

An Exploratory study of ‘Grit’ in Higher Education

By

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August 2016

Dissertation in Partial Fulfilment of the Requirements for the Degree of
MA in Learning and Teaching

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Abstract

Academic success may not be wholly dependent on the cognitive ability of the student. Recently, other non-cognitive factors such as grit, tenacity and perseverance have been identified as important factors in the long term academic success of the student (Farrington *et al* 2012). These concepts combine to form the term ‘Agency in Learning’. This research focuses on grit, which Duckworth and her colleagues identified as a “significant predictor of success” (Duckworth *et al* 2007). It is presented that the level of grit a student has may limit or indeed prohibit progression into and throughout third level education and determine the attainability of long-term academic success.

In this study, a 12 point questionnaire was issued to 231 students of Letterkenny Institute of Technology and the results of those were statistically analysed to determine the level of grit in these students and the potential contributing factors to grit. Those factors include gender, age, year of study, programme of study and route of entry into that programme. With the use of independent *t*-tests and ANOVA, results indicate that there is no significant relationship between (a) gender and (b) programme of study and grit. It was also determined that grit increased as age increased and as a consequence of such, the same was seen with year of study. The more common route of entry into third level is via the Central Applications Office (CAO) and the students via this route were statistically less gritty than the students via other routes.

Literature suggests that there is little empirical evidence of grit presented with regard to the Irish educational system, therefore this study explores what effect encouraging grit may have on levels of progression of students from second level to third level and throughout third level.

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Signed:

“I agree to assign the rights of any intellectual property arising from this study or other activity to LYIT. This dissertation may be used by LYIT for teaching purposes on future Masters Programmes and may be published online by the Institute.”

I agree

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1.0 Rationale and Introduction

1.1 Introduction

The overall aim of my research is to study ‘Agency in Learning’. This philosophy suggests the idea that education is the process through which learners become capable of independent thought which, in turn, forms the basis for self-directed learning. Simply put, the student takes ownership of their own learning. This ownership can be assessed and quantified by measuring ‘Grit’, the more “gritty” the student is, the more ownership that student has. Grit has been defined as “the perseverance and passion for long term goals” (Duckworth *et al* 2007, p.1087).

1.2 Rationale

A limited number of studies have been published determining grit within specific groups of people with the objective to correlate grit with academic success (Duckworth *et al* 2007, Gorman 2015, Eskeris-Winkler *et al* 2014), however there is little known about the levels of tenacity that exists among young adults in Higher Education. This is an exploratory study seeking to address this gap and open further research avenues to an area still in its infancy. The research aims to contribute to this body of knowledge by comparing grit across age, year of study, gender and profile (e.g. mature v’s school leaver) based on the learners that are registered in full time programmes within Letterkenny Institute of Technology. This research then applied the information to a key topic within education in Ireland, that of progression and explores how the level of grit in students may contribute to progression of learners through third level education in Ireland which is a topic of “growing importance in the higher education debate both nationally and internationally” (HEA 2010, p.6). It is hoped that this study will provide important information for educators, policy makers and training providers regarding the planning for, implementation and maintenance of quality services within education.

1.3 Aims and Objectives

An objective of this research is to determine if there is any correlation between level of grit and the learner's individual differences. The following research questions were formulated to guide the study.

- Which department has the students with the most (and indeed the least) grit?
- Are age and route of entry important determinant of the learner's tenacity?
- What relationship is there, if any, between year of study and grit?
- Does gender influence the tenacity of the learner?
- Could the level of grit in a learner contribute to progression in Higher Education?

This dissertation moves through four additional chapters: Chapter 2 includes a literature review on Vygotsky's learning theory, grit, student centered learning and progression of students through higher education. Chapter 3 provides a detailed overview of the methodology involved, results of the statistical analysis and answers to the proposed research questions. Chapter 4 reviews the results, provides conclusions and provides recommendations for future research.

2.0 Literature Review and Critique

This review aims to provide a clear understanding of academic grit and the factors relating to this topic. It is composed of three parts; first the theoretical framework on which this research is based is outlined and it also introduces the "Student Centred Learning" approach to teaching. Second, grit is explained and a critique on the most current published studies is provided. Lastly, current statistics on progression into and throughout higher education in Ireland is reviewed. A developing theme from this literature review is that grit, student centred learning and progression are all linked closely and are embedded in the learning theory proposed by Vygotsky.

2.1 Theoretical Framework

"Social constructivism" is a concept that was developed by Soviet psychologist Lev Vygotsky (Vygotsky 1978). Vygotsky was a cognitivist who believed that all cognitive functions originate in, and must therefore be explained as products of social interactions and that learning was not simply the assimilation and accommodation of new knowledge by learners; it was the process by which learners were integrated into a knowledge community. Social constructivism

highlights the importance of culture and context in understanding what occurs in society and constructing knowledge based on this understanding (Derry 1999; McMahon 1997). This theory therefore suggests that non-cognitive factors plays an integral role in the learning process of the students and provides a solid foundation for the literature reviewed as part of this study.

One of these non-cognitive factors may include grit. This is a student that may not necessarily have a high Intelligence Quotient (IQ) but may have certain attitudes towards their academic work such as completing projects, maintaining focus on assignments, not being discouraged by setbacks and overall being a hard worker. As previously stated, grit has been defined as “the perseverance and passion for long term goals” (Duckworth *et al* 2007). Indeed, the majority of the research on grit has been carried out by Duckworth and her colleagues, with their primary focus on academic grit. However, in her TED Talk, Duckworth stated that she was unsure if gritty skills could be taught but did postulate that students are more likely to be successful when they adopt a mind-set growth approach (Duckworth 2009).

Having that said, an innovative approach to teaching captures that philosophy, namely ‘student centred learning’. This has been defined by Collins and O’Brien (2003, p.276) as “an instructional approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student (learner) in the centre of the learning process. The instructor provides students with opportunities to learn independently and from one another and coaches them in the skills they need to do so effectively”. Essentially, student centred learning is giving control of the module to the students. As long as the module learning outcomes are met, the students can decide the content of the lectures, the delivery method of the lectures and the assessment of the module. This mind-set would go against the traditional methods of teaching in higher education, however it could possibly encourage grit and indeed agency in learning in the students. This relates back to Vygotsky’s theory of learning, which promotes learning contexts in which students play an active role in learning. Specifically within Vygotsky’s theory is that the potential for cognitive development is limited to what he termed as the ‘Zone of Proximal Development’, which is the distance between a person learning from problem solving on their own and the person learning from problem solving under guidance from a peer, mentor or teacher (Vygotsky 1978). The use of student centred learning would support this theory as the use of peers, mentors and teachers are seen as facilitators in learning.

2.2 Critique of Research Studies of Grit

In 2007, Duckworth and Quinn devised a scale to measure grit and used this scale in a series of experiments (Duckworth *et al* 2007). The participants in their experiments included high school students, Spelling Bee contestants and cadets in a military academy, West Point. All experiments resulted in a positive correlation between success and grit, the high school students who exhibited grit performed better at state exams than their peers with higher IQ and less grit, gritty Spelling Bee contestants progressed further in the competition than their less gritty counterparts and grit proved to be a big influence on the cadets finishing the tough cadet training. The authors did highlight various limitations to their study, for example, the chosen populations may have had restrictions in range of IQ which may have resulted in a skew in correlation between IQ and grit. They did conclude that “grit may be as essential as talent to high accomplishment” (p.1100).

This survey has also been implemented in other studies. Strayhorn studied black males attending a predominantly white institution, specifically examining their grit and comparing this to their grades (Strayhorn 2013). He statistically demonstrated a positive correlation between grit and grades and identified background traits, academic factors and grit as factors in academic achievement. He also discusses the implications of the results of this study on educational policy and practice and suggests various interventions educators may use to enhance grit in students, such as mentoring, working in groups and listening to guest speakers.

The application of this survey has not been restricted to academic success. Research by Eskreis-Winkler and her colleagues studied four different types of long term commitments and the role of grit in each (Eskreis-Winkler *et al* 2014). The military, workplace, school and marriage were all studied and it was concluded that across all four, grittier people were less likely to drop-out of their respective life commitments. The authors suggest investigating other long term commitments and the relationship between each of them, for example are people gritty in only one area of their life or in all areas?

The limited research that has been published supports a positive relationship between grit and academic performance. Each of the studies suggest further research that could be undertaken in order to gain a more significant insight in the role of grit in achievements and success, be it academic or otherwise.

2.3 Progression in Higher Education

Internationally, student enrolment in higher education is increasing (OECD 2015), however a growing problem exists, namely retention of those students and progression into and throughout higher education. In Ireland Quality and Qualifications Ireland (QQI) has the responsibility of implementing and overseeing the National Framework of Qualifications (NFQ) in all third levels institutions. The NFQ, established in 2003, is a ten-level system (1–10) of academic qualifications, level 1 being a Certificate and level 10 being a Doctoral Degree. Each level is based on nationally agreed standards of what a learner is expected to know and be able to do after receiving an award. Progression may be defined as “the extent to which learners remain within a higher education institution and complete their programme of study in a pre-determined period of time” (Jones 2008, p.38).

In 2011, the Department of Education and Skills launched the National Strategy for Higher Education to 2030 (Hunt 2011). Within this there is a specific mission to increase the level of student enrolments. Indeed, this is being achieved with an increase in 14% of student enrolments in the Higher Education Authority (HEA). However, an unforeseen issue has arisen. Along with increased rate of enrolment, there is also an increased rate of non-progression. Non-progression is particularly problematic for students studying certain disciplines and at certain levels of award. Acknowledging this, there has been an important policy shift in emphasising the effects of non-progression. The National Strategy for Higher Education to 2030 (2011) emphasises the importance of a positive first-year student experience to achieving the goals of higher education, as “failure to address the challenges encountered by some students in their first year contributes to high drop-out and failure rates, with personal and system-wide implications”.

