



Open Research Online

Citation

McGuinness, Oliver (2021). Investigating the assessment of soft skills development within STEAM based learning. Student dissertation for The Open University module E822 Masters multi-disciplinary dissertation: education, childhood and youth.

URL

<https://oro.open.ac.uk/81180/>

License

(CC-BY-NC-ND 4.0) Creative Commons: Attribution-Noncommercial-No Derivative Works 4.0

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Policy

This document has been downloaded from Open Research Online, The Open University's repository of research publications. This version is being made available in accordance with Open Research Online policies available from [Open Research Online \(ORO\) Policies](#)

Versions

If this document is identified as the Author Accepted Manuscript it is the version after peer review but before type setting, copy editing or publisher branding

Investigating the assessment of soft skills development within STEAM based learning.

A report submitted as the examined component of the project module E822

Oliver McGuinness

Contents

Page 2 - Abstract – (101 words)

Page 2 – 4 - Chapter 1 – Introduction (1074 words)

PART A - Extended Review of the Literature

Page 4 – 11 - Chapter 2 – Literature Review – The topic (3978 words)

Page 11 – 16 - Chapter 3 – Literature Review – The conceptual framework (3218 words)

PART B – The Research Proposal

Page 16 – 17 - Chapter 4 – The Research Proposal (601 words)

Page 17 – 22 - Chapter 5 – The Research Design (2592 words)

Page 22 – 23 Postscript – (496 words)

Page 24 – 28 - References

Page 29 – 33 – Appendix

Page 34 – Ethical appraisal form

TOTAL WORDS – 12,060

Abstract

The development of soft skills has often been discussed within educational stakeholders. Students are qualifying with academic success, but are lacking in skills like communication, resilience and creativity. There has also been a shortage of graduates pursuing careers in engineering or science. These concerns led to the international development of STEAM education. Unlike traditional education, STEAM is project based, student led, cross phase and curriculum, and focuses on soft skill development. Concerns arise when assessing this development. This extended project attempts to summarise current assessment tools available and create a self-assessment tool to be used by STEAM educator for student's development.

Chapter 1 – Introduction

This dissertation will take the form of an EP (Extended Project). The focus for this project will be on STEAM education and how it can provide students with required skills for professional and personal success once they leave education. This project discusses how STEAM can complement traditional education by filling in the gaps that are left behind. It also discusses the concerns that STEAM has due to the lack of having any standardised quantitative assessment strategy for assessing success, and what tools may be utilised to address this.

As the introductory chapter, this section will explain what STEAM is and why it is important. This will be overtly linked to the module themes from the Open University's Masters in Education program (Open University, 2021). Such themes will include drivers for education and learning theories. It will also be linked and related back to my own professional practice. Finally, this section will discuss the reasons why it is important to find an assessment strategy for STEAM.

STEAM (Science, Technology, Engineering, Art/humAnities/Aesthetics/All, Mathematics) has recently become a common part of education internationally, with many schools adapting their curriculum to integrate it (de la Garza. 2019). STEAM has significant differences to traditional education as it does not have a specific curriculum to follow, is student-led, encourages cross-phase and cross-curricular study, and student progress is more difficult to assess. Despite, or possibly due to these differences, STEAM allows the students to develop skills that may have otherwise been missed from a more traditional education system. In this, both STEAM and traditional education can complement each other by filling the gaps that the other misses.

STEAM is the nascent evolution of STEM (Science, Technology, Engineering, Mathematics), which was first introduced by the US National Science Foundation (NSF) in the 1990's (Herranen et al. 2021). STEM originally was developed to address the ongoing low performance of western students of mathematics and science in international assessments, and to encourage students to pursue careers in these fields (Herranen et al. 2021). It gave students a chance to put what they learned in these topics into practice. There was some focus on the development of problem solving and critical thinking in STEM. The skills learnt in STEM education are often valued in non-STEM employment as well (Grinis, 2019).

