so scored 0 for that activity. They therefore queried how the scoring underneath the gamified interface worked (ITS4). There was much discussion about what activities increased the score and this resulted in participant 5 declaring that they had not worked out how to obtain feedback on their score (ITS2, ITS4).

Participant 7 had not noticed many of the features included within the gamified interface. This included noticing the changes in the score as they progressed through the practice experience

and how to interact with the score. They did notice their ranking displayed on the top of the home page.

This suggests that even though the online portfolio system was subjected to a small pilot study and changes were made in relation to the feedback received, some participants were still finding difficulties navigating the system. Therefore, the level of intuitiveness and difficulty in navigation may have influenced how some students interacted with the scoring system and the E portfolio in general.

Mentor engagement with the E portfolio (M1)

The participants were able to gain mentor points for certain activities, if they were able to get their mentor to interact with the E portfolio.

Participants 2 and 3 mentioned that gaining mentor points was not easy as the mentors were:

"Not on board or really cooperating" (M1).

Participants 4, 5 and 6 also commented that their mentors seemed unsure of the scoring system and that it was difficult to get mentors to engage with the E portfolio on a regular basis (M1).

The comments above correlate with the findings of the statistical analysis insofar as Gamification of the interface had little effect on mentors completing entries and carrying out activities on time.

In summary, whilst the data collected from the discussion groups and interview were limited, they do provide some interesting insights into the way the participants responded to the scoring system. Some participants demonstrated internal motivation to increase their scores, whilst others appear to work on external motivating factors which led to gaming the system to rapidly increase their scores. In addition, the data also revealed that scoring system did not motivate all participants to increase their engagement.

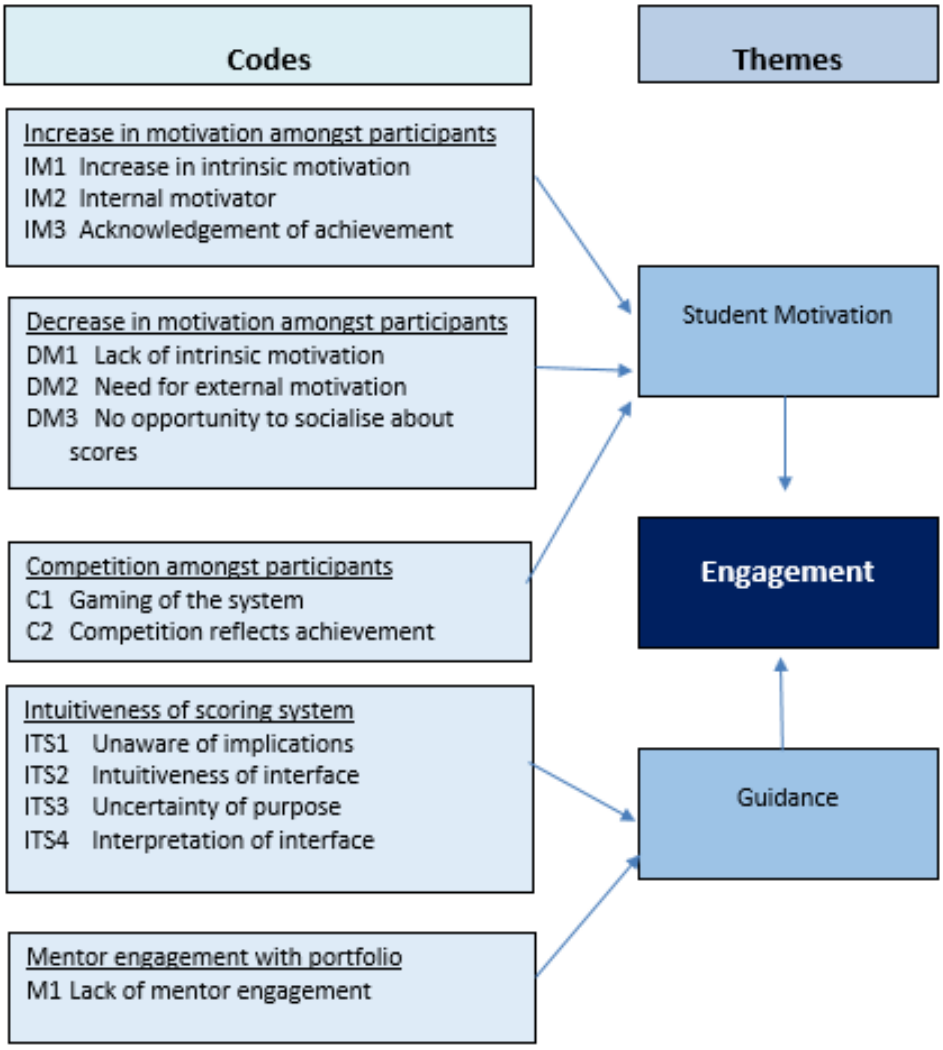


Figure 22 Summary of codes

6.18 Conclusion

The analysis of the quantitative data revealed the following:

In relation to Gamification and scores, the measure of central tendency for the scores awarded demonstrated that in Gamification by group, group a outperformed group b in all three placements before and after the removal of the outliers. The t-tests carried out on the scores attained in groups a and b also found that there were statistically significant differences between the two groups. Group a outperformed group b in PE3, PE4 and PE3, 4, and 5. In PE5, whilst group a outperformed group b, the results of the t-test suggest that for this placement it was not statistically significant. Visual inspection of the scatterplots for score and age, for both groups a

and b, showed no correlation. Linear regression for score when controlled for the strata of age, field and gender showed statistically significant findings for the strata group and for strata dual field. No statistically significant findings could be attributed to age and gender, or the remaining fields. The size of the impact of Gamification in relation to group was much larger than for the dual field participants.

In relation to Gamification and marks, the measure of central tendency for the marks awarded demonstrated very small percentage differences between groups a and b, both with and without the inclusion of outliers. The t-tests carried out on the marks attained in groups a and b also found that there were no statistically significant differences between the two groups. Visual inspection of the scatter diagrams for mark and age for both group a and b showed no correlation. Linear regression for mark when controlled for age, field and gender showed no statistically significant findings between the performances of the two groups.

In relation to Gamification and the impact on formative activities, the comparison of proportion of means demonstrated that there was a statistically significant difference between group a and b in some but not all formative activities, and that this was not consistent across all PEs. In relation to Gamification and the timings of entries, the comparison of proportion of means demonstrated only one statistically significant difference between group a and b. This related to the completion of the initial assessment in PE5. No other statistically significant results were found.

Due to low number of participants who attended the focus groups and interview, the qualitative findings were very limited but do tend to support the quantitative findings. The participants confirmed that they focused their efforts on activities that were easy in order to maximise their scores and that some participants were more motivated than others by the Gamification, which supports the findings that Gamification did not affect all of the participants in the same way.

The next chapter discusses the significance of these findings in relation to the previously discussed, and more current evidence from the literature.

Chapter 7: Discussion and conclusion

The focus of this study has been to determine whether introducing scoring systems into an E portfolio increased student engagement and or learning. During the course of the study several other factors that might have influenced the findings of the study emerged. These factors were related to a) Gamification and personality type, b) Gamification and gender, c) the presence of any novelty effect that could influence the longevity of Gamification and d) the discovery that some students were cheating in the form of 'gaming the system'. These factors are explored in turn within this chapter. The chapter then critiques the strengths and limitations of this research project. It concludes by showing how this research project contributes to opening the field of knowledge surrounding the use of Gamification in nurse education and in E portfolios.

7.1 Gamification and personality type

An emerging theme from the literature is that personality types may influence the way people perceive and interact with different game mechanics. Studies pertaining to nursing students and personality types were very sparse. One notable study by Baldachin and Galea (2012) used the NEO Five-Factor Inventory to review Maltese student nurses' personality traits. The NEO Five-Factor Inventory has been widely used in personality trait testing (Nolen-Hoeksema et al. 2009). The results of this study demonstrated that nursing students obtained low neuroticism scores, mean openness scores, high agreeableness, extraversion and conscientiousness scores. They further commented that these results were stable across all age groups, genders and healthcare programmes.

Quasi-experimental studies carried out by Codish and Ravid (2014) also used the NEO Five-Factor Inventory to assess personality types. They concluded that whilst the most common game mechanics are leaderboards and points, these tend to work well for introverts but not so well for extroverts. One of the reasons given for this was that non-publicly visible scoring systems and leaderboards meant that extroverts were unable to 'brag' about results to others. As can be seen by the work of Baldachin and Galea (2012), student nurses tend to exhibit high levels of extroversion. In the Author's research project, the group and individual discussion participants also mentioned that there was a lack of acknowledgement of their achievements and that they had no way of communicating any achievements with other students as they were usually the only student in a practice area.

An interesting feature is the domain of 'conscientiousness'. Baldachin and Galea (2012) found that nursing students had high levels of conscientiousness. Hakulinen et al.'s (2013) work on the 'Effect of Achievement Badges' found that the most commonly collected badge was that of carefulness. Individuals that displayed the highest scores for conscientiousness displayed personality traits of tidiness and being well-organised and were high achievers. This suggests an overlap between conscientiousness and carefulness. Given that nursing students demonstrated high levels of conscientiousness, a different effect may have been detected if badges were used as well as the scoring system.

Buckley and Doyle (2017) carried out a study with n = 150 undergraduate business students. Their research looked at personality types and Gamification. The study involved students using an online gamified National Tax Forecasting Project. Three statistically significant relationships were found. Firstly, extroverts perceived Gamification more positively than introverts. Secondly, there was a small negative relationship between conscientiousness and Gamification, which indicated that students with a conscientious personality type did not perceive Gamification as positively than the others. Finally, a small negative relationship was detected between emotional stability and overall performance within the gamified setting. This suggested that participants with increased levels of neurosis would not perform as well in gamified settings as their more stable counterparts.

Given the evidence above and as recommended by Buckley and Doyle (2017), personality types should be considered prior to Gamification strategies being developed and implemented. Such analysis had not been undertaken prior to commencing this research project, which is a limitation of this work.

7.2 Gamification and gender

In the Author's research project, there was no statistical difference between gender or age in relation to engagement or in learning. Given the evidence above about personality traits and how this might mediate the effect of the game of mechanics, this result is not surprising. It also fits well with Baldachin and Galea's (2012) findings that age and gender demonstrated consistency with nursing students' personality types. However, this is in contrast to the work of Christy and Fox (2014), who detected stereotypic threat when women were exposed to a leaderboard in a maths classroom that was pre-populated with successful women.