2.4 Current statistics in Ireland

The Higher Education Authority (HEA) is a sector within the Department of Education and Skills that governs and regulates the higher education system within Ireland. They published a report in January 2016 (HEA 2016), summarising the statistics of progression of students in Ireland. This report focused on the transition from first year to the following academic year (March 2013 to March 2014), and reported that on average, 16% of students did not progress from first to second year. This report looked at the progression in the different sectors (University and Institute of Technology’s (IOTs)), different level of award (6, 7 and 8), and

field of study and student characteristics (age, gender, nationality and socio-economic background) (HEA 2016).

Various conclusions were drawn from this report. The overall progression rate for new entrants was 16%, which had not changed from the previous study undertaken in 2011/2012. The rates of non-progression in 2012/13 varied within and between sectors ranging from 26% and 28% at levels 6 and 7 compared to 17%, 11% and 6% at level 8 in universities, institutes of technology and colleges respectively. The points gained at the Leaving Certificate at which new entrants had achieved was identified as a factor contributing to non-progression. The report states that courses at NFQ level 6/7 generally tend to enter students on a lower points (255-300) range than NFQ level 8 programmes (405-450). As expected, the link between prior educational attainment on entry and successful progression after the first year of study was also a factor, those with higher prior educational attainment are more likely to progress to the second year of study than those with lower educational attainment.

Within the field of study, the report concluded that rates of non-progression vary across fields of study. Construction and related disciplines have the highest non-progression rate at 29% while education disciplines have the lowest rate at 5%. At level 8, medicine has the lowest rate of non-progression at 2% of all 2012/13 new entrants in profession-oriented courses while architecture has the highest rate at 22%.

With regards to gender, females are more likely than males to progress to the following year, across all NFQ levels and sectors. Age was an important factor in the rate of progression. In the IOTs at level 6 and level 7, mature students are more likely to progress to the following year of study than a new entrant who is under the age of 23. The opposite is true at level 8 in the university sector, where traditional students are more likely to progress than mature students. Nationality of the students only appeared to be a factor in the Institute of Technology (IOT) sector at level 8. Irish students studying at this level and in this sector are more likely to progress to their second year of study than non-Irish students. The lowest level of non-progression is found among Farmers and Higher Professionals at 10%.

2.5 Factors Effecting Progression

There are many contributing factors as to the rate of progression between primary, secondary and tertiary level, and indeed within tertiary level. In general, they can be categorised into two levels, student level and institutional level. At student level, the individual characteristics may include age, gender, family background, living arrangements, finances and personality. At institutional level, there has been much focus on the type of institution and size (Pascarella & Terenzini 1991).

Lassibille and Gomez (2008) surveyed 7000 students in Spain over an eight year period in order to better understand the non-retention of students in higher education. Their results state that academic preparedness is a major contributing factor. They also stated that “older students and students who delay entry into higher education are more likely to drop out before graduating” (Lassibille and Gomez 2008, p.102). Interestingly they also highlighted the role that financial support plays in reducing drop-out rates. Porter (1990) and Smith and Naylor (2001) found that in the US and the UK, identified a common trend, that drop-out rates peak in first year, while the withdrawal risks decline steadily as the students’ progress through their courses. This reinforces Vygotsky's theory which stresses the fundamental role of social interaction in the development of cognition (Vygotsky 1978), as he believed strongly that community plays a central role in the process of "making meaning."

The Department of Education and Skills have established in 2012, the National Forum for the Enhancement of Teaching and Learning in Higher Education. To date they have conducted numerous studies on transitions to higher education, student completion and retention, open education resources and open access, recognition of prior learning and research on higher education teaching and learning in Ireland. Results from the research on student completion and non-retention (National Forum for the Enhancement of Teaching and Learning in Higher Education 2015) recognised five core themes which are most significant in terms of student non-completion. These include course, personal, financial, medical/health and family. The report emphasises the importance of collecting systematic and standardised information (for example, through a standardised exit form) on why students choose to leave higher education. An additional tool to help identify issues the students are experiencing that may contribute to non-progression is the Irish Survey of Student Engagement (ISSE) which was established in 2013. This focuses on progression between first and second year at third level in particular disciplines.

As mentioned previously, the more pertinent of these factors include: the learners individual characteristics (gender, age), and prior educational attainment. Given that Vygotsky's learning theory is based on how social interaction plays a fundamental role in learning, these factors are not unexpected.

- Gender as a factor for non-progression

Traditionally, females worked at the home and had a limited education, whereas the men worked outside the home and required the educational qualifications in order to do so, hence there was always a high ratio of male to female at third level. This has changed dramatically over the years. The early school leavers rate among women aged 18-24 in 2010 was 8.4%, which was much lower than the male rate of 12.6%. At third level, the ratio of new entrants is 50:50 (HEA 2015a) and women are more likely to leave having a third-level qualification, with over half (53%) of women aged 25-34 having a third-level qualification compared with nearly four out of ten men (39%) in this age group (CSO 2011).

- Age as a factor for non-progression

Research in the area of age and third level education is showing the overall age profile is shifting. No longer is third level dominated with 18-22 year olds, today the figures state that 12% of full time undergraduates are mature, (8% in the university sector and 16% in the IOT sector). Interestingly, the level of mature students for part time courses increases from 12% to 88% (HEA 2015a). At LYIT, the number of mature students is 21% for full time programmes. Whilst it is encouraging to see the number of mature students rising, with it comes a lot of contributing factors to their progression through the system, for example, financial support.

Following the rapid increase in unemployment which resulted from the downturn in the economy, the government's response was to propose a range of new initiatives offering part time, flexible education opportunities for adults seeking to upskill and reskill in emerging employment areas. These include Springboard, MOMENTUM and JobBridge (the National Internship Scheme).

Various agencies and organisations have identified the multiple issues that mature learners have with gaining entry into the third level system and indeed progressing through it. AONTAS (National Adult Learning Organisation) have listed changes in employment status (including unemployment), access to financial resources, transport, family and caring responsibilities as

the main issues (HEA 2014). Over the past number of years these agencies have engaged with a significant reform agenda within the further education and training sector.

- Prior educational attainment as a factor for non-progression

Previous academic qualifications is another widely acknowledged factor for progression of students through higher education. Chapman (1996) reported a positive correlation between the quality of a student's academic performance in second-level to achievement in higher education.

McCoy (2010) on behalf of the HEA indicates that "prior educational attainment is the strongest predictor of successful progression through higher education". She continues: "minimising students' non-completion of courses is an important part of ensuring that the resources available to the higher education sector are utilised with maximum efficiency" (HEA 2010, p.10). Similarly in the UK, Johns and Taylor (1990) reported that students with higher A-level performance were less likely to withdraw from higher education.

The three key factors discussed here can all be related back to Vygotsky's sociocultural theory on learning which focuses not only on how adults and peers influence individual learning, but also on how cultural beliefs and attitudes impact how instruction and learning take place. In summary, the literature review reveals that academic grit, student centred learning and the factors affecting progression are all interrelated and are embedded in Vygotsky's learning theory. The next chapter provides detail regarding the methodology of the study, results of the statistical analysis and answers to the research questions proposed initially.

3.0 Implementation and Evaluation

3.1 Implementation - The survey

This is a quantitative study which employs a self-reporting questionnaire for participants in order to determine their level of grit (Appendix 1). A questionnaire is a widely used and useful mechanism for collecting survey information and providing numerical data. Major advantages include the administration of the questionnaire without the researcher needing to be present, and is often relatively straightforward to analyse (Wilson and McLean 1994). Most questionnaires combine nominal data on participants' backgrounds and relevant personal details with other scales (e.g. attitude scales). Surveys are useful for gathering factual information, data on preferences, beliefs and experiences - both past and present (Weisberg *et al* 1996). Qualitative data analysis involves organising and explaining the data or making sense of data in terms of the participants' definitions of the situation. A disadvantage of qualitative data is that the analysis is unavoidably interpretive (Cohen *et al* 2007).

A self-reported survey was used to determine the level of Grit of each student in this study. This survey was developed by Duckworth *et al* in 2007. The twelve item scale was designed to ascertain a student's interest over time and their ability to sustain effort during that time. Sample items included: "I have overcome setbacks," or "I finish whatever I begin." Items were placed on a five-point response scale ranging from 1 (not at all like me) to 5 (very much like me). Scores were averaged to form an index of students' grit level. One of the attractions of using rating scales is that they provide more opportunity than dichotomous questions for making data more sensitive to respondents while still generating numbers. This makes rating scales particularly useful for tapping attitudes, perceptions and opinions (Cohen *et al* 2007). Whilst other surveys are available (The Passion Scale as suggested by Vallerand *et al* 2003, The Tenacity Scale used by Baum and Locke 2004) it was deemed that this survey (Grit-Scale) was the most suitable given the academic setting and age group of the participants.

Typically, for quantitative research, the reliability and validity of the study design and instrument is statistically analysed (e.g. Coefficient alpha calculated) to confirm trustworthiness Anney (2014). This survey has well-documented reliability and validity. The predictive validity of the Grit-Scale was assessed by its association with higher levels of lifetime schooling among individuals aged 25 years or older (Duckworth and Quinn 2009) and its positive association with happiness and life satisfaction (Singh and Jha 2008). For instance,

the Grit Scale demonstrated high internal consistency ($\alpha=0.85$) for the overall scale and for each factor (Consistency of Interests, $\alpha=0.84$; Perseverance of Effort, $\alpha= 0.78$), in previous studies (Duckworth *et al* 2007; Duckworth and Quinn 2009). Positive relations between grit and outcomes (e.g., conscientiousness, attainment) provide additional evidence of criterion validity.

For the purpose of this study, attached to each survey was an additional sheet which each student completed. This required information on their age, gender, department year of study and route of entry into their chosen programme. This allowed for the statistical correlation between grit score and the students.

3.2 Implementation - Ethical considerations

Ethics was a major consideration for this study particularly considering the age profile of students at third level as some students would be under 18 years old and would require parental consent to participate. Survey was deemed the most appropriate method for data collection for this study. To maintain anonymity of the participants, surveys were used for data collection rather than individual interviews.

Before distribution of the surveys to the students, consent from the relevant Head of Departments was sought. For this, each were met individually by the researcher, the research was verbally outlined and an information sheet was provided (Appendix 2). After reading the information sheet, the Head of Department signed a consent form, which was also provided (Appendix 3).