Investigating the assessment of soft skills development within STEAM based learning EMA – E822

This focus on developing employability skills and confidence in Science and Mathematics based careers suggests that the primary driver towards STEM is financial. This fits into the “human capital” model discussed in OU module EE830 (Robeyns, 2006). In this model, the skills learnt within STEM are considered income-generating abilities used as an investment for a country’s future financial growth. This agrees with current research from technology employers who state that graduates are currently lacking soft skills that STEM/STEAM can help address (Stackpole, 2019). These soft skills will be discussed in more detail in Chapter 2.

As STEM evolved into STEAM, there was also a shift in the driver towards education. Although there is still a clear “human capital” focus, with its potential to provide graduates the skills required for filling employment shortages. There is now more of a focus on global citizenship, such as sustainability and equality, within STEAM (de la Gariza, 2021). This shift suggests that STEAM could now move into another model for education, which more emphasises on emotional and social wellbeing; the “capabilities” model of education (Robeyns, 2006). This focus on global citizenship may become more critical for providing a better future for students as global issues increase.

As the name STEAM suggests, there is a key focus on encouraging students to think further outside of each individual subject (Graham, 2020). By giving the students this opportunity, it allows them to broaden their understanding of the topic outside of what is included within the formal curriculum and therefore makes the students work more relevant to their own interests. This helps develop lifelong learners, who will be better equipped to be able to teach themselves any skills or knowledge needed in the future. This way of learning would be an example of “participatory classroom” discussed in OU module EE830 (Lave and Wenger, 1991). The student decides themselves what information is relevant to their project and what is not required. This is very different to traditional education, where all things taught usually have a chance of being included in an end of course assessment. Allowing the students to have this freedom within specific subjects helps them develop a sense of ownership within their education that may be lacking in other subjects.

This encouragement of going outside of the curriculum and the focus on soft skills development makes the use of traditional assessment methods problematic for quantifying a student’s success within STEAM. Assessment should not be undervalued, as it can be an important part of helping students see where they currently are within their learning journey and how they can progress. Smith (2017) explained that when soft skills like creativity is being assessed, it is easy for the assessor to be less impartial in their marking when compared to assessing subjects like science, where there is a clear mark-scheme. While Beghetto (2005) explained that certain assessment practices, if used incorrectly, can inhibit a student’s creativity within their projects. Assessment of STEAM needs to be used in a way that it provides motivation and useful information on how the student can improve their work. It is important that the assessment technique used should value the uniqueness of each student’s project, while also taking into consideration a student’s individual skills, interests, personal ambition, and growth. If used in this way it can be useful for helping students see their own progress, and this EP endeavors to explore this in more detail. In chapter 2 we will discuss what strategies currently exist and whether they could fulfill these criteria.

This SSI aims to research the following question:

1. What effect does assessment for STEAM-based learning have on student's development of their soft skills?

I have chosen this as I am the STEAM co-ordinator within our school and a member of an international group of STEAM educators in Asia. This question has been a topic of discussion in many of our meetings. I hope that by researching this and conducting an EP, I will have more of an answer to share with my fellow educators in our next meeting and may have the opportunity to conduct the research at a time that COVID no longer affects the student's education.

Chapter 2 – Literature review

This chapter will review recent literature regarding what are some of the current issues that exist in traditional education, in particular “high-stakes exams”, and how STEAM can provide solutions to them. It will be split into four subsections. Section one will focus on these issues. Section two will explore whether STEAM can provide solutions to these issues, while section three will look at what new issues STEAM education brings with it, with a focus on assessment. Section four will analyse what assessment strategies already exist for STEAM.