Further exploration of the literature uncovered a study carried out by McDaniel, et al (2012). This study involved incorporating badges into an online learning environment and then exploring, via survey, whether any gender differences were present. The results revealed that males were less motivated by badges than women quoting the results as "marginally significant p = .059". In

addition, Pedro, et al. (2015) detected statically significant gender differences between males and females insofar that females were less motivated by Gamification than males. The types of Gamification used were points, badges and feedback. The researchers did not discuss whether any variation in motivation could be attributed to a specific game element. In addition, the average age of the participants was 12 and so, whilst interesting, their work may lack transferability to an adult setting. Codish and Ravid (2017) carried out a study to examine gender differences. The study involved three repeated experiments (semester a, b, and c) carried out during a gamified academic course to examine the 'perceived playfulness' of points, badges, leaderboards, progress bars and reward game elements. No differences were found for progress bars or reward game elements. Significant findings were found for badges and leaderboards. These were that women enjoyed the badges more than men in all studies. However, the degree of 'perceived playfulness', whilst still statically significant, declined in both genders over the 3 studies. Women enjoyed using leaderboards more than their male counterparts in the 1st study but by the 3rd study, this relationship had reversed with males expressing higher levels of 'perceived playfulness'. Codish and Ravid postulated that this difference could be due to the fact that there was a higher ratio of male participants to female participants in the 3rd study.
These studies combined start to indicate that gender differences do exist in the way that game elements are perceived, and more research is required to understand why and what the impact of such differences might be. In addition, the reduction in 'perceived playfulness' for both genders over the course of the 3 studies might indicate the presence and gradual waning of a novelty factor.

7.3 Gamification and gaming the system

According to Wood et al. (1999) 'Gaming the System manifests itself when students ignore the essence of the learning activities and find ways to complete them mechanically without learning the content'. In addition, students who game the system are often associated with a lower level of academic attainment (Baker et al. 2008). In the Author's study, the qualitative findings revealed that the participants revealed that a way of quickly increasing their score was by increasing the number of detailed drug records. Prior to the study, a known limitation with the E portfolio was the way in which the detailed drug records section had been structured. Students had admitted that it was easy to just copy and paste the information from online pharmacopoeia. Copying and pasting of information would be unlikely to accomplish the outcome of the learning activity - namely developing an in-depth understanding of the medication that was being recorded.
Duh and Chen (2009) investigated cheating in online gaming and highlighted that cheating in single player games was very common. Their review of literature at that time suggested that the

online environment caused players to feel 'disembodied from their actions'. This disembodiment led to disinhibition allowing players to behave in a way that they would not normally do, such as cheating. In addition, they highlighted the fact that players who cheat in a single player game justify their actions by claiming that they are not actually hurting or affecting anyone else. Fang et al. (2013) highlighted that students cheat in online environments because they are motivated by performed goals rather than learning goals. This explanation fits with the concepts of extrinsic motivation. Several authors have highlighted that external reward systems such as points and gold stars can reduce an individual's internal feelings that are associated with intrinsic motivation (Fang et al. 2013, Hendijani 2016, Kim 2015, Lavorata 2013). This, in turn, leads to individuals responding more positively to external motivators, which in the presence of disinhibition leads to cheating. A reduction in intrinsic motivation is not the only reason why students game the system. Baker et al. 2008 also identified that gaming occurred when students disliked or were frustrated with the subject matter. Therefore, they found ways to circumvent undertaking the activity.

Whilst the E Portfolio scoring system was not an online game, as the participants did not collaborate, communicate or directly interact with each other's scores it bored many similarities to a single player game. Blackburn et al. (2014) drew attention to the importance that the design of Gamification features should be robust as well as structured in a way that prevents cheating occurring. It was not possible to change this feature prior to the start of the study due to financial and time constraints. In addition, changing this part of the E portfolio might have introduced a confounding variable.

7.4 Gamification, novelty effect and longevity

As highlighted in the previous section, Codish and Ravid (2017) along with the Author's work found that the effects of Gamification appeared to diminish over time. Similar findings have been reported by several authors (Farzan et al. 2008, Hanus and Fox 2015, Koivisto and Hamari 2014). This has led to the question of the presence of a novelty effect which, when worn off, reduces the effectiveness of Gamification over time. In their earlier work, Codish and Ravid (2014) discuss that it may be necessary to change the game mechanics being used over the period of the gamified intervention. It was not possible to identify research studies that focused specifically on this aspect of Gamification. The reason for this is that the behaviour effects produced by individual and combinations of Gamification elements are still not completely understood. In addition, the findings of studies relating to Gamification have provided conflicting results relating to engagement. In 2019, Koivisto and Hamari conducted a review of the current state of research in relation to Gamification. They drew attention to the fact that, since its inception in 2010, a multitude of research has been undertaken. However, they state that what is currently know

about Gamification 'tends to stem from fragmented pieces of knowledge, and from a variety of perspectives'. They further highlight the tendency of research studies conducted over a short duration can potentially skew any findings. Given the current state of research, this raises the question as to the long-term effects of Gamification on engagement and hence the value of investing in long term Gamification strategies. Koivisto and Hamari (2019) called for future research to be coordinated and more structured, in order to advance the knowledge base surrounding Gamification rather than keep adding additional fragments of varying reliability.

7.5 Strengths of this research project

The strengths of this research project were that it was carried out in the actual practice setting in a variety of locations with variations in computer access. As such, the backdrop in which the research study was conducted reflected the variations that students normally would encounter when they undertook PEs. Recruiting participants from within the same cohort controlled for any unexpected external variables, such as changes to the course content that might have impacted on student experience. Therefore, this study had a high level of ecological validity. The data were subjected to robust statistical analyses, which included analyses with the outliers included and then excluded. This strengthened the findings that the outperformance of the Gamification group was not due to any inflation caused by outliers. The criticism made by Hamari (2014) was that many studies used multiple forms of Gamification. This made it difficult to determine the effect of individual game mechanics on engagement and/or learning. In order to address this criticism, the Author's research project used only one type form of Gamification, which confirmed that scoring systems can be used to increase engagement.

7.6 Limitations of this research project

The low attendance at the group and individual discussions meant that only a very limited amount of qualitative data could be collected, and so these findings must be used with care. In addition, this research project involved one moderate size cohort in one university within the UK that used a bespoke E portfolio system. Any of these factors could have acted as an extraneous variable and influenced the results. Therefore, care needs to be made when generalising the results of the Author's research project to other HEIs or settings.

As discussed earlier, constructive alignment between the learning activities and the summative assessment was assumed rather than determined prior to the Author's research project. It was also difficult to tell from the results whether Gamification within the E portfolio, if sustained for a longer period of time, would decline over time due to the novelty effect.

In addition, once the participants had remembered that they were on the study, a Hawthorne effect could have been created. The Hawthorne effect is when the participants knowingly or unknowing alter their behaviours due to the fact that they are being studied or observed. Therefore, when the participants are not being studied or observed then their true behaviour manifests. One way of reducing any impact of the Hawthorne effect is to extend the duration of the study (Coolican 2014). Hence the reason why this study was run over 3 PEs and the results analysed per PE as well as all PEs combined. In addition, if the results were influenced by a Hawthorne effect, it would most likely be greater for the gamified participants as the score on their screen would have acted as a constant reminder about being involved in the study.

7.7 Contribution of this project to the fields of Gamification nurse education and E portfolios

This research project makes a strong contribution to the fields .of Gamification nurse education and E portfolios. As part of the project, several structured and detailed literature reviews were carried out to identify primary research within each of these fields and then the fields combined. The results of the searches identified that there is a dearth of literature in relation to Gamification and nurse education and the use of Gamification and scoring systems to support online work-based learning in E portfolios. Much of the research carried out has examined the impact of Gamification in blended learning situations, where lecturer input played a significant role. No lecturer input featured in this research project and the students' activities were self-directed. In addition, many of the studies examined have used multiple Gamification strategies and game mechanics. This research project only explored the impact of a simple scoring system on engagement and learning.

The research approach featured primarily RCTs, and statistical analysis demonstrated that the use of scoring systems in an online portfolio does increase student nurse engagement. This creates the foundations to open up the field for further research into Gamification within nurse education and in E portfolio learning.

7.8 Recommendations for further research

Further research should be undertaken to view the longevity of a single Gamification factor in relation to student engagement and the impact of using an incremental number of mechanics to try to further this engagement. In addition, research should be directed at exploring the effects that different game mechanics and dynamics have on engagement when considered alongside the personality types of nursing students, who are predominantly female. Within the field of

Gamification generally, there is a need for further research to build a much stronger evidence base that Gamification can increase learning and that Gamification can be effective in totally student-managed online environments. As per the recommendations of Koivisto and Hamari (2019), further research projects need to be designed to advance the knowledge base on Gamification with long term studies to prevent skewed data from short term studies distorting future finding.

7.9 Concluding summary

This thesis has systematically and rigorously explained a research study that explored the impact of a minimal level of Gamification, namely the introduction of a scoring system and points, into an E portfolio.

Chapter 1 provided an overall introduction to the thesis, including the way in which the thesis had been set out. Chapter 2 set the scene of nursing within today's healthcare settings and the need for educators to ensure that teaching and learning strategies promoted safe clinical and professional practice. This chapter also provided the findings of the baseline audit, which highlighted that students were not fully engaging, as several areas of their E portfolios remained incomplete and deadlines for formative assessments were not being met. This chapter also introduced the concept of Gamification as a potential way of increasing student engagement.

Chapter 3 provided a review of student engagement and motivation. It also gave details of the emergence and uses of Gamification within a wide variety of industries. Links between Gamification and motivation and goal-directed theories were also highlighted. A review of literature published between 01.01.2010 and 31.12.2014 was presented in Chapter 4. Eleven articles were critiqued, and three key themes emerged. These were Gamification and motivation/engagement; Gamification and learning; and Gamification and scoring systems. These themes were used to summarise what the current state of knowledge was in relation to the use and impact of Gamification. This section also highlighted the lack of research in relation to Gamification, nurse education and E portfolios.

Chapter 5 followed on from Chapter 4 by developing the methodology for the research project. The chapter provided an explanation and justification for the theoretical framework, overall research aim, questions and hypothesis, and methods. The main research method was the use of RCTs, with a secondary subsequent method that used focus groups. Whilst this research study was predominantly quantitative, it was considered that qualitative focus group findings would complement and increase the interpretation and understanding of any findings from the RCTs. This section also provided details of the processes of ethical approval, the associated documentation which is contained within Appendix B.

Chapter 6 documented the processes of data collection and analysis and highlighted any significant findings. This chapter also highlighted any problems that were encountered during the RCTs and focus groups. In particular, it identified problems associated with a lack of attendance at focus groups that limited the amount of qualitative data available for analysis. The analysis did lead to the following hypotheses being upheld:

Hypothesis 1 – overall scores

H11 There will be a significant statistical difference in the scores attained by student nurses who are exposed to the scoring system compared with the student nurses in the control group, who cannot see the scoring system.

Hypothesis 2 – timing of entries

H20 There will be no significant statistical difference in the timing of the entries made by the student nurses who are exposed to the scoring system compared with the student nurses in the control group, who cannot see the scoring system.

Hypothesis 3 – the number of students making entries

H31 There will be a significant statistical difference in the number of students making entries when the student nurses who are exposed to the scoring system are compared with the student nurses in the control group, who cannot see the scoring system.

Hypothesis 4 – overall marks

H40 There will be no significant statistical difference in the marks attained by student nurses who are exposed to the scoring system when compared with the student nurses in the control group, who cannot see the scoring system.

Therefore, in this research study, Gamification did increase students' overall engagement with the activities in an E portfolio. When engagement with specific activities was measured, it was found that engagement was not uniform across all activities. Gamification did not impact on time-sensitive activities and Gamification did not increase student marks. In addition, any effects of age, gender or branch impacting on the results was considered and no statistical correlation found.