Attached to each survey were two additional pages. The first page was an information sheet for the students (Appendix 4). This included pertinent information regarding the research study, outlining the rationale for the survey research as well as procedures. This information sheet also outlined the rights of the participants and how the data will be collected and stored. Participants also had the opportunity to email the researcher for any additional information.

The second sheet was the consent form (Appendix 5). This required the participants name, signature and date, if the student was over 18 years old. If the student was younger than 18, consent from parents/guardians would be required.

3.3 Implementation - Population of study

The research population comprised the registered students of Letterkenny Institute of Technology (LYIT). LYIT is comprised of four Schools (Science, Engineering, Business and Tourism), each of which contains three to four departments. The total number of full time undergraduates is 2568, within which 814 students are mature.

3.4 Implementation - Sampling and sample size

Surveys were distributed to as many of the different departments as feasibly possible. No groups of particular students were targeted in order to avoid purposeful sampling. To ensure informed consent, the students were provided with an information sheet and ethics form prior to the survey. The total number of participants was 231.

3.5 Implementation - Data collection

Data for this study was collected during March and April 2016. The information sheets, ethics forms and surveys were clipped together and distributed amongst the lecturing staff from various departments. These were filled in by the students during class time. The lecturers then collated all forms and surveys, put them back into a large brown envelope, sealed the envelope and either hand delivered them to the researcher or put them in a secure mail box.

3.6 Implementation - Method of data analysis

Data analysis consisted of two different parts. The first part employed descriptive statistics to calculate straightforward percentages, means and standard deviations. The second part involved the statistical calculation of correlation between grit and the individual factors. This addressed the hypotheses that were proposed for this study (see section 3.7). Both Excel and SPSS were used for statistical analysis.

3.7 Evaluation - General Statistics

In total, 231 students participated in the survey. Within this, both male and female, from ages 18 to 57 responded. Figure 3.1 and 3.2 illustrates the composition of the participants with regard to their gender and age, respectively.

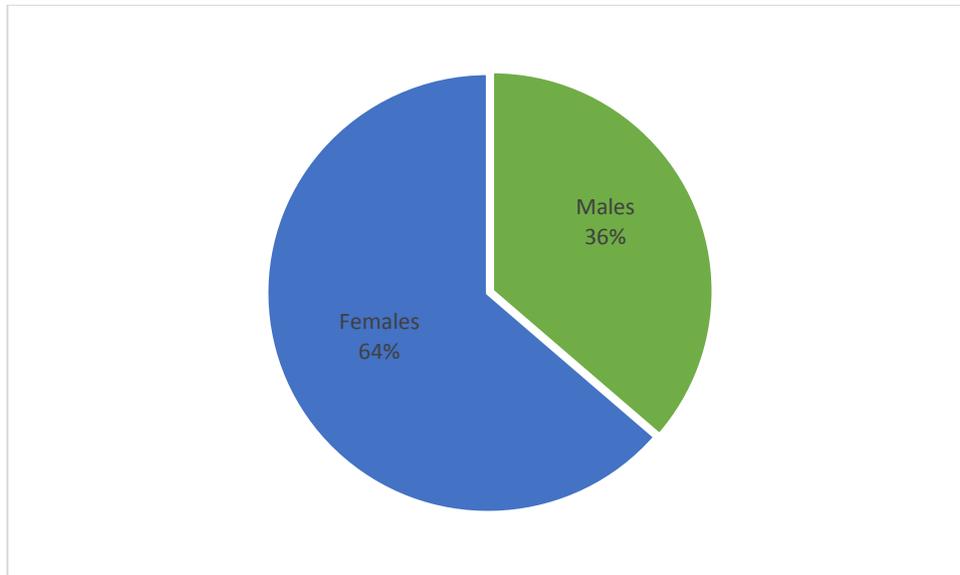


Figure 3.1. The distribution of gender amongst the participants in this study

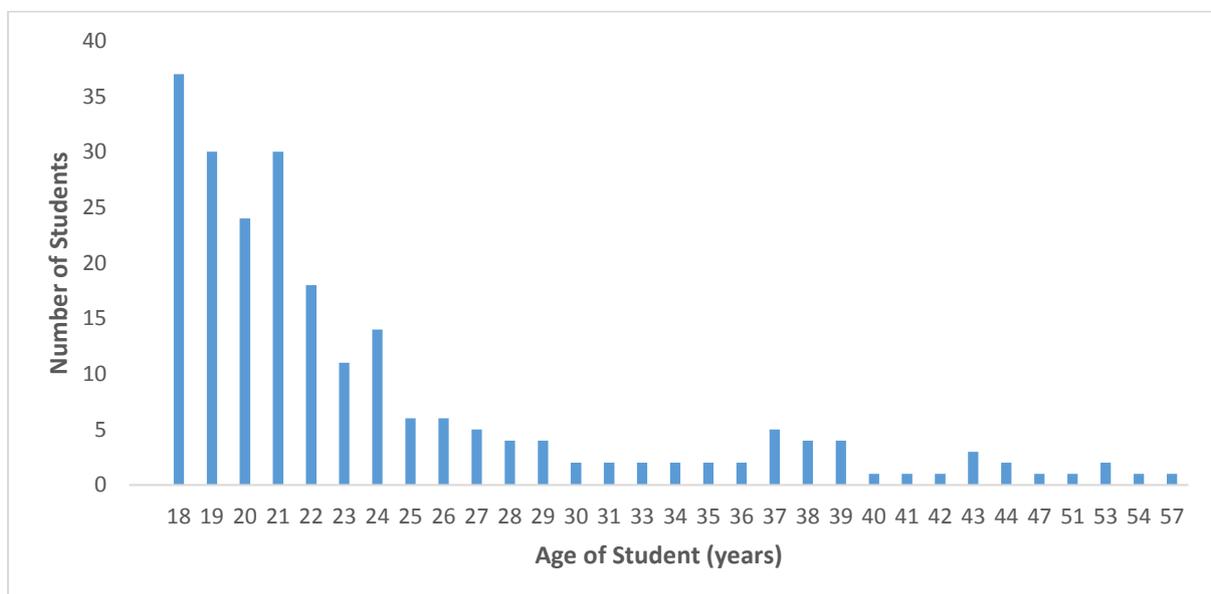


Figure 3.2. The distribution of age amongst the participants in this study

The initial experimental plan was to issue surveys to as many of the different departments within LYIT as possible. However, given the time frame and the total numbers involved, the number of departments was reduced to five. Students enrolled in the nursing department completed the most surveys, whilst law students completed the fewest (Figure 3.3).

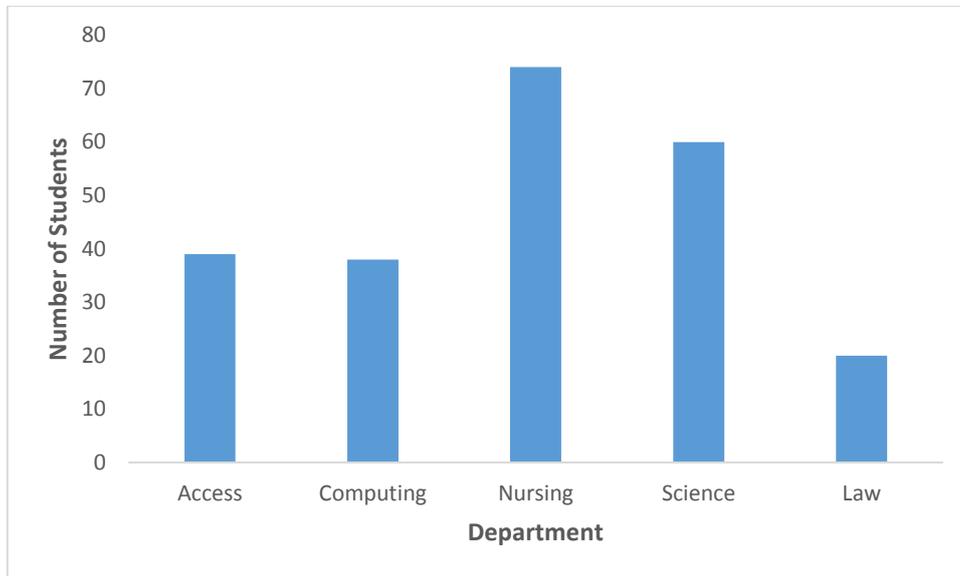


Figure 3.3. The number of students in each department in this study

Again, the initial experimental plan was to issue surveys to as many students enrolled in the different years of programme within LYIT as possible. This was achieved and students from Access (Year -1) through to Masters (Year 5) were surveyed (Figure 3.4).

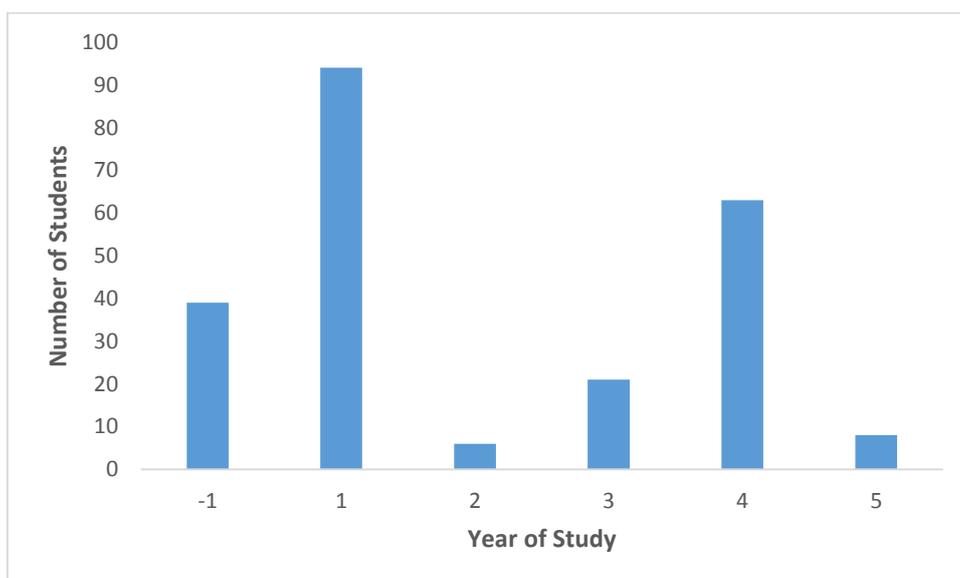


Figure 3.4. The number of students in each year of study

In general, grit scores ranged from 2 to 4.83 and the average grit score was 3.2503 with a standard deviation of 0.56666 (Figure 3.5).