Issues in education

In England, Wales and Northern Ireland, the current policy for assessing the success of a student's education is demonstrated with the use of high-stakes exams given to the student at particular ages. High-stakes exams refer to any assessment that has a significant impact on the future of the students. GCSE and A Level exams are examples of these. The benefits of these assessments are that they provide a large set of quantitative data, which is easy to analyse (Kaliszewski et al. 2017). How successful assessment is in supporting a student's learning was discussed by James (2006). She explained that there are currently many examples of assessment, in particular the high-stakes exams, that only test a student's ability to memorise facts. A student can give a correct answer for a common question asked in a science exam but may not fully understand why it is correct. In this, assessment does not tap into the conceptual understanding of a subject. James (2006) continues by explaining that assessments would be more beneficial to a student's education if they somehow encouraged students to become lifelong learners. Tan (2020) takes this even further by saying that high-stakes exams neglect self-cultivation and self-transformation. This topic will be discussed further on in the chapter but does suggest that these assessments are not always beneficial to a student's educational or wellbeing development and are simply an easy way to categorise students at key stages of their schooling.

The use of these high-stakes exams can also cause a phenomenon known as *washback*, which was discussed in OU module EE830. Taylor (2005) explained that washback is where teachers adapt their lessons to reflect what will likely be on upcoming assessments. This washback can be positive or negative, depending on how constricting it is to the student's education. Examples of positive washback is increased motivation of students who are preparing for their exam, and clear objectives and outcomes for students to achieve (Qureshi, 2018), but does not allow such opportunity for the students to decide what

information is important to their own personal growth. Cairns (2020) report explained a more negative impact from washback. Many teachers feel the pressure of this exam washback and adapt their lessons accordingly many years in advance to the exam. These teachers know that not only are the students being assessed, but the teacher's professional performances are also being assessed. This may disempower a teacher's agency as teachers can feel forced to follow a very structured curriculum with specific time frames to make sure all students have learnt the full spectrum of the topics that are included on the exam. Most school assessments that are taken before the high-stakes exams are created to mimic those exams instead of finding more creative assessment strategies that could produce deeper and more conceptual thinking. This does not mean that teaching beyond the curriculum is not beneficial for assessment success. Elliot et al. (2011) reported that in the 200 schools and colleges that they surveyed, the mathematics teachers who taught beyond the curriculum gained higher student exam results when compared to those who did not. Over 70% of these teachers believed that deeper teaching should be undertaken if time allows, but it is not clear whether there are other variables that cause the difference between which teachers felt that they had the required additional time and those who did not.

Another benefit considered by high-stakes exams is that they are considered to be a fair and equal way of assessing all students who take them. Cambridge Assessments, who are one of the examination organisations that grade GCSE's, state that their assessments have a significant opportunity to promote equality in education (Cambridge Assessment, 2020). In England, Wales and Northern Ireland, all students are given the same exam paper at the same time regardless of geographical location and each student should have the same opportunity to gain high grades. This was disputed by Stopforth et al. (2021) using 20 years of GCSE grades as evidence. Their results showed a significantly higher risk of students gaining zero GCSE grades A*- C (considered the "good" grades) if they have parents who live in social housing, are in the "wage earning" working class, or do not have an education higher than school level. This inequality has also been researched in the USA by Au (2016) whose research into high-stakes exams found that "Black and Brown" Americans had a much higher rate of low exam grades and "drop-out" rates.

It was mentioned earlier that high-stakes exams have been reported to neglect self-cultivation and self-transformation (Tan, 2020). To demonstrate these traits, students need to develop their *soft skills*. According to Heckman and Kautz (2012), 'soft skills [are] personality traits, goals, motivations, and preferences that are valued in the labor market, in school, and in many other domains.' These soft skills are also an example of a student's emotional strength and intelligence (Succi & Canovi, 2020), and could include leadership, communication, critical thinking, collaboration, and many other skills. One example of a soft skill required for self-development would be *resilience*. This is the ability to make mistakes, learn from them and try again without giving up. This means, in the context of assessments, the students should be able to potentially retake their assessment if they did not gain the grade that they required. This is currently possible in GCSE papers, but Machin et al. (2020) explained that the effect of narrowly failing high-stakes exams can have significant effects on a student's educational performance in later years when compared to those who narrowly passed. Students who were considered to be similar abilities were followed after completing their GCSE exams. Those students that narrowly failed their English GCSE (by

gaining less than a C grade) had higher probability of dropping out of education at aged 18, or not being in either education or employment by 18 years old. This dataset is still somewhat young, and it is possible that these students may later on develop more resilience due to their situation, but in the short term it seems likely that gaining lower GCSE grades does affect a student's resilience in a negative way. Erricker (2014) also found that GCSE assessments affected resilience in her study of students with learning difficulties. She found that these students could demonstrate signs of resilience while working in group classroom environments but became more risk-adverse when working on individual GCSE style exam questions.