In Chapter 7 the factors that might have influenced the findings of the study emerged. These factors were related to a) Gamification and personality type, b) Gamification and gender, c) the presence of any novelty effect that could influence the longevity of Gamification and d) the discovery that some students were cheating in the form of gaming the system. Chapter 7 also highlighted that whilst there was an increasing amount of research being generated in relation to Gamification, rather than advancing the body of knowledge, more and more fragmentation was being added. In addition, it drew attention to the dearth of literature in relation to Gamification and nurse education and the use of Gamification and scoring systems to support online work-based learning in E portfolios. This research project was one of the first studies to explore these

areas. Therefore, it makes a unique contribution to the field of Gamification in nursing and online E portfolios and has created a foundation for other researchers to take forward further research in these fields.

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Appendices

Appendix A Focus group questions

Questions used to guide focus groups

1. What we were your thoughts about seeing your score on the screen?
2. What would be your thoughts if your score could be viewed by your mentor or academic tutor?
3. What did you think about the targets set ?
4. Did you notice the colour change in the scores?
5. Which, if any, particular activities did you focused upon to improve your score?
6. If so, why did you choose these particular activities?
7. Were there any activities you found difficult to achieve?
8. How else could we have increased your engagement with the e portfolio?
9. How could we increase the amount of service user feedback collected?
10. What do you see as the purpose of the e portfolio?
11. What you think about the activities within the e portfolio?
12. Is there anything further you would like to add that you think might be helpful to this project?

Appendix B Ethics submission documentation

i. Final amended version with changes in yellow highlight

FPSE Ethics Committee
FPSE EC Application Form Ver 6.6d

Reference number: **ERGO/**FPSE**/13446**	~~Version: 2~~ Version 3	Date: ~~2016-07-20~~ 21/02/2017
Name of **investigator**(s): Pauline Morgan		
Name of supervisors; Dr Gary Wills , Dr Mary Gobbi		
Title of study: A randomised control trial to explore whether gamification increases the frequency and quality of student nurse engagement in an ePortfolio of Professional Practice		
Expected study start date: 2015- 04- 01	Expected study end date: ~~2016- 12 -31~~ 31/03/2017	
Note that the dates requested on the "IRGA" form refer to the start and end of *data collection*. These are not the same as the start and end dates of the study for which approval is sought. Note that approval must be obtained before the study commences; retrospective approval cannot be given.		

The investigator(s) undertake to:

- Ensure the study Reference number ERGO/FPSE/13446 is prominently displayed on all advertising and study materials, and is reported on all media and in all publications;
- Conduct the study in accordance with the information provided in the application, its appendices, and any other documents submitted;
- Conduct the study in accordance with University policy governing research involving human **participants** (http://www.southampton.ac.uk/ris/policies/ethics.html);
- Conduct the study in accordance with University policy on data retention (http://www.southampton.ac.uk/library/research/researchdata/);
- Submit the study for re-review (as an amendment through ERGO) or seek FPSE EC advice if any changes, circumstances, or outcomes materially affect the study or the information given;
- Promptly advise an appropriate authority (Research Governance Office) of any adverse study outcomes, changes, or circumstances (via an adverse event notification through ERGO);
- Submit an end-of-study form as may be required by the Research Governance Office upon completion of the study.

Refer to the Instructions *document when completing this form*

PRE-STUDY

Characterise the proposed **participants**

The proposed participants will be recruited from the 2014/15 Faculty of Health Sciences (FOHS) Batchelor of Nursing pre-registration undergraduate student nurse intake.

Describe how **participants** will be approached

The participants will be approached by the Batchelor of Nursing Programme Lead. The Programme Lead will send an email to the participants, inviting them to take part in the study.

Describe how inclusion and/or exclusion criteria will be applied (if any)

There are no further inclusion or exclusion criteria, other than being part of the 2014/15 Batchelor of Nursing pre-registration undergraduate student nurse intake.

Describe how **participants** will decide whether to take part

The email from the Programme Lead will contain a link to the online participant information sheet ERGO/FPSE/13446 main study V1 (appendix 1) and the online consent form V1 ERGO/FPSE/13446 main study V1 (appendix 2).

The Programme Lead will ask the participants to contact them if they wish to opt out of the study. The Programme Lead will pass on the participants' student identification numbers of any participants who wish to opt out of the study to the investigator. These participants will receive no further contact from the investigator and no data will be collected.

The remaining potential participants will be sent two reminder emails from the Programme Lead. Following the second reminder, any potential participants who have not completed the online consent form, will be withdrawn from the study.
The schedule for sending emails is as follows:

Initial email 1st June 2015
First reminder 14th June 2015
Second reminder 1st July 2015
The main study is not due to start until 1st September 2015, therefore participants will have 8 weeks to decide whether they wish to take part.

Once the main study has completed, the investigator will ~~contact the Programme Lead with the student identification~~ 1 week ~~number of any participants whose data requires further investigation. The Programme Lead will then~~ email ~~these~~ the participants in the experimental group to ask whether they would be willing to participate in a follow up focus group. This email will have the participant information sheet focus group, V1 ERGO/FPSE/13446 (appendix 1) consent form focus group V1 ERGO/FPSE/13446 (appendix 2) as attachments~~. Reminders will be sent as above; in this case the schedule is as follows: Initial email 7th November 2016~~
~~First reminder 14th November 2016~~
~~Second reminder 21st November 2016~~

The focus groups will be held ~~late November~~ at the beginning of March giving the participants ~~3 weeks~~ 1 week to decide if they wish to take part in the study.

DURING THE STUDY

Describe the study procedures as they will be experienced by the **participant**

As a normal part of their programme, participants are required to complete practice placements. The participants and their mentors/supervisors use an electronic Assessment of Professional Practice (eAoPP) portfolio system to record formative activity, gain feedback, create development plans and capture the grades awarded by mentors at the midpoint (formative) and end (summative) of the participants' placements. This study proposes to introduce a leaderboard in to the eAoPP to see if it changes the student engagement with the activities that they carry out as part of their normal practice experience. The timeframes and activities associated with the research project are illustrated in appendix 5. It is not known whether the inclusion of a leaderboard will increase or decrease the quality and/or frequency the participants' level of engagement with the eAoPP. This creates state of equipoise. Therefore, a randomised control trial design has been chosen in order to maximise the credibility of any findings.

The first part of the study will start at the beginning of September 2015 at the start of Placement (P) 3. It will run throughout P3, P4 and P5 and end shortly after P5 completes in ~~October 2016~~. January 2017. The participants will stay in their allocated group for the duration of the study. They will not know whether they are in the control group or the experimental group, until they log into their eAoPP at the start of P3. The participants will also not know the identity of the participants in their subgroup and this information will not be revealed at any time during the study, or following its conclusion.

Participants in the control group will see no change in their eAoPP. It will look and function in the normal way. However, data will be collected from the database that supports the main functions of the eAoPP. The participants in the control group will be aware of the data collection because it is drawn to their attention in the Participant Information Sheet ERGO/FPSE/13446 Main study (appendix 1)

Participants in the experimental group will see that a leaderboard has been added to the home screen of their eAoPP. They will be asked to complete their eAoPP as normal. Throughout P3 and P4, they will have points awarded to them for the activities that they have undertaken within the eAoPP. They will be able to see the points that they have gained in the leaderboard. The leaderboard will also show their ranking in relation to the rest of their subgroup. They will not be able to see the points gained by other participants. They will only see their rank. Their points and ranking will be updated in real time. Once a day, the participants will be able to see their rank in relation to the whole of the experimental group. This rank will be updated overnight. The participants will be able to interact with the leaderboard to see where they have been gained points and therefore how they could increase their points. The leaderboards will be cleared at the end of P3 and the process repeated in P4 and then cleared at the end of p4 and the process repeated in p5. Data will be collected from the database that supports the main functions of the eAoPP and the leaderboards. The participants in the experimental group will only be aware of the data collection because it is drawn *to* their attention in the Participant Information Sheet ERGO/FPSE/13446 Main study (appendix 1). Leaderboard data will be treated as confidential and will only be available in the participant's view of the eAoPP. The participant's mentor and academic tutor will not be able to view the leaderboard scores.

If a participant wishes to withdraw at any point, then they would contact the investigator. If the participant is in the experimental group, their leaderboard will be turned off. The data gathered from the relation database for research purposes will then be deleted for the participant who wishes

to withdraw from the study. This latter point will apply to both control and the experimental participants who wish to withdraw.

This part of the study will conclude at the end of P5, with no further data being collected for research purposes.

As completing the eAoPP is a normal part of the participants placement activity, they will not be expected to spend any additional time performing specific activities for this part of the study. However, if the investigator reveals data that requires further exploration in order to be understood, the student identifier number, associated with this data anomaly, will be passed the Programme Lead who will invite the participants back to take part in a follow up focus group. The details of the focus group activity can be found on the participant information sheet ERGO/FPSE/13446 focus group (appendix 1).

Focus groups

Any findings that cannot be explained by the data analysis will be followed up through focus groups. The focus groups will run during ~~November 2016.~~ March 2017. A maximum of ~~4~~ 3 focus groups will be held. Each focus group will comprise of up to 8 participants and will last 30 minutes. These will explore how the participants perceived the usefulness of the leaderboard. The participants of the focus group will include be participants who were in the experimental group ~~whose data requires further inquiry in order to gain greater insight into their scores and behaviours.~~

The focus groups will be held in a teaching room on the Highfield Campus and, as such, will be a safe environment for group discussion. Where possible, the focus groups will be held when the participants are attending university taught sessions. This will prevent participants having to make addition travel arrangements in order to attend the focus group. However, if this is not possible, the participants will be reimbursed for any travel expenses incurred (appendix 1).

The focus groups will be facilitated by the investigator and a peer academic staff member, who will act as a note taker during the focus group. The focus groups will run as detailed below:

5 minutes welcome and purpose of the focus group, review of the consent forms, ground rules, data usage, protection and storage.
20 minutes to explore how the participants felt the leaderboard influenced their behaviours.
5 minutes to gather any last thoughts, to debrief and close the session.

Identify how, when, where, and what kind of data will be recorded (not just the formal research data, but including all other study data such as e-mail addresses and signed consent forms).

All information about the participants will be handled in confidence. In keeping with the principles of the Data Protection Act (1998), all attempts to maintain the protection of the participants' identities will be made. Participant confidentiality will also be respected during any presentation of the data in public dissemination events, as well as in printed publications.

All correspondence, including consent forms, participants' student identifier numbers and correspondence between the participants and the investigator that may contain the participants' email address, will be stored on the University server at: \\soton\Resource\Health SciencesResearch\Private\PaulineMorgan This is within the University's 'Enhanced Research Data Storage' facility. This data will only be accessed by the investigator's supervisory team and the FOHS Research Statistician.

Storage of the participants emails addresses and participant identifier numbers.
The participants' student identification numbers will be provided by the FOHS student administration team. These will be entered onto a spread sheet and stored on a University computer as stated above. This data will also be uploaded and held in iSurvey for the purposes of sending out and collecting consent forms. This information will also be used to locate and withdraw the data of any participants who wish to opt out of the study. Unless disclosed through correspondence with a participants who requires further information, the investigator will not access or store any of the participants email addresses.