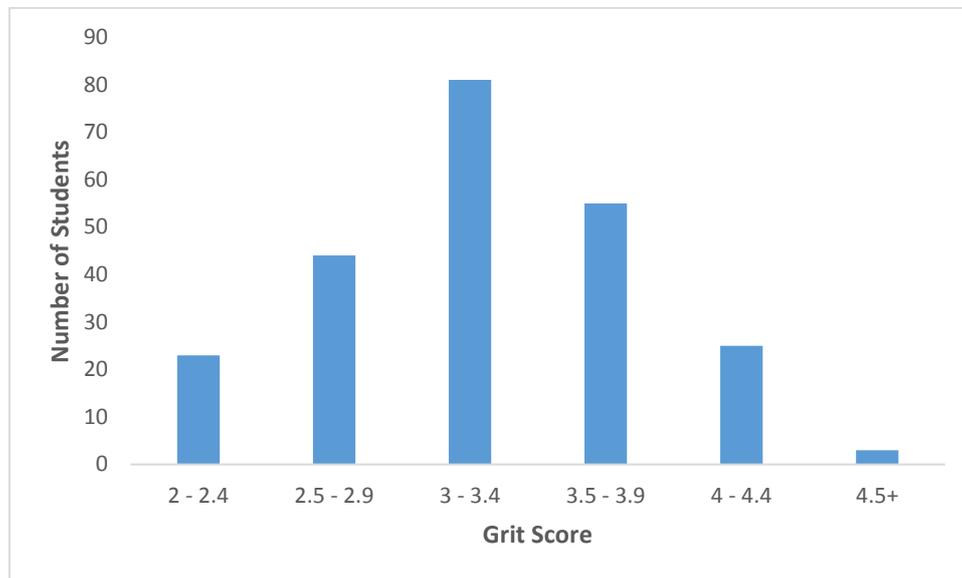


Figure 3.5. The range of Grit scores in this study

3.8 Evaluation - Hypothesis Testing

Based on the objectives of the study and the stated research questions, the following hypotheses were constructed to help address the research problem.

Hypothesis 1

- H₀: There is no relationship between gender and grit in learners in Higher Education.
- H₁: There is a relationship between gender and grit in learners in Higher Education.

Hypothesis II

- H₀: There is no relationship between age and grit in learners in Higher Education.
- H₁: There is a relationship between age and grit in learners in Higher Education.

Hypothesis III

- H₀: There is no relationship between department and grit in learners in Higher Education.
- H₁: There is a relationship between department and grit in learners in Higher Education.

Hypothesis IV

- H₀: There is no relationship between year of study and grit in learners in Higher Education.
- H₁: There is a relationship between year of study and grit in learners in Higher Education.

Hypothesis V

- H₀: There is no relationship between route of entry and grit in learners in Higher Education.
- H₁: There is a relationship between route of entry and grit in learners in Higher Education.

The aim of these hypothesis is to determine if there is a relationship between grit and various factors, and how much do those factors contribute to grit. In order to do so, independent *t*-tests were used to statistically accept or reject these hypotheses.

A *t*-test is a type of statistical test where the mean of two different groups (independent variable) which are measured for the one outcome (dependant variable) are compared to determine if they are statistically different. For this study, an independent *t*-test was used, which is typically used in cases where there are different participants measured for the same outcome.

3.8.1 Hypothesis 1: Gender and Grit

The initial hypothesis was based on the relationship, if any, between the gender of the learner and grit. The null hypothesis (H₀) proposed was: There is no relationship between gender and grit in learners in Higher Education. The experimental hypothesis (H₁) is: There is a relationship between gender and grit in learners in Higher Education.

The output from the independent *t*-test contains two tables. Table 3.1 provides summary statistics for the two experimental conditions. From this table, it can be seen that 84 males (Gender 1 = male) and 147 females (Gender 2 = female) participated in this study (column labelled N). The male participants had a mean grit score of 3.2571, with a standard deviation of 0.61036. The standard error for that group (the standard deviation of the sampling group) is 0.0660 ($SE = 0.61036/\sqrt{84} = 0.61036/9.165 = 0.0660$). The female participants had a mean grit score of 3.2465, with a standard deviation of 0.54224. The standard error for that group (the standard deviation of the sampling group) is 0.04472 ($SE = 0.54224/\sqrt{147} = 0.54224/12.124 = 0.04472$).

Table 3.1: SPSS output of summary statistics (unequal sample size) using gender data set

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Grit	1	84	3.2571	.61036	.06660
	2	147	3.2465	.54224	.04472

The second table from the SPSS output contains the main test statistics. However, at this point the unequal sample sizes becomes a problem. The independent *t*-test is more readily interpretive if the sample number is equal for both, i.e. the same number of males and females. There are complicated equations that could be used to overcome this. For this study, a simpler method of ‘random sampling’ within the data set was carried out so that there were equal numbers of samples. More specifically, 84 female samples were randomly chosen by SPSS from the 147 female data set. The independent *t*-test was then performed on this new data set, i.e. 84 males and 84 females. The data from Table 3.1 is still very relevant and contains important information. Table 3.2 is the summary statistics from this new data set. The sample size for both gender is now 84. The mean of the male grit score hasn’t changed, as it shouldn’t but the mean of the grit score for the females has changed slightly from 3.2465 to 3.2273 and the standard deviation changed from 0.54224 to 0.57372. A knock on effect from the change in standard deviation and sample size is the change in standard error, which is now 0.06260 ($SE = 0.57372/\sqrt{84} = 0.57372/9.16515139 = 0.06260$).

Table 3.2. SPSS output of summary statistics (equal sample size) using gender data set

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Grit	1.00	84	3.2571	.61036	.06660
	2.00	84	3.2273	.57372	.06260

Table 3.3 are the results from the *t*-test using equal sample size. In this table there are two rows containing values for the test statistics, one row is labelled ‘Equal variances assumed’ and the other is labelled ‘Equal variances not assumed’. In order to identify which assumption to base the statistics on, the values of the variances must be examined to compare similarity. The Levene’s test is similar to a *t*-test in that it test the hypothesis that the variances in the two

groups are equal (i.e. the difference between the variances is zero). Therefore, if Levene's test is significant at $p \leq 0.05$ then it can be concluded that the null hypothesis is incorrect and that the variances are significantly different. If however, Levene's test is not significant (i.e. $p > 0.05$) then the null hypothesis must be accepted, that the difference between the variance is zero. For this data set, Levene's test is not-significant (because $p = 0.527$, which is greater than 0.05) and the row labelled 'Equal variances assumed' should be used to interpret the statistics. With regards to the t-test itself, the mean difference ($\bar{X}_1 - \bar{X}_2 = 3.2571 - 3.2273 = 0.0298$) is reported. With regard to the standard error of the sampling distribution of differences, this was calculated using the following equation:

$$\begin{aligned}
 &= \sqrt{\left(\frac{S_1^2}{N_1}\right) + \left(\frac{S_2^2}{N_2}\right)} \\
 &= \sqrt{\frac{0.61036^2}{84} + \frac{0.57372^2}{84}} \\
 &= \sqrt{0.004435 + 0.0039188} \\
 &= \sqrt{0.008352} \\
 &= 0.09139
 \end{aligned}$$

The t -statistics is calculated by dividing the mean difference by the standard error of the sampling distribution of difference ($t = 0.0298/0.09139 = 0.327$). This value of t is then assessed against the value of t you might expect to get by chance when you have certain degrees of freedom. For the independent t -test, degrees of freedom are calculated by adding the two sample sizes and then subtracting the number of samples ($df = (N_1 + N_2) - 2 = (84 + 84) - 2 = 166$). SPSS produces the exact significance value of t and it's whether this number is greater or equal to 0.05 is important. In this case the two-tailed value of p is 0.744, which is great than 0.05. From this, it can be concluded that there was no difference between the means of each sample set, i.e. there is no difference in grit between male and female students in this study.

Table 3.3. SPSS output of main test statistics using gender data set

Independent Samples Test									
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.401	.527	.327	166	.744	.02988	.09140	-.15057	.21033
Equal variances not assumed			.327	165.368	.744	.02988	.09140	-.15058	.21034

Statistically speaking, on average, male learners did score higher in grit ($M = 3.2571$, $SE = 0.06660$), than the female learners ($M = 3.2465$, $SE = 0.04472$). This difference was not significant $t(166) = 0.327$, $p > 0.05$.

From these statistics, the null hypotheses can be accepted, meaning there is no relationship between gender and grit in learners in Higher Education.

3.8.2 Hypothesis 2: Age and Grit

This hypothesis was based on the relationship, if any, between the age of the learner and grit. The null hypothesis (H_0) proposed was: There is no relationship between age and grit in learners in Higher Education. The experimental hypothesis (H_1) is: There is a significant relationship between age and grit in learners in Higher Education.

For this hypothesis a different type of statistical test was required. The previous test, the t -test is only useful for a data set that has two levels of independent variables, e.g. male and female. As age is a factor with more than two levels, ANOVA is a more appropriate used test for this data set. Analysis of Variance (ANOVA) is typically used in experiments where there are multiple levels of the independent variables.

Table 3.4 shows the table of descriptive statistics from the one-way procedure for the grit data. The first column is the age category, the next column, N, is the number of learners who were

this age. The mean and standard deviation within each age category is also listed, as is the standard error which is the standard deviation of the sampling distribution of the data. The 95% confidence interval is listed, providing both the lower and upper limits.

Whilst this information may be of interest, it does not test the hypothesis proposed. For that, the Table 3.6 needs to be examined and interpreted. However, in order to prove that the variances within the groups are the same and indeed the results in Table 3.6 are valid, the Levene's test was applied to the data set first. Table 3.5 shows this output. Here, it is testing whether the variances of the age groups are significantly different. If the Levene's test is significant (i.e. *Sig.* value < 0.05) then additional data handling would be required before applying ANOVA. Table 3.5 lists the significance value at 0.492, which is greater than 0.05, which means that variances are significantly different.