Solutions offered by STEAM

In the last subsection it was identified that traditional education does not encourage deep, conceptual understanding and risks disempowering teachers/students by forcing them to follow a specific curriculum with little opportunity to teach/learn outside of the context. It can also encourage a lack of creativity in assessments leading up to the high-stakes exams, and has been said to neglect self-transformation and self-cultivation. The quality of results often reflects social or racial differences as opposed to student ability. This subsection will explore whether STEAM can provide solutions to these issues.

STEAM has been shown to improve conceptual and deep understanding of the subjects covered in some research. Kang (2019) conducted a literature review of six studies, which included analysing 256 papers from schools that provide STEAM education, and the results demonstrated that there is a positive and immediate effect on a student's conceptual understanding. Kang explained that there is currently a lack of long-term data, but in the interviews conducted with college students who underwent STEAM interventions, it does seem that these effects have the potential to be long term. However, there is conflicting data on whether STEAM can have a positive effect on high-stakes exam grades. The media and STEAM organisations often tout that many peer-assessed articles state that STEAM improves student's exam grades (Jacobson, 2018) (Learn It By Art, 2021). Banerjee (2017) concluded that after researching 300 UK schools that have STEAM interventions, the students did not perform any better in their maths GCSE when compared to control data. This contradicts Wahono et al. (2020), who stated that STEAM learning activities had a significant effect on higher-order thinking skills, student motivation and academic success. This contradiction suggests that the quality of these STEAM interventions may not be equal within each report. This will be discussed further in subsection three.

As STEAM does not follow a specific curriculum, it allows teachers and students to focus on attaining information that they feel is relevant to them. This gives more agency to both the teachers and the students. Students feel more responsible for their own learning as they do not have to learn the same information, or the same speed as the rest of their group and can become the group expert on a particular topic. This can encourage students to become lifelong learners. Teachers have more freedom to allow the students to lead their own learning, but still have an opportunity to direct the students into topics that they feel may be relevant to each individual. In Herro and Quigley's (2017) paper, they found after analysing several years' worth of STEAM teacher's professional development data, teachers who were trained to provide STEAM education found that their roles in the classroom

changed from teacher to facilitator. They felt empowered to employ more student-led learning that allowed cross-curricular projects in a way that is not encouraged in traditional education. This conclusion was also supported by Gardner et al. (2019) who explained that teachers trained in STEAM education feel more self-efficacy than those untrained. Interestingly, this report showed the focus teachers did not show any improvement within their own subject knowledge and the benefits of the STEAM training was more on motivation and confidence, which can then be passed onto the students within their class.

As previously mentioned, adding creativity into STEM was one of the foundation decisions for the STEAM evolution. By adding the arts into the more technical subjects it gave students the opportunity to be more creative when trying to solve a problem, allowing them to be better prepared for an uncertain and rapid developing future. Creativity has been deemed a 21st Century skill in Conradty et al. (2020) paper, meaning that it will likely become a critical skill for employees to have in the future. They explained that this creativity found in STEAM improves a student's problem-solving skills, motivation, self-efficacy, while encouraging a deeper learning of the topics. This was additionally supported by Thuneberg et al. (2018) in their enquiry on maths-based STEAM learning for students aged 12-13. The many benefits of including creativity into education is beyond the scope of this report, but further research on this would be recommended.