Consent forms (appendix 2)
Consent forms will be distributed in two ways. In the main study this will be achieved by using the University's iSurvey system. iSurvey uses encryption in the form of Secure Sockets Layer (SSL). This ensures that data sent by participants cannot be intercepted by third parties. Data is stored on site. The data collected will be taken from the iSurvey database and stored in the University's 'Enhanced Research Data Storage' facility. The consent form that will be used with the focus groups participants will be disseminated as an email attachment. A written consent form will be signed and collected at the start of the focus group. This will contain the participants name and student ID. The paper consent form will be scanned as soon as the focus group has completed and uploaded to the secure storage area detailed earlier. The paper copies will then be shredded.

Leaderboard numeric scores
The leaderboard data will be collected from the eAoPP platform provided by Axia Interactive Media. This is a 3rd party platform commissioned by FOHS to record its students' assessment of practice feedback and clinical grading. The site has met strict NHS information governance requirements. In addition, the faculty students' personal data including name, student identifier and programme of study is passed to Axia via an upload from the University's banner system on a nightly basis. As this data is confidential, Axia Interactive Media has been required to satisfy iSolutions/University IT security requirements.

The leaderboard scores will be downloaded in the form of a spread sheet from Axia Interactive's eAoPP platform, at the end of placement 3 (November 2015), placement 4 (May 2016) and placement 5 (October 2016). The participants' data will be again stored as stated above.

Leaderboard formative activity written data
The participants' written entries are captured in the eAoPP. These will be exported in a "print View" as an electronic record, and again stored in the University's 'Enhanced Research Data Storage' facility.

Focus group data

Confidentiality will be maintained during the focus group activity by ensuring that participants cannot be identified by the data that is being written down. The note taker, who will be an academic member of FOHS staff, will not record identifying information such as participants' names and addresses during the focus group activity. Confidentiality will also be maintained by ensuring that no personal characteristics that could allow others to guess the participants' identity are included. At the end of the focus group, the notes will be transcribed and the original paper copies scanned to the University's 'Enhanced Research Data Storage' facility. All paper copies will be shredded. Each typed transcript will contain a list of the participants' student identification numbers, as well as the time and date of the focus group. This will enable the investigator to withdraw all or part of the contribution made by the participant, if requested to do so.

POST-STUDY

Identify how, when, and where data will be stored, processed, and destroyed

Please see DPA Plan in appendix 3.
If Study Characteristic M.1 applies, provide this information in the **DPA Plan** as an appendix instead and do not provide explanation or information on this matter here.

STUDY CHARACTERISTICS

(L.1) The study is funded by a commercial organisation: **No**
If 'Yes', provide details of the funder or funding agency here

(L.2) There are **restrictions** upon the study: **No**
If 'Yes', explain the nature and necessity of the **restrictions** here

(L.3) Access to **participants** is through a third party: **Yes - please see permissions in appendix 3**
If 'Yes', provide evidence of your permission to contact them as a separate appendix. Do not provide explanation or information on this matter here

(M.1) **Personal data** is collected or processed: **Yes - please see DPA plan in appendix 4**
Data will be processed outside the UK: **No**
If 'Yes' to either question, provide the **DPA Plan** as a separate appendix. Do not provide information or explanation on this matter here. Note that using or retaining e-mail addresses, signed consent forms, or similar study-related **personal data** requires M.1 to be "Yes"

(M.2) There is **inducement** to **participants**: **No**

(M.3) The study is **intrusive**: **/ No**

(M.4) There is **risk of harm** during the study: **No**

(M.5) The true purpose of the study will be hidden from **participants**: **No**
The study involves **deception** of **participants**: **No**

(M.6) **Participants** may be minors or otherwise have **diminished capacity**: **No**

(M.7) **Sensitive data** is collected or processed: **No**

(H.1) The study involves: **invasive** equipment, material(s), or process(es); or **participants** who are not able to withdraw at any time and for any reason; or animals; or human tissue; or biological samples: **No**

APPENDICES

Appendix (1): Participant Information in the form that it will be given to participants.
Appendix (2): Consent Form in the form that it will be given to participants.
Appendix (3): Evidence of permission to contact participants or prospective participants through any third party.
Appendix (4): DPA Plan.
Appendix (5): Research plan and summary of data collection.

ii. Participant Information Sheet ERGO/Error! Unknown document property name./13446 Main study

Participant Information

Ethics reference number: **ERGO/**Error! Unknown document property name.**/13446**	Version: V1	Date: 2015-03-01
Study Title: A randomised control trial to explore whether Gamification increases the frequency and quality of student nurse engagement in an ePortfolio of Professional Practice		
Investigator: Pauline Morgan Supervisors: Professor Hugh Davies and Dr Mary Gobbi		

Please read this information carefully before deciding to take part in this research. If you are happy to participate, you will be asked to sign a consent form. Your participation is completely voluntary.

What is the research about?

This is a student research project that aims to explore whether the use of leaderboards increases the level of student engagement within their online assessment of practice portfolio (also known as eAoPP). The study is supported by the University and is part of a PhD project. At the end of the study, you will be able to access the Blackboard site eAoPP research projects, to see the study findings as well as how your data was used.

Why have I been chosen?

You have been approached because I am asking the 2014/15 Batchelor of Nursing pre-registration student intake to contribute to the project, and you are a member of that student intake.

What will happen to me if I take part?

The study will start at the beginning of September 2015 at the start of Placement (P) 3. It will run throughout P3 and P4 and end shortly after P4 completes in May 2016. If you agree to take part you will be randomly allocated to either a control group or an experimental group. Both control and experimental groups will then be divided into smaller subgroups that contain approximately 20 students. You will stay in your allocated group for the duration of the study. You will not know whether you are in the control group or the experimental group, until you log into your eAoPP at the start of P3. You will also not know the identity of the students' in your subgroup and this information will not be revealed at any time during the study or following its conclusion.

If you are in the control group your eAoPP will look and function in the normal way. I will be collecting data from the database that supports the main functions of the eAoPP. Some of this

data is already collected, for example, dates of interim assessments and the grading given to you by your mentor. During the period of the study, I will also be collecting additional data that shows when activities, such as external visits, the formative exercise and other non-summative activities, are carried out. I will also be reviewing any typed entries that you make in the eAoPP.

If you are in the experimental group, you will see that a leaderboard has been added to the home screen of your eAoPP. You will be asked to complete your eAoPP as normal. Throughout P3 and P4 you will be awarded points for the activities that you undertake within your eAoPP. You will be able to see the points you have gained in the leaderboard. The leaderboard will also show your ranking in relation to the rest of your subgroup. You will not be able to see the points gained by other students. You will only see the rank. Your points and ranking will be updated in real time. Once a day you will be able to see your rank in relation to the whole of the experimental group. This rank will be updated overnight. You will be able to interact with the leaderboard to see where you have gained points and therefore, how you could increase your points. The leaderboards will be cleared at the end of P3 and the process repeated in P4. I will also be reviewing any typed entries that you make in the eAoPP.

Your student ID number will be the only identifying characteristic associated with the data that I collect. This is needed, if as you decide to withdraw from the study your student ID number will allow me to locate your data and remove it.

At the end of P4, I will compare the data collected from the control and the experimental groups to see if there are any differences in the way the formative activities have been undertaken. As completing the eAoPP is a normal part of your placement activity, you will not be expected to spend any additional time performing specific activities for this part of the study.

If I come across any data that requires further exploration in order to be understood, I will pass the student identifier to your Programme Lead and ask them to invite you back to take part in a focus group. The details of the focus group activity can be found on the participant information sheet ERGO/**Error! Unknown document property name.**/13446 focus group.

Are there any benefits in my taking part?

The study will add to current knowledge about the use of leaderboards and the way in which they influence students to carry out formative activities in an online environment such as the eAoPP. This in turn will then be shared within the educational academic community to improve students practice learning.

Are there any risks involved?

There are no particular risks associated with your participation.

Will my data be confidential?

All data collected will be held on a secure University server. Your data will be used only in accordance with the Data Protection Act (1998). In addition, the data will be anonymised by separating identifying data. Your data will be linked to your consent form by your student identification number. Only the Faculty Research Statistician, I and my supervisory team have access to the folder on this server. If you would like to access your data after your participation, change it, or withdraw it, please contact the investigator p.morgan@soton.ac.uk or the project supervisory team supervisory team Hugh Davis hcd@soton.ac.uk and Mary Gobbi at m.o.gobbi@soton.ac.uk who will arrange this.

What happens if I change my mind?

You may withdraw at any time and for any reason. You may access, change, or withdraw your data at any time and for any reason prior to its destruction.

What happens if something goes wrong?

Should you have any concern or complaint, please contact me at p.morgan@soton.ac.uk , or please contact my supervisory team, Hugh Davis at hcd@soton.ac.uk or Mary Gobbi at m.o.gobbi@soton.ac.uk or any other authoritative body such as Dr Martina Prude, Head of Research Governance (02380 595058, mad4@soton.ac.uk).

iii. Participant Information Sheet ERGO/Error! Unknown document property name./13446 Focus group

Participant Information

Ethics reference number: **ERGO/**Error! Unknown document property name.**/13446**	Version: V1	Date: 2015-03-01
Study Title: A randomised control trial to explore whether Gamification increases the frequency and quality of student nurse engagement in an ePortfolio of Professional Practice		
Investigator: Pauline Morgan Supervisors: Professor Hugh Davies and Dr Mary Gobbi		

Please read this information carefully before deciding to take part in this research. If you are happy to participate, you will be asked to sign a consent form. Your participation is completely voluntary.

What is the research about?

This is a student research project that aims to explore whether the use of leaderboards increases the level of student engagement within their online assessment of practice portfolio (also known as eAoPP). The study is supported by the University and is part of a PhD project. At the end of the study, you will be able to access the Blackboard site eAoPP research projects, to see the study findings as well as see how your data was used.

Why have I been chosen?

You have been approached because I have identified data from the main study that I would like to follow up in more depth using a focus group. Some of this data will have been data collected from your portfolio.

What will happen to me if I take part?

You will be invited to attend a focus groups meeting that will be held in a teaching room on the Highfield Campus. Where possible, I will try to ensure that the meeting takes place on a day when you are due to attend the University for other purposes. However, if this is not possible, I will ensure that any travel expenses are reimbursed. Each focus group will comprise up to 8 participants and will last 30 minutes. The focus group will be led by me (Pauline Morgan) and another member of academic staff, who will be present in the capacity of a note taker. Tea and Coffee will be provided.

At the beginning of the focus group, I will start with introductions and outline the purpose of the focus group. The overall purpose of the focus group is to explore how you perceived the usefulness of the leaderboard. I will highlight the ground rules that the focus group members

need to adhere to. These are that all information discussed in the focus group is confidential and that you are asked not to divulge this information to anyone once the group is finished. In addition, all of the focus group members must treat everyone's views with due consideration and respect. If you choose to stay for the rest of the focus group, I will collect in your signed consent forms. At the end of the focus group, these consent forms will be scanned and uploaded onto a secure University server and the paper copies shredded.

You will then be invited to discuss with the other focus group members, how you felt about being able to see the points and ranks in relation to your work. You may be asked to give examples of how you perceived this to influence your behaviour and whether the leaderboard could be adapted in any way to enhance yours and other students' engagement. This part of the session will be loosely guided by me as a facilitator so that the focus group does not get side tracked and the discussions are not restricted.