Table 3.4: SPSS output of descriptive statistics of grit scores within each age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
					18	39			3.0070	.53926	.08865	2.8272	3.1868	2.00	4.25
19	31	3.1197	.51238	.09203	2.9317	3.3076	2.00	4.08
20	24	3.1900	.47272	.09649	2.9904	3.3896	2.00	4.08
21	30	3.2397	.52731	.09627	3.0428	3.4366	2.42	4.08
22	18	3.3872	.51090	.12042	3.1332	3.6413	2.42	4.25
23	11	3.2936	.59463	.17929	2.8942	3.6931	2.33	4.08
24	14	3.3029	.48031	.12837	3.0255	3.5802	2.75	4.16
25	6	3.3450	.60738	.24796	2.7076	3.9824	2.42	4.25
26	6	3.5117	.54996	.22452	2.9345	4.0888	2.83	4.00
27	5	3.5480	.32828	.14681	3.1404	3.9556	3.16	3.92
28	4	2.8300	.59459	.29729	1.8839	3.7761	2.25	3.66
29	4	2.6450	.41837	.20918	1.9793	3.3107	2.08	3.00
30	2	3.9150	.47376	.33500	-.3416	8.1716	3.58	4.25
31	2	4.0000	.59397	.42000	-1.3366	9.3366	3.58	4.42
33	2	3.2500	.24042	.17000	1.0899	5.4101	3.08	3.42
34	2	3.9550	.99702	.70500	-5.0029	12.9129	3.25	4.66
35	2	3.3750	.17678	.12500	1.7867	4.9633	3.25	3.50
36	2	3.2050	.64347	.45500	-2.5763	8.9863	2.75	3.66
37	5	3.4160	.52890	.23653	2.7593	4.0727	2.83	4.00
38	4	3.3100	.84356	.42178	1.9677	4.6523	2.08	4.00
39	4	3.7400	.47525	.23763	2.9838	4.4962	3.14	4.16
40	1	3.0800	.	.	.	.	3.08	3.08
41	1	3.1600	.	.	.	.	3.16	3.16
42	1	3.5800	.	.	.	.	3.58	3.58
43	3	4.0267	1.11787	.64540	1.2497	6.8036	2.75	4.83
44	2	4.1650	.23335	.16500	2.0685	6.2615	4.00	4.33
47	1	3.8300	.	.	.	.	3.83	3.83
51	1	4.2500	.	.	.	.	4.25	4.25
53	2	3.5400	.16971	.12000	2.0153	5.0647	3.42	3.66
54	1	3.0000	.	.	.	.	3.00	3.00
57	1	2.0800	.	.	.	.	2.08	2.08
Total	231	3.2503	.56666	.03728	3.1769	3.3238	2.00	4.83

Table 3.5: SPSS output for Levene’s test using the age data set

Levene Statistic	df1	df2	Sig.
.982 ^a	24	199	.492

a. Groups with only one case are ignored in computing the test of homogeneity of variance for Grit.

Table 3.6: SPSS output for ANOVA using the age data set

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	17.284	31	.558	1.961	.003
Within Groups	56.571	199	.284		
Total	73.855	230			

Table 3.6 is the output for ANOVA using the age data set and by interpreting this data, the null hypothesis can be rejected or accepted. This table is divided into two rows, between groups (experimental effects) and within groups effects (unsystematic variation in the data). The second column lists the sum of squares values for each, which is the total amount of variation within the data sets. This is the difference between each observed data point and the grand mean. The differences are then squared and added together to give the total sum of squares. The sum of squares for between-groups is 17.284 with 31 degrees of freedom. The mean square is calculated by dividing the sum of squares by the degrees of freedom, rather than dividing by the number of observations. This is value is required in order to calculate the *F* value. In this case, $0.558 \div 0.284 = 1.961$. This value is greater than 1, which indicates that the experimental manipulation had a greater effect than the effect of individual differences in grit, i.e. age has a significant effect on grit. The final column states the likelihood of an *F* ratio of the one obtained occurring by chance. From Table 3.6, it can be seen that there is a probability of 0.003 or a 0.3% chance of the *F* ratio occurring by chance. Due to this low significance value (<0.05) it is now statistically proven that age does have a significant effect on grit.

Overall, the null hypothesis can be rejected and the experimental hypothesis accepted, i.e. there is a significant relationship between age and grit in learners in Higher Education, $F(31, 199) = 1.961, p < 0.05$.

3.8.3 Hypothesis 3: Department and Grit

This hypothesis was based on the relationship, if any, between the department in which the learner was registered and grit. The null hypothesis (H_0) proposed was: There is no significant relationship between department and grit in learners in Higher Education. The experimental hypothesis (H_1) is: There is a significant relationship between age and grit in learners in Higher Education.

As for the previous hypothesis, ANOVA was the most appropriate test to apply. Additionally post-hoc tests were also applied to this data set. For the purposes of SPSS data analysis, each department was given a numerical identification code, as SPSS cannot process string variables as easily as numeric variables. Department 1 is Access, 2 is Computing, 3 is Nursing, 4 is Science and 5 is Law.

Table 3.7 is the table of descriptive statistics from the one-way procedure for the grit data. As previously described, the first column is the department category, the next column, N, is the number of learners in each department. The mean and standard deviation of grit scores within each department is also listed, as is the standard error which is the standard deviation of the sampling distribution of the data. The 95% confidence interval is listed, providing both the lower and upper limits.

Table 3.7: SPSS output of descriptive statistics of grit scores in each department

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1.0	39	3.1551	.54252	.08687	2.9793	3.3310	2.00	4.08
2.0	38	3.3384	.67232	.10907	3.1174	3.5594	2.08	4.83
3.0	74	3.2619	.54442	.06329	3.1358	3.3880	2.08	4.25
4.0	60	3.2218	.57335	.07402	3.0737	3.3699	2.00	4.66
5.0	20	3.3115	.46634	.10428	3.0932	3.5298	2.66	4.25
Total	231	3.2503	.56666	.03728	3.1769	3.3238	2.00	4.83

To test the variances within the groups, the Levene's test was applied. Table 3.8 lists the significance value at 0.396, which is greater than 0.05, which means that variances are significantly different. This in turn means that no additional data handling is required.

Table 3.8: SPSS output for Levene's test using the department data set

Levene Statistic	df1	df2	Sig.
1.022	4	226	.396

Table 3.9: SPSS output for ANOVA using the department data set

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.782	4	.195	.604	.660
Within Groups	73.073	226	.323		
Total	73.855	230			

Table 3.9 is the output for ANOVA using the department data set and by interpreting this data, the null hypothesis can be rejected or accepted. This table is divided into two rows, between groups (experimental effects) and within groups effects (unsystematic variation in the data). The second column lists the sum of squares values for each, which is the total amount of variation within the data sets. This is the difference between each observed data point and the grand mean. The differences are then squared and added together to give the total sum of squares. The sum of squares for between-groups is 0.782 with 4 degrees of freedom. The mean square value is calculated to be 0.196. The F value is 0.604 and as this value is less than 1, which indicates that there is no effect of department on grit. The significance value for this test is reported at 0.660 which is > 0.05 which implies again that there is no significant relationship between department and grit.

Overall, the null hypothesis can be accepted i.e. there is no significant relationship between department and grit in learners in Higher Education, $F(4, 226) = 0.604, p > 0.05$.

An additional test was applied to the data set, specifically the Hochberg's test. This allowed for a more comprehensive analysis on the data set and explicitly compared the grit scores in each department with one another, i.e. are science students more gritty than computing

students, rather than analysing the overall effect of department on grit as previously seen with ANOVA. Table 3.10 is the output from SPSS for this test. To interpret the table, the most important columns are (I) Department, (J) Department and Sig. The first column and row on Table 3.10 compares Department 1 (Access) with Department 2 (Computing). If the *Sig.* value is greater than 0.05, there is no significant difference between the grit score between those two departments. As it can be seen, the *Sig.* value is 0.818 which is much greater than 0.05, which means there is no difference in grit between Access students and Computing students. By inspecting the *Sig.* column throughout Table 3.10, it can be clearly seen that all values are > 0.05, therefore levels of grit are not notably different across departments.

Table 3.10: SPSS output for Hochberg's test using the department data set

(I) Department	(J) Department	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.0	2.0	-.18329	.12961	.818	-.5496	.1830
	3.0	-.10676	.11252	.984	-.4247	.2112
	4.0	-.06671	.11696	1.000	-.3972	.2638
	5.0	-.15637	.15639	.977	-.5983	.2856
2.0	1.0	.18329	.12961	.818	-.1830	.5496
	3.0	.07653	.11348	.999	-.2442	.3972
	4.0	.11659	.11789	.979	-.2166	.4497
	5.0	.02692	.15708	1.000	-.4170	.4708
3.0	1.0	.10676	.11252	.984	-.2112	.4247
	2.0	-.07653	.11348	.999	-.3972	.2442
	4.0	.04006	.09878	1.000	-.2391	.3192
	5.0	-.04961	.14330	1.000	-.4546	.3554
4.0	1.0	.06671	.11696	1.000	-.2638	.3972
	2.0	-.11659	.11789	.979	-.4497	.2166
	3.0	-.04006	.09878	1.000	-.3192	.2391
	5.0	-.08967	.14682	1.000	-.5046	.3252
5.0	1.0	.15637	.15639	.977	-.2856	.5983
	2.0	-.02692	.15708	1.000	-.4708	.4170
	3.0	.04961	.14330	1.000	-.3554	.4546
	4.0	.08967	.14682	1.000	-.3252	.5046

3.8.4 Hypothesis 4: Year of study and Grit

This hypothesis was based on the relationship, if any, between the year of programme in which the learner was registered and grit. The null hypothesis (H_0) proposed was: There is no relationship between year of programme and grit in learners in Higher Education. The experimental hypothesis (H_1) is: There is a significant relationship between year of programme and grit in learners in Higher Education.