The inclusion of students with different racial background, gender and social class can be promoted in STEAM. An outline for a potential STEAM project with the use of educational robotics was designed by Plaza et al (2020) for diverse student groups. Their aim was to promote teamwork, leadership, confidence, interaction, inclusion and communication within each group with a focus on encouraging female students to embrace STEAM. Zayyad (2019) also devised a plan for using STEAM to encourage inclusivity of students with learning difficulties to gain a better education. There is currently little research on the success of STEAM as a tool for inclusion. This is likely due to the relatively short age of STEAM. Inclusivity, as a soft skill, is certainly worth focusing on for the EP research design in Chapter 4.

The difference between STEAM and STEM has been discussed in chapter one, but a key feature in STEAM over STEM is that it encourages focusing on emotional development, in the form of soft skills. Having these skills gives the next generation the tools to solve future world problems in creative ways. With the threats of global warming, future pandemics, over-population, and the loss of fossil fuel stocks, it is clear that new and innovative ways of thinking will be needed to solve these issues. Some evidence actually states that the demonstration of soft skills at a young age is actually a better predictor of success than standardized achievement exams (Heckman, 2012). The use of STEAM to develop these soft skills was researched by Widarwati et al. (2021) on a group of 203 Indonesian students in 4th grade learning about Energy Science. The researchers gave the students pre-test and post-test questionnaire to gauge their soft skills before and after the intervention. This small sample size and short-term intervention received a result of "excellent" for the development of the students' soft skills when assessed by the students. This will be discussed further and be another focus of the research design.

The issues with STEAM and why we still need traditional education

STEAM is currently within its infancy in education. It was first proposed in 2013 (Catterall, 2017), so there is still little research available on it. There is still no official universal agreement on what STEAM learning represents. Specific terms have not been decided upon and may have different meanings depending on what researcher is using them. It is still not even 100% clear what the “A” in STEAM represents (Herranen et al. 2021). This has made researching STEAM problematic. White & Delaney (2021) conducted a literature review on 548 research papers to look for evidence-based methodologies demonstrating the successful implementation of a STEAM pedagogy and the success it has shown in improving students’ performance and engagement in school. Out of these 548 articles, only 11 could be included within their report. The majority of the papers did show a strong emphasis on the use of project-based STEAM learning but were excluded from their study due to the lack of evidence for an improvement on the students learning outcomes compared to more traditional pedagogical approaches. The 11 papers that were included in the report demonstrated good evidence that STEAM did result in enhanced motivation within the students and a greater academic success within technical subjects. This lack of research means that it may still be unethical to use STEAM as the main pedagogical technique for a student’s education, due to the risk of it potentially having detrimental effects on their learning. Herranen et al. (2021) considered this lack of research as a sign that the full benefits of STEAM have yet to be discovered or even considered. It is clear that more research is needed to establish what STEAM is and what benefits it can provide.

The project-based and student-led element to STEAM is something already well established and agreed upon within the educational research community (White and Delaney, 2021). As previously mentioned, there is no specific curriculum that has been written for STEAM, which means that students can choose what STEAM topics they wish to research for each project. Concerns with this is that if STEAM was to become the main pedagogical technique for a student’s education, then there is a chance that key educational information could be omitted by the student (Glennie et al. 2016). A student that does not enjoy mathematics could potential avoid it altogether if their only education was STEAM based. For this reason, my belief is that STEAM could never fully replace traditional education. Students will still need to learn the basics of each subject before being able to choose what they would like to utilise.

The use of traditional standardized assessments to map the progress of students’ soft skills development will unlikely be successful to capture what is considered quite subjective skills. They are named soft skills due to the difficulty to establish strictly measurable criteria within them (Succi & Canovi, 2020). One issue with assessing soft skills is that they are susceptible to uneven grading. A teacher may mark give uneven marking simply by completing the work at different times of the day (Smith, 2017). Unlike assessing mathematics and science individually, where there are clear correct and incorrect answers, positive demonstration of soft skills can be very subjective depending on the assessor’s opinions. Biases, human error, weaknesses, and discrepancies are commonplace while assessing these skills. The use of rubrics has been researched to assess the student’s development of soft skills during STEAM based learning (Smith, 2017). They can help generate structure to the assessment process,

but it still does not solve the bias concern. In this, high-stakes exams do offer more opportunity for unbiased grading by assessors (Latifi et al. 2016).