After twenty minutes, the note taker and I will summarise the key points and capture any last thoughts. I will then spend five minutes explaining how the data will be analysed, stored and used.

In summary the 30 minute session will run as follows:

5 minutes welcome and purpose of the focus group, review of the consent forms, ground rules, data usage, protection and storage.

20 minutes to explore how the participants felt the leaderboard influenced their behaviours.

5 minutes to gather any last thoughts, to debrief and close the session.

You will only need to attend one focus group and will not be asked to return for any follow up session. You are also free to leave the focus group, at any point, without fear of penalty.

Are there any benefits in my taking part?

The study will add to current knowledge about the use of leaderboards and the way in which they influence students to carry out formative activities in an online environment, such as the eAoPP. It will help me to understand any unusual findings, which can then be shared within the educational academic community to improve students practice learning.

Are there any risks involved?

There are no particular risks associated with your participation

Will my data be confidential?

Once the focus group has been completed, the notes will be types up and original written notes scanned. All written paperwork from the focus group will be destroyed by shredding. Only the electronic form of the data will kept and held on a secure University server. Only the Faculty

Research Statistician, I and my supervisory team have access to the folder on this server. Your data will be used only in accordance with the Data Protection Act (1998). In addition, the data will be anonymised by separating identifying data so that others cannot guess your identity. Your data will be linked to your consent form by your student identification number. If you would like to access your data after your participation, change it, or withdraw it, please contact me, the investigator p.morgan@soton.ac.uk or the project supervisory team supervisory team Hugh Davis hcd@soton.ac.uk and Mary Gobbi at m.o.gobbi@soton.ac.uk who will arrange this.

What happens if I change my mind?

You may withdraw at any time and for any reason. You may access, change, or withdraw your data at any time and for any reason prior to its destruction.

What happens if something goes wrong?

Should you have any concern or complaint, please contact me at p.morgan@soton.ac.uk , or please contact my supervisory team, Hugh Davis at hcd@soton.ac.uk or Mary Gobbi at m.o.gobbi@soton.ac.uk or any other authoritative body such as Dr Martina Prude, Head of Research Governance (02380 595058, mad4@soton.ac.uk).

iv. Consent Forms

Consent Form ERGO/**Error! Unknown document property name.**/13446 main study V1

Ethics reference number: **ERGO/Error! Unknown document property name./ 13446**	Version: 1	Date: 2015-03-01
Study Title: A randomised control trial to explore whether Gamification increases the frequency and quality of student nurse engagement in an ePortfolio of Professional Practice.		
Investigator: Pauline Morgan		

Please initial the box(es) if you agree with the statement(s):

I have read and understood the Participant Information (ERGO/**Error! Unknown document property name.**/ 13446 version 1 Main Study) ☐

I agree to take part in this study. ☐

I understand my participation is voluntary and I may withdraw at any time and for any reason. ☐

Data Protection

I understand that information collected during my participation in this study is completely anonymous and will be stored on a secure University server and that this information will only be used in accordance with the Data Protection Act (1998). The DPA (1998) requires data to be processed fairly and lawfully in accordance with the rights of participants and protected by appropriate security.

Name of participant (print name)……

Signature of participant……..

Student identification number ……..

Date……

Consent Form ERGO/**Error! Unknown document property name.**/13446 focus groupV1

Ethics reference number: **ERGO/Error! Unknown document property name./ 13446**	Version: 1	Date: 2015-03-01
Study Title: A randomised control trial to explore whether Gamification increases the frequency and quality of student nurse engagement in an ePortfolio of Professional Practice.		
Investigator: Pauline Morgan		

Please initial the box(es) if you agree with the statement(s):

I have read and understood the Participant Information (ERGO/**Error! Unknown document property name.**/ 13446 version 1 Focus Group) ☐

I agree to take part in this study. ☐

I understand my participation is voluntary and I may withdraw at any time and for any reason. ☐

Data Protection

I understand that information collected during my participation in this study is completely anonymous and will be stored on a secure University server and that this information will only be used in accordance with the Data Protection Act (1998). The DPA (1998) requires data to be processed fairly and lawfully in accordance with the rights of participants and protected by appropriate security.

Name of participant (print name)……

Signature of participant……..

Student Identification Number ……

Date……

v. DPA Plan

Ethics reference number: **ERGO/Error! Unknown document property name./ 13446**	Version: 1	Date: 2015-03-01
Study Title: **A randomised control trial to explore whether Gamification increases the frequency and quality of student nurse engagement in an ePortfolio of Professional Practice.**		
Investigator: Pauline Morgan Supervisors : Professor Hugh Davies and Dr Mary Gobbi		

The following is an exhaustive and complete list of all the data that will be collected through focus groups and from data extracted from the ePortfolio data base and participants text entries.
The completion date and text entries under the ePortfolio sections listed below will be interrogated

- professional development analysis
- initial interview
- formative exercise
- formative review and learning needs
- formative action plan
- summative review
- future development plan

The number of entries made under the following categories in the ePortfolio will be collected

- service user feedback
- Each record of an external visit completed
- Each desirable skill obtained and countersigned
- Each detailed drug administration
- Each record of drug administration

In addition, and only is required, the discussions that take place within any follow up focus groups will be recorded in written transcript.
The data is relevant to the study purposes, because it captures the engagement of the participant with the e-portfolio, which is the main aim of the study.
The data is adequate, because the sample size is large and can be statistically analysed to reveal any significant findings within recognised limits of statistical confidence.
The data is not excessive, because it is only taken from the parts of the portfolio that are linked to formative activity and is captured automatically within the portfolio system relational database. Therefore there are no demands in the main study for additional participant activity. In keeping with this ethos, focus groups will only be held if the data cannot be explained via statistical analysis. Follow up focus groups will be the only data that is collected by canvassing participant opinion.
The data will be processed fairly, because the data from the database will only be identifiable from the participant's student identifier number and not the participant's name. Therefore, it will be anonymised. The participants will have given explicit consent to allow their data to be collected for the purposes of the study. The participants will also be given information as to how to withdraw their contributions from the study.

The accuracy of the data is ensured, because the quantitative data will be generated by the automated database and the analysis overseen by the FOHS Research Statistician. The analysis of all qualitative data will be carried out by the investigator and then be subject to peer review by a member of Faculty of Health Sciences staff. All data will be made available to the project supervisors to review as part of the supervision process.
The data will be stored on the University server at \\soton\Resource\Health Sciences Research\Private\PaulineMorgan . This is within the 'Enhanced Research Data Storage' area provided to the Faculty by iSolutions for the specific purpose of storing research data. Access to this folder is restricted to the investigator, project supervisors and the faculty research statistician. No data will be transferred outside the European Economic Area (EEA).

The data will be held in an electronic format and in accordance with University policy on data retention. No physical /paper data will be kept. Any paper notes will be scanned and uploaded to the enhanced research storage area, and the original paperwork shredded by the investigator. This method of data storage will be applied to consent forms, email addresses and all other correspondence between the investigator and the participants.
The data will be processed in accordance with the rights of the participants because they will have the right to access, correct, and/or withdraw their data at any time and for any reason. Participants will be able to exercise their rights by contacting the investigator, p.morgan@soton.ac.uk or the project supervisors, Hugh Davies hcd@soton.ac.uk and Mary Gobbi m.o.gobbi@soton.ac.uk

Appendix B

Research plan and summary of data collection V1.

<table>
<tr><td>Date</td><td colspan="2">Project time line</td></tr>
<tr><td>Feb 15</td><td colspan="2" rowspan="4">Planning and build of the leaderboard</td></tr>
<tr><td>March</td></tr>
<tr><td>April</td></tr>
<tr><td>May</td></tr>
<tr><td>June</td><td rowspan="2">Testing and pilot of the leaderboard using volunteers from the PG Dip Nursing student group</td><td rowspan="2">Recruitment to the main study via email sent by the BN Nursing Programme Lead with iSurvey link to participant information sheet (main study) and link to consent form (main study).

Initial email 1st June 2015
First reminder 14th June 2015
Second reminder 1st July 2015</td></tr>
<tr><td>July</td></tr>
<tr><td>August</td><td colspan="2"></td></tr>
<tr><td>September</td><td colspan="2" rowspan="2">Online consent completed via iSurvey
First period of data collection 2014/15 P3</td></tr>
<tr><td>Oct</td></tr>
<tr><td>Nov</td><td colspan="2" rowspan="3">First period of data analysis</td></tr>
<tr><td>Dec</td></tr>
<tr><td>Jan 16</td></tr>
<tr><td>Feb</td><td colspan="2" rowspan="2">Second period of data collection 2014/15 P4</td></tr>
<tr><td>March</td></tr>
<tr><td>April</td><td colspan="2"></td></tr>
<tr><td>May</td><td>Second period of data analysis</td><td>Recruitment to the Focus Group via email sent by the BN Nursing Programme Lead with participant information sheets (focus group) and the consent form (focus group) added as attachments.</td></tr>
</table>

		Initial email May 1st 2016 First reminder May 14th 2016 Second reminder May21st 2016
June		**Face-to-face written consent gained** **Focus groups held over June**
July		**Focus group data analysis**
August		
September	**Project findings released onto blackboard and made available to participants**	

Sources of quantitative and qualitative data collection and methods of analysis

Quantitative data will be taken from the leaderboard. Points will be awarded to the participants as detailed below:

- Completing my professional development 1 on time 3
- Completing my initial interview 1 on time 3
- Completing my learning needs 1 on time 3
- Completing my learning needs at formative assessment 1 on time 3
- Completing my future development plan 3
- Completing my summative review at the summative point 1 (they fail if not completed on time and could be disadvantaged if they complete early hence no bonus points)
- Completing the student progression 1

- Each formative exercise completed 1
- Each service user completed 3
- Each record of an external visit completed 2
- Each desirable skill obtained and countersigned 2
- Each detailed drug administration completed 1
- Each record of drug administration completed 1

Completed = Completed by the student, submitted to the mentor and signed off as achieved by the mentor (if sign off is required)