Again ANOVA was the most appropriate test to apply. Additionally post-hoc tests were also applied to this data set. For the purposes of SPSS data analysis, students from Access were given the numerical code ‘-1’ and students registered at level 9 (Masters) were given the code ‘5’.

Table 3.11 is the table of descriptive statistics from the one-way procedure for the grit data. As previously described, the first column is the year category, the next column, N, is the number of learners in each year. The mean and standard deviation of grit scores within each year is also listed, as is the standard error which is the standard deviation of the sampling distribution of the data. The 95% confidence interval is listed, providing both the lower and upper limits.

Table 3.11: SPSS output of descriptive statistics of grit scores in each year

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
-1	39	3.1551	.54252	.08687	2.9793	3.3310	2.00	4.08
1	94	3.0818	.48407	.04993	2.9827	3.1810	2.00	4.25
2	6	3.1467	.80968	.33055	2.2970	3.9964	2.00	4.06
3	21	3.5148	.65464	.14285	3.2168	3.8128	2.08	4.83
4	63	3.4087	.54909	.06918	3.2704	3.5470	2.08	4.66
5	8	3.8313	.46292	.16367	3.4442	4.2183	3.33	4.42
Total	231	3.2503	.56666	.03728	3.1769	3.3238	2.00	4.83

To test the variances within the groups, the Levene’s test was applied. Table 3.12 lists the significance value at 0.096, which is greater than 0.05, which means that variances are significantly different. This in turn means that no additional data handling is required.

Table 3.12: SPSS output for Levene’s test using the year data set

Levene Statistic	df1	df2	Sig.
1.897	5	225	.096

Table 3.13: SPSS output for ANOVA using the year data set

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.836	5	1.767	6.116	.000
Within Groups	65.018	225	.289		
Total	73.855	230			

Table 3.13 is the output for ANOVA using the year data set and by interpreting this data, the null hypothesis can be rejected or accepted. This table is divided into two rows, between groups (experimental effects) and within groups effects (unsystematic variation in the data). The second column lists the sum of squares values for each, which is the total amount of variation within the data sets. The sum of squares for between-groups is 8.836 with 5 degrees of freedom. The mean square value is calculated to be 1.767. The F value is 6.116 and as this value is > 1 , this indicates that there is an effect of year on grit. The significance value for this test is reported at 0.000 which is < 0.05 which implies again that there is a significant relationship between department and grit. Overall, the experimental hypothesis can be accepted i.e. there is a significant relationship between year and grit in learners in Higher Education, $F(5, 225) = 6.116, p < 0.05$.

As before, the Hochberg’s test was applied to the data set. This explicitly compared the grit scores in each year with one another, i.e. are 4th year students more gritty than 1st year students. Table 3.14 is the output from SPSS for this test. The first column and row on Table 3.14 compares Year -1 (Access) with year 1. If the *Sig.* value is greater than 0.05, there is no significant difference between the grit score between those two years. As it can be seen, the *Sig.* value is 1.00 which is much greater than 0.05, which means there is no difference in grit between Access students and 1st year students. However, there is a significant difference in grit

scores between certain years, which can be seen from the *Sig.* column in the table. In general, 1st year students are very different in terms of grit when compared to 3rd years (0.015), 4th years (0.04) and Masters students (0.03). Additionally, it is quite clear that Access students and Masters students are very different (0.02).

Table 3.14: SPSS output for Hochberg’s test using the year data set

(I) Year	(J) Year	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
-1	1	.07332	.10239	1.000	-.2295	.3762
	2	.00846	.23574	1.000	-.6888	.7057
	3	-.35963	.14550	.191	-.7900	.0707
	4	-.25360	.10953	.275	-.5775	.0703
	5	-.67612*	.20864	.020	-1.2932	-.0590
1	-1	-.07332	.10239	1.000	-.3762	.2295
	2	-.06486	.22635	1.000	-.7343	.6046
	3	-.43295*	.12975	.015	-.8167	-.0492
	4	-.32692*	.08753	.004	-.5858	-.0680
	5	-.74944*	.19798	.003	-1.3350	-.1639
2	-1	-.00846	.23574	1.000	-.7057	.6888
	1	.06486	.22635	1.000	-.6046	.7343
	3	-.36810	.24884	.892	-1.1041	.3679
	4	-.26206	.22967	.987	-.9413	.4172
	5	-.68458	.29032	.250	-1.5432	.1741
3	-1	.35963	.14550	.191	-.0707	.7900
	1	.43295*	.12975	.015	.0492	.8167
	2	.36810	.24884	.892	-.3679	1.1041
	4	.10603	.13545	1.000	-.2946	.5067
	5	-.31649	.22334	.920	-.9771	.3441
4	-1	.25360	.10953	.275	-.0703	.5775
	1	.32692*	.08753	.004	.0680	.5858
	2	.26206	.22967	.987	-.4172	.9413
	3	-.10603	.13545	1.000	-.5067	.2946
	5	-.42252	.20176	.430	-1.0193	.1742
5	-1	.67612*	.20864	.020	.0590	1.2932
	1	.74944*	.19798	.003	.1639	1.3350
	2	.68458	.29032	.250	-.1741	1.5432
	3	.31649	.22334	.920	-.3441	.9771
	4	.42252	.20176	.430	-.1742	1.0193

*. The mean difference is significant at the 0.05 level.

3.8.5 Hypothesis 5: Route of Entry and Grit

This hypothesis was based on the relationship, if any, between the route of entry into the programme for each learner and grit. The null hypothesis (H_0) proposed was: There is no significant relationship between route of entry and grit in learners in Higher Education. The experimental hypothesis (H_1) is: There is a significant relationship between route of entry and grit in learners in Higher Education.

As for the previous hypothesis, ANOVA was the most appropriate test to apply. Unfortunately, no post hoc tests could be applied as not all groups had more than one data point. For the purposes of SPSS data analysis, each route was given a numerical identification code, as SPSS cannot process string variables as easily as numeric variables. Route 1 is CAO, 2 is Mature, 3 is Access and 4 is Springboard.

Table 3.15 is the table of descriptive statistics from the one-way procedure for the grit data. As previously described, the first column is the route category, the next column, N, is the number of learners in each route. The mean and standard deviation of grit scores within each route is also listed, as is the standard error which is the standard deviation of the sampling distribution of the data. The 95% confidence interval is listed, providing both the lower and upper limits.

Table 3.15: SPSS output of descriptive statistics of grit scores in each route

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	185	3.2025	.53505	.03934	3.1249	3.2801	2.00	4.66
2	33	3.3452	.65749	.11445	3.1120	3.5783	2.08	4.83
3	5	3.4660	.74046	.33114	2.5466	4.3854	2.75	4.25
4	1	4.3300	.	.	.	.	4.33	4.33
Total	224	3.2344	.56332	.03764	3.1602	3.3086	2.00	4.83

To test the variances within the groups, the Levene's test was applied. Table 3.16 lists the significance value at 0.07, which is greater than 0.05, which means that variances are significantly different. This in turn means that no additional data handling is required.

Table 3.16: SPSS output for Levene’s test
using the route data set

Levene Statistic	df1	df2	Sig.
2.685 ^a	2	220	.070

a. Groups with only one case are ignored in computing the test of homogeneity of variance for Grit.

Table 3.17: SPSS output for ANOVA using the route data set

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.062	3	.687	2.201	.089
Within Groups	68.702	220	.312		
Total	70.764	223			

Table 3.17 is the output for ANOVA using the year data set and by interpreting this data, the null hypothesis can be rejected or accepted. This table is divided into two rows, between groups (experimental effects) and within groups effects (unsystematic variation in the data). The second column lists the sum of squares values for each, which is the total amount of variation within the data sets. The sum of squares for between-groups is 2.062 with 3 degrees of freedom. The mean square value is calculated to be 0.687. The remaining results are quite ambiguous with regards to the hypothesis. The F value is 2.201 and as this value is > 1 , this indicates that there is an effect of route on grit. However, the significance value for this test is reported at 0.089 which is > 0.05 which implies that there is no significant relationship between route and grit. In essence, the F value is saying to reject the null hypothesis whilst the significance value is saying to accept the null hypothesis. On closer inspection of these two values, the F value is a lot bigger than 1, whilst the $Sig.$ value is slightly above 0.05. So technically, the $Sig.$ value is not significant however, it could be argued that given such the large F value, that the $Sig.$ value is borderline significant. For that reason, the experimental hypothesis can be accepted i.e. there is a significant relationship between route of entry and grit in learners in Higher Education, $F(3, 220) = 2.201, p > 0.05$.

3.9 Evaluation – Summary of results

The five research questions proposed in this study can all be related back to Vygotsky's sociocultural theory on learning, specifically the sociocultural aspect to his theory which examined the important contributions that society makes to individual development and the interaction between developing people and the culture in which they live.

The five research questions that were originally formulated are:

- Which department has the students with the most (and indeed the least) grit?
- Are age and route of entry important determinant of the learner's tenacity?
- What relationship is there, if any, between year of study and grit?
- Does gender influence the tenacity of the learner?
- Does the level of grit in a learner contribute to progression in Higher Education?

To answer these questions, data from 231 surveys was statistically analysed and the five hypotheses (section 3.8) were tested.

Table 3.18. Summary of results of hypotheses testing.

Hypothesis	Result
I	H ₀ accepted
II	H ₁ accepted
III	H ₀ accepted
IV	H ₁ accepted
V	H ₁ accepted

Table 3.18 summarises the results of the hypothesis testing. The first hypothesis determined the existence of a relationship, if any, between gender and grit. Whilst the average grit score for the males was slightly higher ($M = 3.2571$, $SE = 0.06660$) than the females ($M = 3.2465$, $SE = 0.04472$), this was considered statistically not significant ($t(166) = 0.327$, $p > 0.05$). This means that there is no difference in grit between male and female learners. The next hypothesis examined the relationship between the age of the learner and their grit. The statistics did prove that there was a relationship between age and grit ($F(31, 199) = 1.961$, $p < 0.05$) and the alternative hypothesis was accepted. Ideally, the statistics would have been more

comprehensive and pinpoint exactly what age is grit at an optimum level, or when does grit start to increase/decrease. A limitation of the study must be highlighted here, that the study could not address this query. For meaningful statistics, there should be more than one student at each age, for example there was only one participant who was 57. If more than one student for each year of age responded, more definite conclusions would have been formed.