The lack of established learning objectives in STEAM can mean that it may not always be clear for students what they are trying to achieve in their project (Mejias et al. 2020). Within my professional education setting, we emphasise to students that we are more interested in them focusing on their soft skills development over the quality of their finished STEAM project. This can be confusing to the students as it is very different to any other pedagogical approach used in school. They are often unsure what would be considered a successful STEAM project as they are fixated on the final product. One advocate for trying to provide clear learning outcomes and success criteria in education is Hattie (2012). In his book *“Visible Learning for Teachers”*, he stated that *“powerful ways of increasing impact are to share and know both the learning intentions and success criteria of the lesson with students. When students know both, they are more likely to work towards mastering the criteria of success, more likely to know where they are on the trajectory towards this success, and more likely to have a good chance of learning how to monitor and self-regulate their progress”*. Developing a clear set of objectives and success criteria for elements of STEAM will be another focus of the research design.

What assessment strategies exist for STEAM?

As mentioned in Chapter one, assessment should not be undervalued. It is a tool that can help students identify where they are in their learning journey and how they can progress further (Black et al. 2003). It can help teachers reflect on their own teaching craft and identify what teaching strategies have been successful for their students and which have not (Smaill, 2012). It can also assist policy makers in identifying areas of education that still needs support (Ferguson et al. 2017). As previously mentioned in the last subsection, assessing STEAM is problematic due to its focus on soft skills. Even the name “soft skills” suggests skills that are hard to measure or quantify (Succi & Canovi, 2020). In this subsection, the current strategies available for assessing STEAM will be summarised. This includes peer, teacher and self-assessment.

Smith (2017) researched the use of teacher assessment on the soft skill “creativity”, by grading digital graphics portfolios using rubrics. He explained that as each student’s work is unique to themselves, their goals, and their own skill set, then an assessment strategy that can identify these criteria must be used. A rubric was designed that would assist a teacher in their assessment. The hope was that this rubric would assist the teacher to be more subjective in their marking and avoid allowing personal emotions to affect the grades given to each student. This unstandardised marking is likely to be a concern when grading elusive soft skills. Personal feelings about students, the topic focused on and even the time of day are likely to cause some differences in the grading awarded (Tierney, 2013). Blamires and Peterson (2014) also researched assessing creativity and explained that even identifying creativity in the classroom is challenging, let alone assessing it. They decided that the following criteria would demonstrate creativity: questioning and challenging; making connections and seeing relationships; envisaging what might be; exploring ideas, keeping options open; and reflecting critically on ideas, actions, and outcomes. Issues arise as many of these criteria could also be used to identify other soft skills like communication,

resilience, and critical thinking as well as creativity. A description for each soft skill being focused on and how it can be identified is clearly required before an assessment strategy is designed.

Zhang (2012) researched the use of peer assessment on both soft and hard skills in students studying Information Technology (IT) related subjects. He focused on 17 in-demand skills from the IT sector, which included motivation, integrity, creative thinking, resilience, and communication. Zhang (2012) is a clear advocate to the peer assessment movement explained that peer assessment can be a better predictor to success in the first year of university than standardised exams. He did acknowledge that peer assessment is also susceptible to bias caused by emotional attachments. The conclusion of his research was that peer assessment is beneficial in assessing the performance of a team and most data sources within the team gave consistent data but assessing individuals within the team is more problematic to get consistent data from each member of the team. Murray et al. (2018) also researched the use of peer monitoring soft skills in college students studying agriculture. The soft skills that they focused on was leadership, communication, and professionalism. Key definitions were given for each soft skill to avoid confusion. They identified 43 instruments from peer-reviewed articles that could be used by the mentors to assess these skills in their mentees, but none of the 43 were considered perfect as they could not fit within their chosen age group, or subject studied. Their summary was that further research was required due to there being a gap in the literature for mentor peer assessment tools focusing on agricultural science. This form of peer assessment, using a mentor to assess a mentees soft skill development over a long period of time is an area with potential for STEAM. It would allow older students to mentor their younger peers, which is something recommended in STEAM (Catterall, 2017). Further research on this would be recommended.