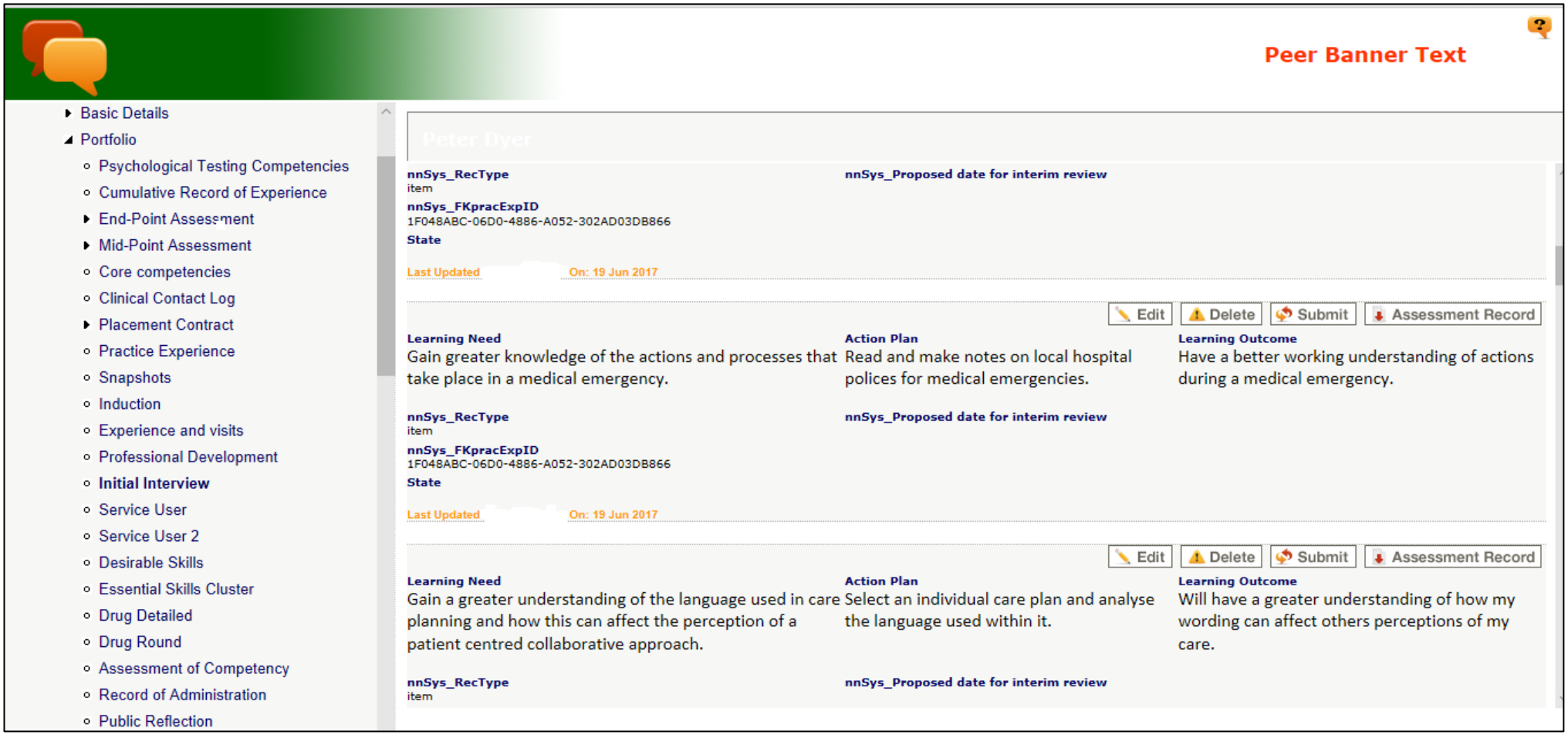
Quantitative data will be subjected to a "student t-test" to identify is there are significant differences between the control and experimental data sets. If this is found to be the case, then the data will be interrogated using regression techniques. SPSS will be uses to support these analyses.

Qualitative data will be taken from the following text entry made by participants into the eAoPP. These will be analysed by look in at the length of the entries and the quality of the entries. Quality will be judged using an adapted FOHS level 5 criterion reference grading tool. A level 5 tool is used as this is the academic level of study that the participants will be working to in the theory elements of their programme. Below are the sources that will be scrutinised from the eAoPP entries.

- professional development analysis
- initial interview
- formative exercise
- formative review
- formative action plan
- summative review
- future development plan

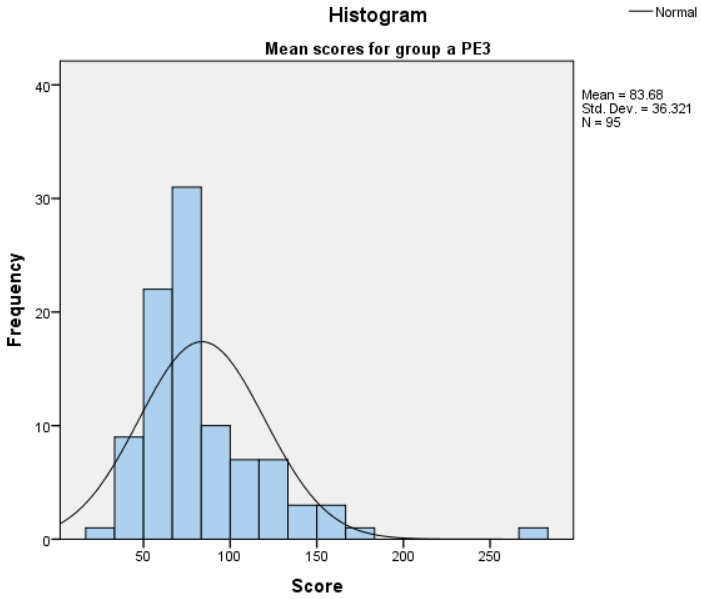
Focus group transcripts will also be analysed using thematic analysis using thematic coding elective key trends and themes within the data. Once the analysis is has been completed the codes and themes will be peer reviewed with a view to increasing the validity of the findings.

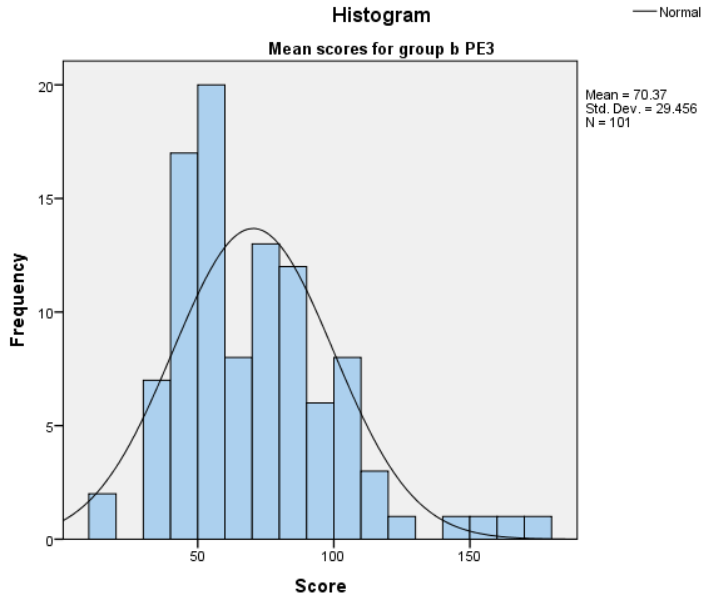
Appendix C Admin interface in the E portfolio

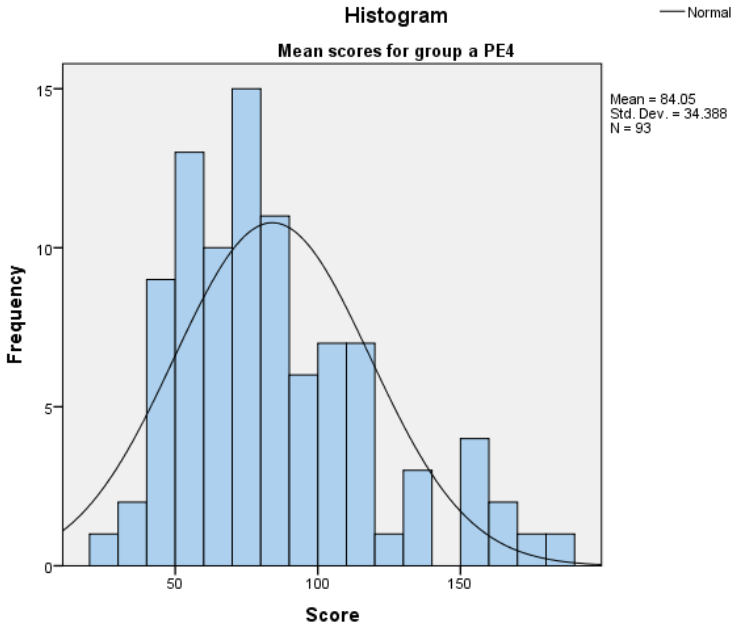


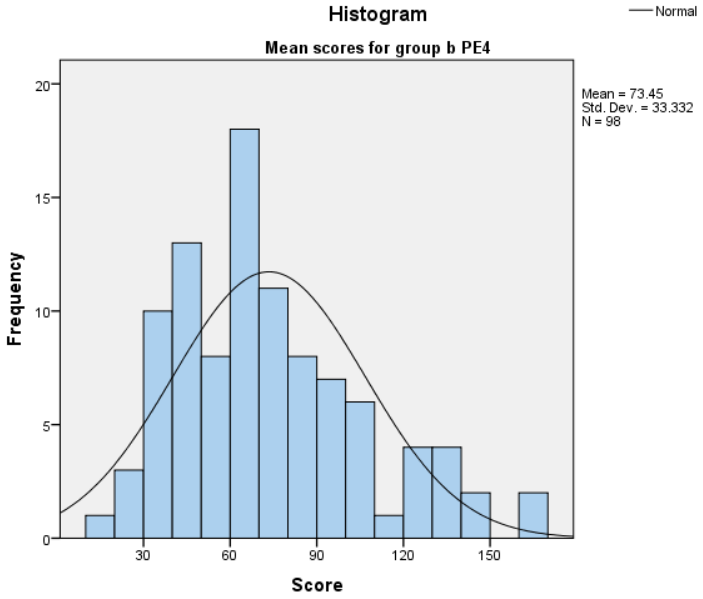
Appendix D Results and diagrams

Measure of dispersion

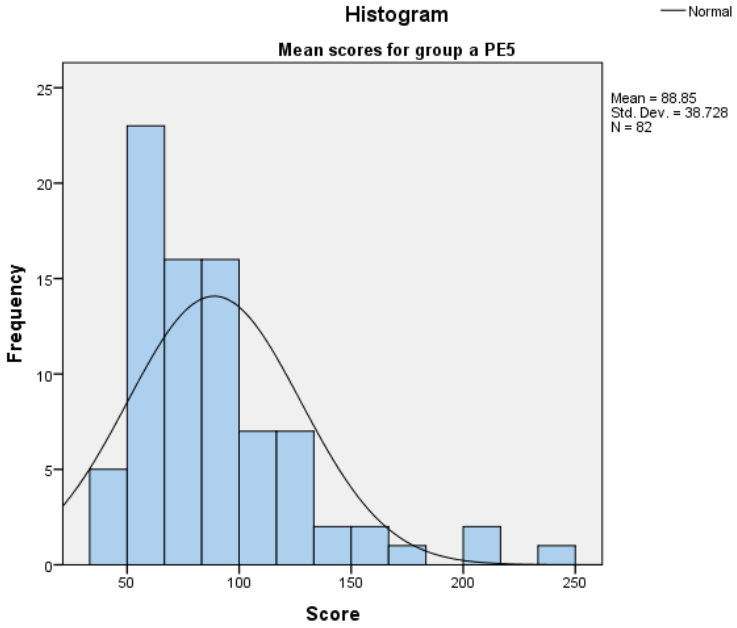





Histogram
Normal
Mean scores for group a PE4
Mean = 84.05
Std. Dev. = 34.388
N = 93
Frequency
Score
0
5
10
15
50
100
150


Histogram
Normal
Mean scores for group b PE4
Mean = 73.45
Std. Dev. = 33.332
N = 98
Frequency
Score
0
5
10
15
20
30
60
90
120
150

Appendix D


Histogram
Normal
Mean scores for group a PE5
Mean = 88.85
Std. Dev. = 38.728
N = 82
Frequency
Score
0
5
10
15
20
25
50
100
150
200
250