The next hypothesis tested was that linked grit with the department in which the student was registered. This was to ascertain whether for example science students had more grit than computing students. Here, the null hypothesis can be accepted i.e. there is no significant relationship between department and grit in learners in Higher Education, $F(4, 226) = 0.604$, $p > 0.05$. Having that said, only five departments were surveyed. Ideally, students from all departments within LYIT (N = 10) should have been surveyed to give a better insight, however due to time constraints this was not feasible.

The fourth hypothesis tested the relationship between year of study and grit. Year 1 students had the lowest grit, however, this improved after each subsequent year. In terms of statistics, the difference in grit between the years was significant $F(5, 225) = 6.116$, $p < 0.05$. However, it must be noted that mean grit scores were higher in Access students than first year students. Access students are typically mature students (>23 years) who have either never completed the Leaving Certificate or students who have never been in the third level sector and are wishing to return to education. Anecdotally, it would be assumed that these types of students, i.e. those students who are not forced or coerced into third level as in the case of most CAO first years, are more gritty than the typical first year. Indeed the statistics in this study would prove that that is the case. In fact, the mean grit of Access students (3.1551) is more in line with the mean grit of second years (3.1497).

The results from the final hypothesis testing were somewhat ambiguous and more difficult to interpret. It was clear from the calculated means in Table 3.15 that there was a difference in grit scores between students from different routes of entry. ANOVA was used to determine if this difference was statistically significant. In the end, the experimental hypothesis can be accepted i.e. there is a significant relationship between route of entry and grit in learners in Higher Education, $F(3, 220) = 2.201$, $p > 0.05$. The students that entered through the traditional CAO route had the lowest grit score, whilst the student on the Springboard course had the highest grit score. The only Springboard course whose students were surveyed was the level 9

programme (year 5) and as previously discussed, the higher the level of year, the more gritty the student, which corroborates the previous hypothesis.

Having tested all the data, the original research questions can now be answered.

1. Which department has the students with the most (and indeed the least) grit?

The statistics prove that there is no difference between departments in terms of their student's grit. Having that said, more departments should have been surveyed to substantiate these findings.

2. Are age and route of entry important determinant of the learner's tenacity?

This study has proven that age is a significant factor on grit. The results demonstrated that grit generally increased from 18 to 27, with 18 years being the lowest. Additionally, the route of entry has an impact on grit. Students from the non-traditional routes (mature, Access, Springboard) all scored higher than the traditional CAO students.

3. What relationship is there, if any, between year of study and grit?

There was a substantial correlation between year of study and grit, i.e. the grit scores increased as the year of study increased. There was one exception though, the grit scores of first year students were slightly lower than those of the Access students. After first year there was a statistically significant increase in grit scores as the years increased. Given that the data in this study suggests that a typical 18 year old entering via CAO has the lowest grit, it would make sense that students in first year would also have the lowest grit.

4. Does gender influence the tenacity of the learner?

Whilst the grit scores for male students was slightly higher than those of female students, it was not a statistically significant difference. This is quite a surprising results given the data that were stated in the literature review, where over half (53%) of women aged 25-34 has a third-level qualification compared with nearly four out of ten men (39%) in this age group (CSO 2011). From that data set it would imply that females were grittier than males, but that was not the case in this study.

5. Could the level of grit in a learner contribute to progression in Higher Education?

The statistics cannot directly answer this question. However, given that year of study is positively correlated with grit, i.e. grit increases as year of study increases, it can be assumed

that yes, the grittier student will progress through third level. If the educational management want to improve the levels of progression, then an obvious factor in this is to promote and nurture grit amongst students, especially amongst the first year students. Given that this study identified students in year 1 as those with the least tenacity, an emphases should be made in that year of study on this notion of grit and possibly lecturers should be made more aware and trained on how to stimulate and encourage grit in their first year students. Overall, based on the results of this study, the conclusion that can be made is that an increase in grit will lead to an increase in levels of progression.

3.10 Evaluation – The survey

Advantages to self-reporting methods are that they are easy to administer and provide scores that are easy to interpret. A disadvantage to this type of method is that people do not always assess their own skills appropriately, a limitation which was also outlined in Duckworth *et al* (2007). For example, in the survey, statement 9 reads “I finish whatever I begin”, to which most people scored themselves the highest possible “Very much like me” yet a number of these particular participants did not finish the rest of the survey. This perhaps indicates that these participants actually believe that they finish whatever they begin however this evidence would point to the contrary.

For those participants who did not complete the survey, a score of zero was assigned to those specific statements, which would have lowered their overall grit score. Whilst the majority of the surveys were completed in their entirety, there were three surveys in which the grit surveys were complete but the additional information sheet was incomplete. These surveys were therefore not accounted for. Additionally four students completed the entire survey but did not sign the consent form. Again, these surveys were not accounted for.

Another challenge that presented itself during surveying was the time in the academic calendar. At this period, March/April, lectures tend to be finishing which limits the audience that can be targeted. A better response rate may have been achieved if the surveys were distributed earlier in the academic calendar.

4.0 Conclusions and Recommendations

From the literature review, it has been established that worldwide, grit or ‘agency in learning’ is still only an emerging topic within education and is notably absent within the Irish educational system. Much of the current research is based in the USA with very little undergoing in Europe. Perhaps, if research closer to home was conducted, the importance of this subject may be easier highlighted to educational leaders in this country.

Nationally, there has been a slight change in educational landscape over recent years. Whilst not acknowledging grit, there has been an emphasis on the promotion and nurturing of progression, specifically from second level to third level. The Department of Education and Skills issued a report in 2015 and identified one of their goals as “Improving the transition from school to Higher Education”. To achieve this they are working with the Higher Education Authority, State Examinations Commission, National Council for Curriculum and Assessment and higher education. The acknowledged the pressure to achieve high points from a student’s Leaving Certificate exam results and hopes that the changes being implemented will reduce the pressure to achieve high points for entry to higher education and help to change the ‘learning to the exam’ culture in schools.

Also, the HEA have published two national plans for enhancing equity of access to higher education, namely Achieving Equity of Access to Higher Education in Ireland: Action Plan 2005-2007 and National Plan for Equity of Access to Higher Education 2008-2013. The HEA has recently launched a new National Plan for Equality of Access to Higher Education, 2015-2019, which aims to further “promote access for disadvantaged groups and to put in place coherent pathways from second-level education, from further education and other non-traditional entry routes” (HEA 2015b).

Institutionally, LYIT has included as one of their objectives in the LYIT Strategic Plan 2014-2017 to “develop our student-centred culture and further support students to fulfil their potential; important initiatives will include easing the transition into higher education, encouraging students to take greater responsibility for their own learning, and preparing students for a lifetime of learning” (LYIT 2014). Since the launch of this strategic plan, to the researchers knowledge, no new institute-wide initiatives have been implemented. The tools for

supporting progression have been in place for a number of years. These include induction for first years, Student Services and The Curve Learning Support Unit.

The Curve is a unit within the Department of Business who supports mature students and students with physical or learning difficulties. Staff in The Curve facilitate these possible difficulties that may lead to non-progression by supporting the students with one-to-one tuition, learning support, and assisted technologies. They also have the responsibility of screening all new entrants at the beginning of the academic year for any learning disabilities. This helps identify those students who may need the supplementary support throughout their time at the IT that The Curve provides.

Various initiatives are in place in Department of Science to support progression of students. One of these includes Peer Mentoring. This typically involves a student from third year of a programme mentoring a small group of first years of the same programme. They meet once a week for the first six weeks to discuss any problems or issues that they might be having, either with their course or personally. This was introduced two years ago with an aim to help ease the transition of the students from secondary level to third level.

Another initiative, which is to pilot this year in the various departments, is to timetable revision classes in August for those students in first year who failed exams during the year. This is being facilitated by The Curve and will consist of one day long lessons in specific modules. This aims to improve the pass rate in repeat exams and ultimately improve progression from first year to second year.

Additionally, the Department of Science has student progression meetings early in the academic year. At that stage in the year, conditions assessments have taken place and results recorded and attendances at lectures and laboratory practicals have been recorded. This helps to identify those students early on who may have issues, either personally or academically. The Head of Department then follows up on this meeting with a one-to-one consultation with the student. One common theme that is emerging over the years, is that not all issues are academically related. Students previously have stated reasons such as anxiety, depression and serious health issues for their poor performance. For those students that do have serious personal issues, LYIT provides the Student Services Unit, where counselling services are

available with a trained professional. Also, at the other end of the scale are simpler issues, such as arranging childcare, which requires a simple timetable change to resolve this.

Whilst various initiatives to support student progression at LYIT are heartening to see, little exists to support staff or students in the area of supporting grit. Having established that grit is a major factor in the academic success and progression of a student, the question remains how do you encourage grit in student? Gorman (2015) concluded that the majority of grit is taught at home. That still leaves enough scope for the educators to nurture grit in the students. The internet is abundant with various methods on how to integrate ideas into everyday teaching. However, given the limited time a lecturer has with their students, one-off tasks within the classroom from time to time are not sufficient. There needs to be a deeper, more significant and more lasting change in the way in which the students are taught at third level. One outcome of this study is to encourage the use of a student centred learning approach to teaching in the classroom.

One way in my opinion in which this can be achieved and how eventually grit can be encouraged is by changing the mind-set of the students and creating a more student centred learning environment, an idea which is supported by Farrington *et al* (2012). The first module undertaken for this masters was “Student Centred Learning” at the beginning of which the question was asked “are we, the lecturers, educators or facilitators?” Initially, it was agreed that we were all educators and our role was to teach a specific subject in order for the student to complete the module learning outcomes. However, as the module developed, it was soon clear that if students took ownership of their own learning, that we, the lecturers, are mere facilitators in their learning. This was a new concept to me and changed my outlook on the provision of education within LYIT. Student centred learning is not the traditional ethos in third level institutions, especially LYIT. In order to change the mind-set of the students, the mind-set of the lecturers must be first changed to this new way of thinking.