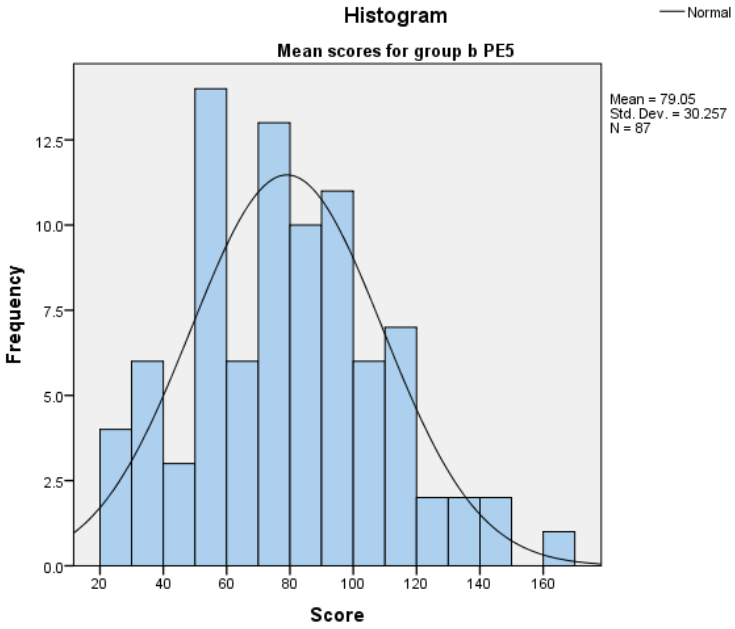
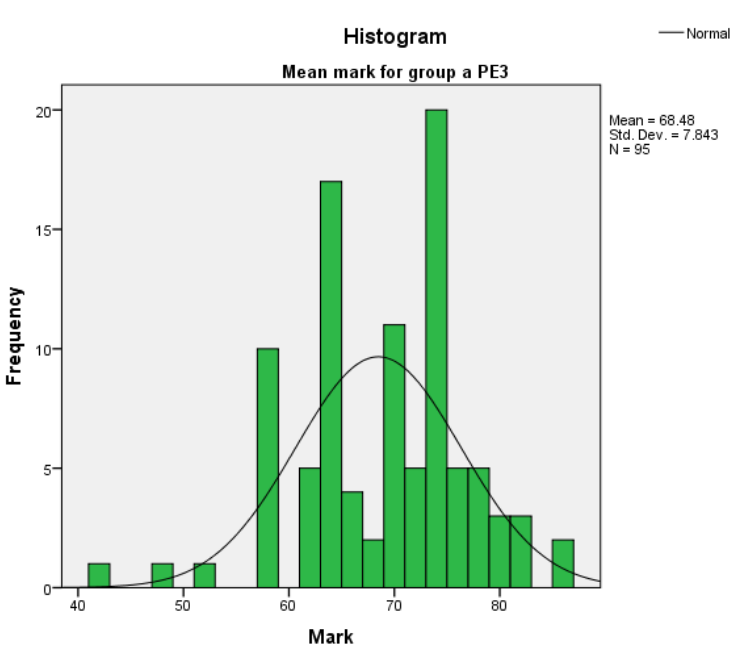
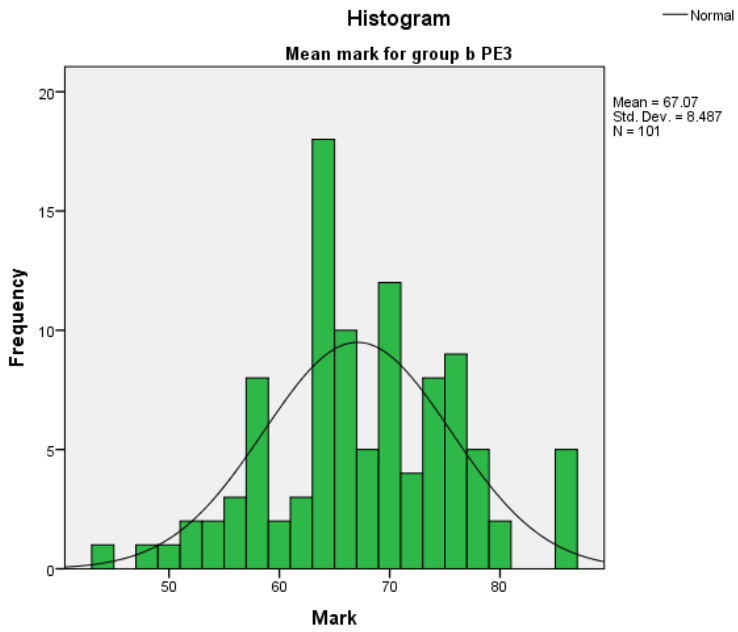
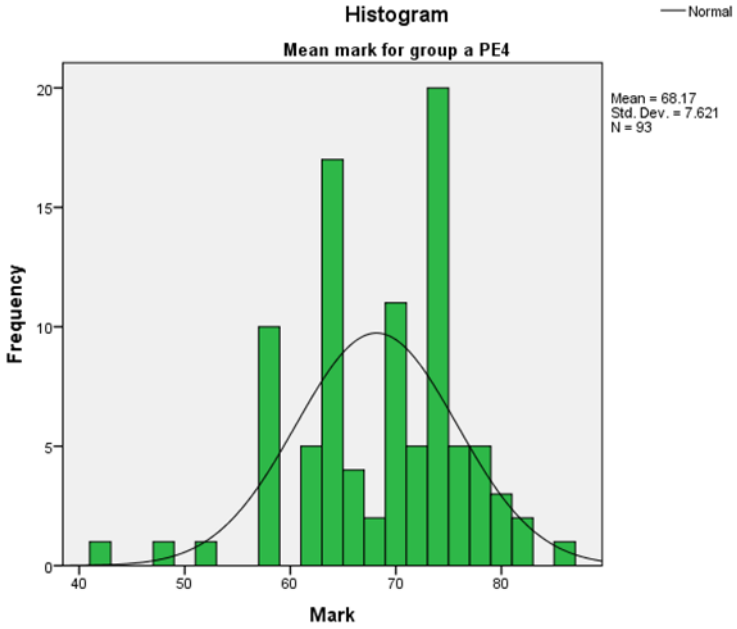

Histogram
Normal
Mean scores for group b PE5
Mean = 79.05
Std. Dev. = 30.257
N = 87
Frequency
Score
0.0
2.5
5.0
7.5
10.0
12.5
20
40
60
80
100
120
140
160

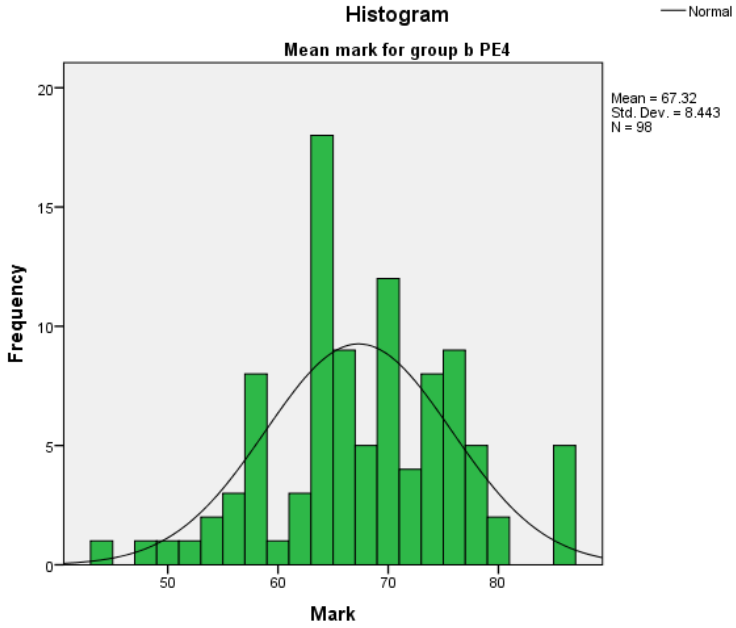
Figure x Histograms of marks achieved

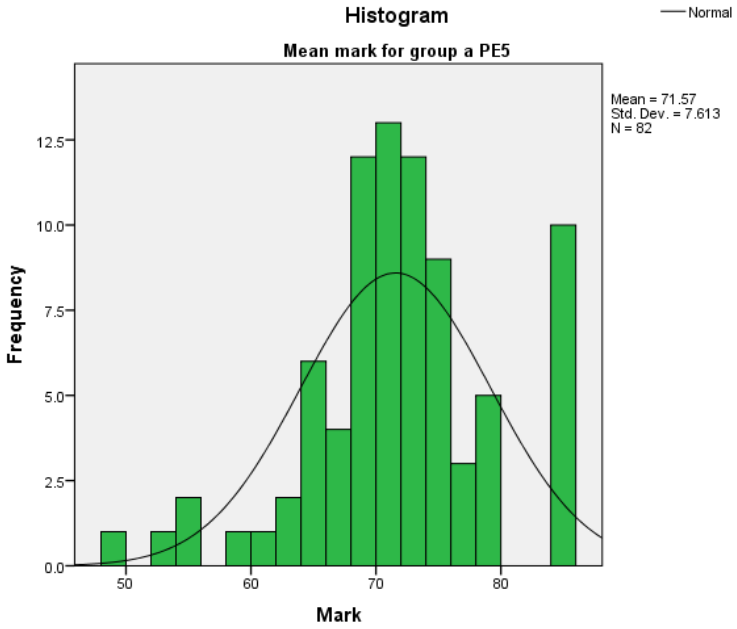




Appendix D


Histogram
Normal
Mean mark for group a PE4
Mean = 68.17
Std. Dev. = 7.621
N = 93
Frequency
Mark
0
5
10
15
20
40
50
60
70
80


Histogram
Normal
Mean mark for group b PE4
Mean = 67.32
Std. Dev. = 8.443
N = 98
Frequency
Mark
0
5
10
15
20
50
60
70
80


Histogram
Normal
Mean mark for group a PE5
Mean = 71.57
Std. Dev. = 7.613
N = 82
Frequency
Mark
0.0
2.5
5.0
7.5
10.0
12.5
50
60
70
80