Supporting educators through continuous provision of additional services is the key concept to obtaining change in mind-set. If the educators are made more aware of the emerging educational concepts via workshops, seminars, conferences and the educators are indeed educated in these concepts, then this mind-set change is more feasible. The new knowledge gained could be filtered down through to their students and thus, in turn, the students can have more agency in their learning.

Future work for research on grit is limitless, however, I feel the following studies are feasible:

1. Within the time frame of this study, not all students were surveyed. Ideally, all the students registered at LYIT would be surveyed. This would give a deeper insight into the grit of the students and overall more significant statistics and meaningful conclusions.
2. An interesting study, if time allowed, would be to survey students at Leaving Cert level during their final year at second level and re-survey them during their first year at third level. This would determine whether their grit score changed from progression to third level and also identify those that did not progress (did those students have low grit?).
3. An additional study relating grit scores to exam results would be interesting. Students prior to taking the Leaving Cert exams should be surveyed and their results obtained should be collated in order to determine if there is any correlation between the two. Indeed, this is not and should not, be limited to Leaving Cert students. Students within third level should also be surveyed and exam results compared.
4. The HEA report in 2016 stated that the rates of non-progression were lowest in Medicine at 2%. Whilst LYIT does not offer Medicine as a programme, students studying Medicine at other third level institutions should be surveyed and their grit scores calculated in order to determine are those students more gritty than others.
5. As prior educational attainment was recognised as a major factor in progression, future questionnaires should include this on the information sheet to determine if there is a relationship between this and grit.

Future work for educators should be focused on encouraging grit in the traditional 18 year old, CAO first year student. This study identified these as the students with the lowest grit score. By targeting these students, grit scores would improve which would result in better progression rates throughout third level.

Future work for the policy makers within the educational system in Ireland should focus on supporting educators for additional learning and training in the developing topics within education research. Grit has emerged and acknowledged as a tool that leads to better academic success in a student. No doubt, there are further concepts that we as educators must be made aware of in order to better prepare our students.

This study provided valuable findings and a greater understanding of academic grit in students in higher level education at LYIT. Using Vygotsky's learning theory to connect grit, student centred learning and progression, and applying the knowledge resulting from this study may lead to greater academic success for the student. The use of student centred learning strategies to encourage grit in the students may improve progression data and facilitate more students to attain advanced academic accomplishments.

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Appendix 1

Please tick the box that best describes how you feel for each question. Be honest – there are no right or wrong answers!

		Very much like me	Mostly like me	Somewhat like me	Not much like me	Not like me at all
1	I have overcome setbacks to conquer an important challenge.					
2	New ideas and projects sometimes distract me from previous (older) ones					
3	My interests change from year to year					
4	Setbacks (delays and obstacles) don't discourage me. I bounce back from disappointments faster than most people					
5	I have been obsessed with a certain idea or project for a short time but later lost interest					
6	I am a hard worker					
7	I often set a goal but later choose to pursue (follow) a different one					
8	I have difficulty maintaining (keeping) my focus on projects that take more than a few months to complete					
9	I finish whatever I begin					
10	I have achieved a goal that took years of work					
11	I become interested in new pursuits every few months					
12	I am diligent (hard working and careful)					

Appendix 2

Information Sheet for Heads of Department

An exploratory study of ‘Grit’ in Higher Education

Who Am I?

My name is Dr. Kim McFadden. I am a student doing the MALT programme at LYIT. I am also a lecturer in the Science Department at the Letterkenny Institute of Technology.

What is the Research About?

The overall aim of my research is to study ‘Agency in Learning’. This philosophy suggests the idea that education is the process through which learners become capable of independent thought which, in turn, forms the basis for self-directed learning. Simply put, the student takes ownership of their own learning. This ownership can be assessed and quantified by measuring ‘Grit’, the more gritty the student is, the more ownership that student has. Grit is an emerging topic within educational research with current research focusing on fostering grit in students. My research aims to contribute to this body of knowledge by comparing grit across year of study, gender and profile (e.g. mature v’s school leaver). It is hoped that this study will provide important information for educators, policy makers and training providers regarding the planning for, implementation and maintenance of quality services within education.

Why Am I Doing the Research?

There is little known about the levels of tenacity that exist among young adults in Higher Education. This is an exploratory study seeking to address this gap and open further research avenues to an area still in its infancy.

How Will I Do the Research?

Participants of this research are required to fill out a 12 point questionnaire. This should take no longer than five minutes. Accompanying this questionnaire will be an information sheet and an informed consent form.

The researcher will print the questionnaires and ask Heads of Department to disseminate amongst their student population, via lecturing staff. The lecturing staff will be provided with an envelope which can be returned with the completed questionnaires sealed to Dr. Kim McFadden.

Rights

Permission for students to be involved in this research will be sought from the Heads of Department and the students themselves.

If one party does not give consent the student(s) will not be involved in the research but will still be able to engage in their usual class activities which will be carried out as usual. As the usual class will still take place it will allow students who do not want to take part in the survey or who wish to withdraw from the study to carry on as normal.

Anybody can withdraw at any time from the study even if they have said yes initially if data analysis has not commenced. Please note that changing your mind will not impact in any way the student or the Department.

The data generated by this study will be used in my dissertation for a Masters of Art in Learning and Teaching, and may also be used in academic papers, journal articles and in future research studies. The information gathered will **not** be used in a way that any student, School or Department could be identified. Students' name will be used in the dissertation, reports, articles or presentations emerging from this research. If you would like to obtain more information about the study then please contact me via the details given below.

All material /data collected, will be kept securely on the researcher's laptop. All collected data will be stored in the School of Business, LYIT for five years after the completion of the research then it will be destroyed securely.

Further Details

For more information please contact me at: kim.mcfadden@lyit.ie

Appendix 3

Consent Form for Heads of Department

An Exploratory study of 'Grit' in Higher Education

This study aims to find out what levels of grit (tenacity) exist among students studying in a Higher Education environment.

Participation in the research is entirely voluntary and department's involvement will only be allowed with your agreement. Student consent will also be required. Only students aged 18 or over will be allowed to take part.

Non-participation in the study will have no adverse impact on any of your future contact with myself, the School of Business or staff involved in the MALT programme at LYIT.

Please tick:

I have read the information sheet which explains the research study []

I understand that all the information my students give will be kept strictly confidential and that my students' name(s) will not be asked for, nor included in any reports []

I understand that my students' participation is voluntary and that I am free to withdraw my consent up to the point of data analysis (April 2016) []

I understand that this research will be published as a dissertation and possibly in academic journals. The research may also be presented at conferences and seminars []

Please sign below.

School/Department name (in CAPITALS): _____

Your name (in CAPITALS): _____

Signature of Head of Department: _____

Date: _____

Please return this form to Dr Kim McFadden within 5 days. Thank you.

Appendix 4

Information Sheet for Students

An exploratory study of ‘Grit’ in Higher Education

Who Am I?

My name is Dr. Kim McFadden. I am a student doing the MALT programme at LYIT. I am also a lecturer in the Science Department at the Letterkenny Institute of Technology.

What is the Research About?

The overall aim of my research is to study ‘Agency in Learning’. This philosophy suggests the idea that education is the process through which learners become capable of independent thought which, in turn, forms the basis for self-directed learning. Simply put, the student takes ownership of their own learning. This ownership can be assessed and quantified by measuring ‘Grit’, the more gritty the student is, the more ownership that student has. Grit is an emerging topic within educational research with current research focusing on fostering grit in students. My research aims to contribute to this body of knowledge by comparing grit across year of study, gender and profile (e.g. mature v’s school leaver). It is hoped that this study will provide important information for educators, policy makers and training providers regarding the planning for, implementation and maintenance of quality services within education.

Why Am I Doing the Research?

There is little known about the levels of tenacity that exist among young adults in Higher Education. This is an exploratory study seeking to address this gap and open further research avenues to an area still in its infancy.

How Will I Do the Research?

Participants of this research are required to fill out a 12 point questionnaire. This should take no longer than five minutes. Accompanying this questionnaire will be an information sheet and an informed consent form.

The researcher will print the questionnaires and ask Heads of Department to disseminate amongst their student population, via lecturing staff. The lecturing staff will be provided with

an envelope which can be returned with the completed questionnaires sealed to Dr. Kim McFadden.

Rights

Permission for students to be involved in this research will be sought from the Heads of Department and the students themselves.

If one party does not give consent the student(s) will not be involved in the research but will still be able to engage in their usual class activities which will be carried out as usual. As the usual class will still take place it will allow students who do not want to take part in the survey or who wish to withdraw from the study to carry on as normal.

Anybody can withdraw at any time from the study even if they have said yes initially if data analysis has not commenced. Please note that changing your mind will not impact in any way the student or the Department.

The data generated by this study will be used in my dissertation for a Masters of Art in Learning and Teaching, and may also be used in academic papers, journal articles and in future research studies. The information gathered will **not** be used in a way that any student, School or Department could be identified. Students' name will be used in the dissertation, reports, articles or presentations emerging from this research. If you would like to obtain more information about the study then please contact me via the details given below.

All material /data collected, will be kept securely on the researcher's laptop. All collected data will be stored in the School of Business, LYIT for five years after the completion of the research then it will be destroyed securely.

Further Details

For more information please contact me at: kim.mcfadden@lyit.ie

Appendix 5

Consent Form for Students

An Exploratory study of ‘Grit’ in Higher Education

The overall aim of my research is to study ‘Agency in Learning’. This philosophy suggests the idea that education is the process through which learners become capable of independent thought which, in turn, forms the basis for self-directed learning. Simply put, the student takes ownership of their own learning. This ownership can be assessed and quantified by measuring ‘Grit’, the more gritty the student is, the more ownership that student has. My research aims to contribute to this body of knowledge by comparing grit across year of study, gender and profile (e.g. mature v’s school leaver).

At no point during the questionnaire will you be asked your name or student number.

Declaration: I _____, acknowledge that:

- I have been informed about the research and have an opportunity to ask questions
- I consent to partake in this study
- My participation is voluntary
- I can withdraw at any time
- I consent to the publication of results
- I am a registered student of Letterkenny Institute of Technology
- I am aged 18 or over

Participant’s Name: _____

Signature (if over 18): _____

Date: _____