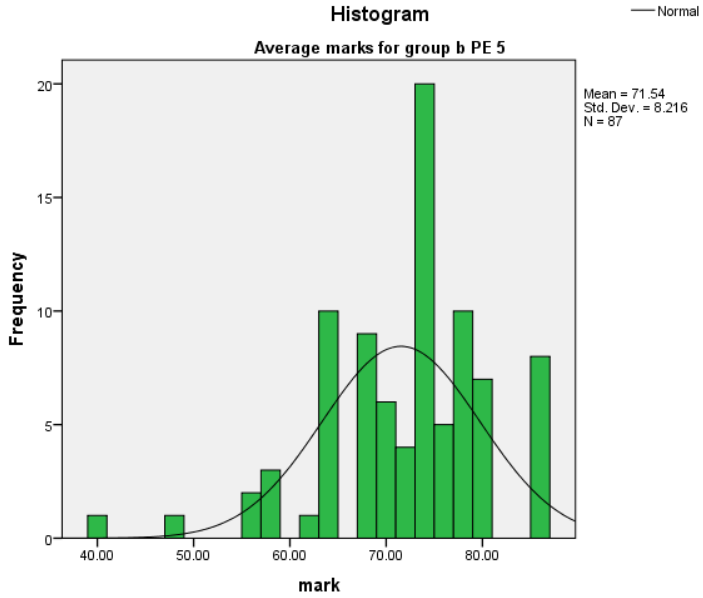
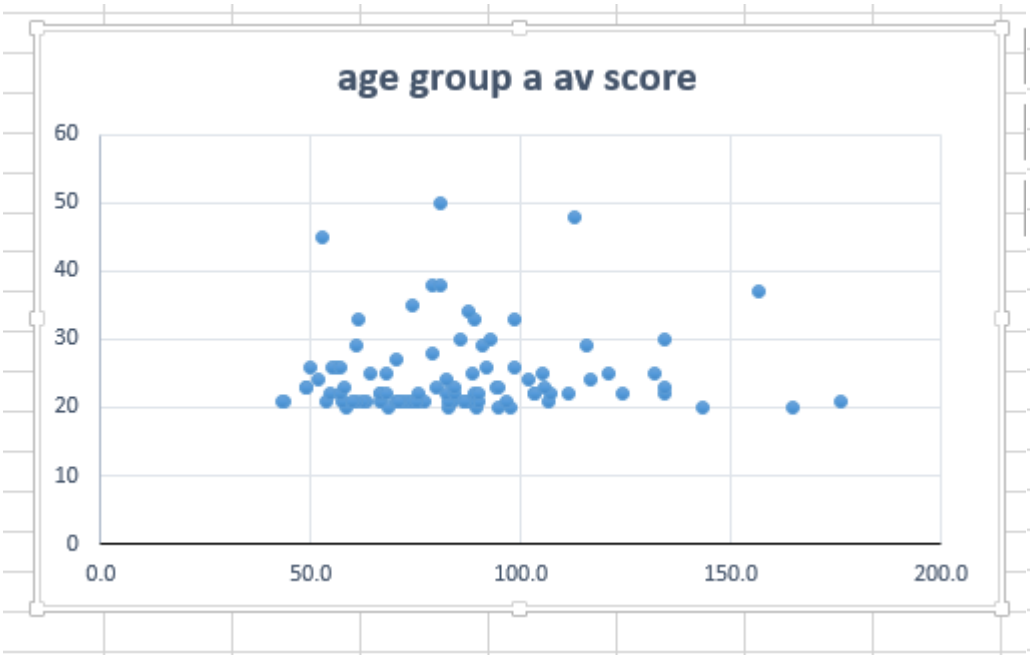

Histogram
Normal
Average marks for group b PE 5
Mean = 71.54
Std. Dev. = 8.216
N = 87
Frequency
mark
0
5
10
15
20
40.00
50.00
60.00
70.00
80.00

Table x Calculation of Outliers identified using 1.5 x IQR

		pe3 score group a	PE4 score group a	PE5 S score group a	PE3,4 & 5 score group a	pe3 score group b	PE4 score group b	PE S score group b	PE3,4 & 5 score group b	pe3 mark group a	PE4 mark group a	PE5 S mark group a	PE3,4 & 5 mark group a	pe3 mark group b	PE4 mark group b	PE S mark group b	PE3,4 & 5 mark group b
N		95	93	82	95	101	98	87	101	95	93	82	95	101	98	87	101
Median		75	77	78	82.3	65	66	77	70.7	70	69	71	69.3	65	68	73	68.3
Percentiles	25	61	57.5	60.8	66.7	49	48.5	58	56	64	64	68	67.3	64	64	67	64
	75	95	106	102.3	97.7	86.5	92.3	98	91.5	73	73	75	73	73	73	77	73
IQR		34	48.5	41.5	31	37.5	43.8	40	35.5	9	9	7	5.7	9	9	10	9
IQR x 1.5		51	72.8	62.3	46.5	56.3	65.7	60	53.3	13.5	13.5	10.5	8.6	13.5	13.5	15	13.5
Lower outlier boundary		10	-15	-2	20	-7	-17	-2	3	51	51	58	59	51	51	52	51
Outliers to be removed		None	None	None	None	None	None	None	None	48 42	48 42	55 55 52 49	58 57 50 49.7	49 48 44	49 48 44	48 40	42.7
Upper outlier Boundary		146	179	165	144	143	158	158	145	87	87	86	82	87	87	92	87
Outliers to be removed		271 175 166 163 160 149	181	239 206 205 176	176 164.7 156.7	175 166 150 144	169 167	168	None	None	None	None	None	None	None	None	None


age group a av score
60
50
40
30
20
10
0
0.0
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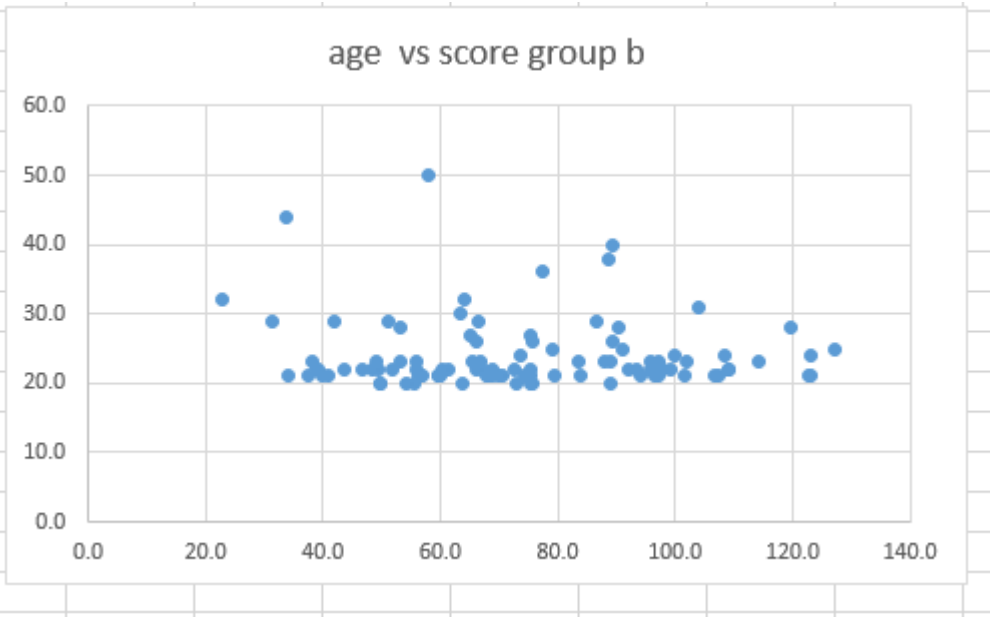
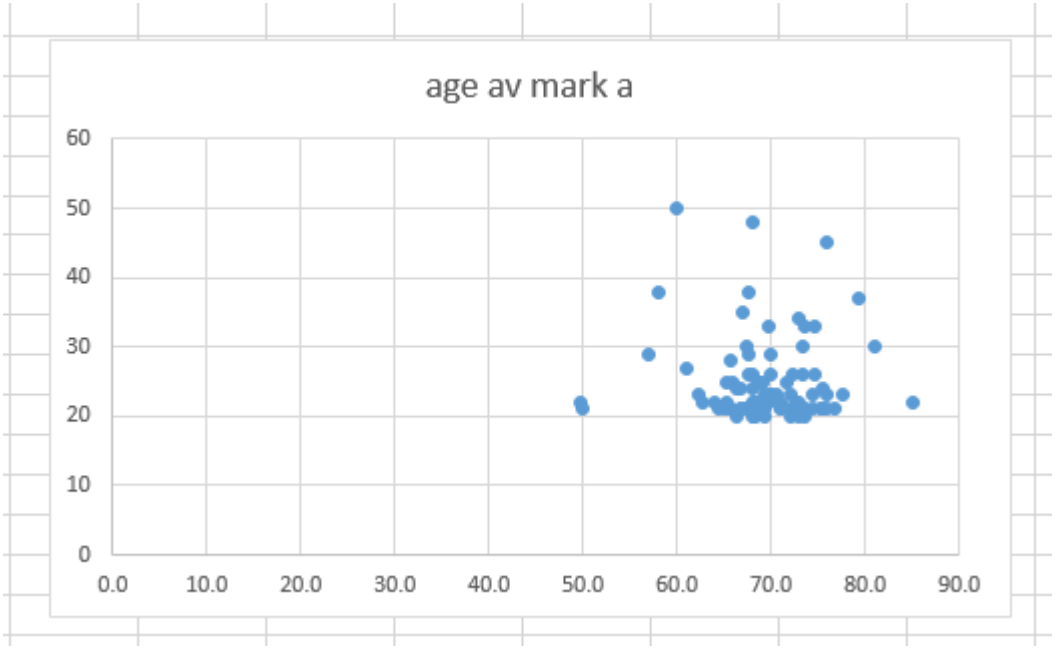
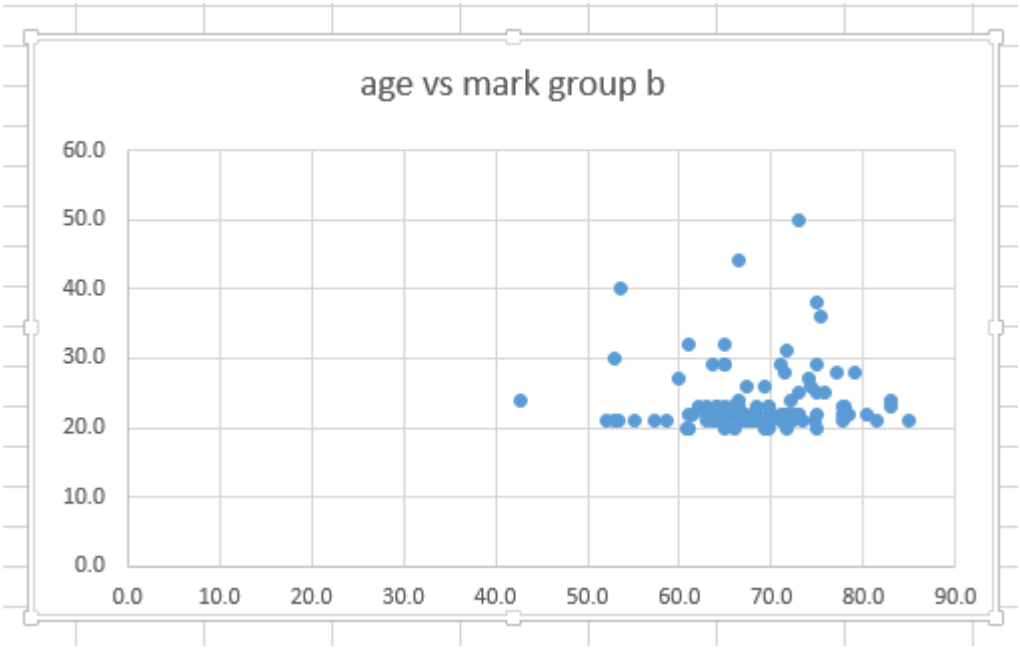
100.0
150.0
200.0


age vs score group b
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0

Appendix D


age av mark a
60
50
40
30
20
10
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0


age vs mark group b
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0