The final assessment strategy to consider after peer and teacher would be self-assessment. Nikolaou et al. (2019) developed a same-based self-assessment strategy focusing on adaptability, flexibility, resilience and decision making. Interestingly, their results showed that the use of the self-assessment tool did not provide evidence on soft skills development, but did show that students who participated scored higher in high-stakes standardised exams. This contradicts Banerjee's (2017) research previously mentioned in this chapter, which stated that STEAM education and focusing on soft skills had no effect on high-stakes exam scores. Nikolaou et al. (2019) use of "gamification" for self-assessment is an interesting idea and would be worth exploring in further research.

Hattie (2017) conducted a well-known research project on the effect sizes related to the success of student's achievement using over 150 educational strategies currently in use. Within his list, he found self-reported grade to have the strongest effect on achievement, with teacher's assessment as a close second. Feedback from peers was also in the top ten strategies. This would suggest that each assessment strategy would be beneficial to student development, but self-assessment is currently considered the best and will be utilised in chapter four in the research design for soft skills assessment.

This chapter has discussed current concerns that exist in traditional education, in particular "high-stakes" exams. It has discussed how STEAM could potentially resolve these issues.

Further concerns with utilizing STEAM into education has also been discussed, and current assessment tools that could be used to assess STEAM was summarised. Concerns with assessing STEAM and providing a clear set of objectives and success criteria has been introduced in this chapter and will be explored further later in this report.

Chapter 3 – Conceptual understanding

In the last chapter, several different research papers were referenced that discussed soft skills and how to assess them, such as Zhang's (2012) research on the use of peer assessment, Smith's (2017) alternative look on teacher assessment, and Nikolaou's et al. (2019) research on self-assessment. This chapter will analyse and compare what ontological approach is used by each of these researchers, in addition to the ontological approach used in the traditional high-stakes exam approach to assessment. The epistemological approach used in these different assessment styles will then be discussed. The paradigms that are best suited to this are positivism, post-positivism, and interpretivism. Finally, the methodological approach used by each researcher will then be discussed. This information will be used in Chapter 4 to decide what position will be used for this EP's research design.

Ontology

Ontology asks, "what is the nature of reality?" (Open University, 2020). The word itself come from the Greek words "Onto", meaning existence, and "logia", meaning science or study. In a basic sense, it asks the question "what exists?" (Hofweber, 2021). Within the context of STEAM assessment ontology can take an *interpretivist* approach, which questions whether reality exists within the mind of the student being assessed. In this situation, reality is subject to change depending on a myriad of variables, including emotional and physical state at the time of the subjects. An example of this would be the famous work of Freud (1923) and his study on the unconscious mind. Ontology can alternatively take a *positivist* approach, which suggests that reality exists outside of the student and therefore no internal variables will affect the result given. Positivism follows the approach used in the natural sciences, where the researcher chooses a dependent and independent variable, which controlling all other variables to prove that any trends identified must be a result of the changing independent variable. This subsection will show that such a binary position is not always appropriate. A sliding scale within a spectrum with positivism on one side and interpretivism on the other, where a researcher can position themselves with varying amounts of either paradigm is more appropriate to find strategies for assessing soft skills. This sub-section will discuss where on the ontological paradigm spectrum each different assessment strategy could be placed.

High stakes exams would be a good example of an assessment strategy that follows the positivistic paradigm for ontology. It is considered that if any student works hard, studies well and has good teachers, then they will achieve high grades. Examination organisations like Cambridge (Cambridge Assessment, 2021) and Edexcel (Pearson, 2021) work hard to try to be sure that every year of exams are equal and fair. Grade boundaries are only given for the exam once the examination has taken place. This allows them to calibrate each exam to the number of students achieving each grade, and no exam could be considered more

difficult to another. Ideally, it should not matter what questions are asked on subject exam as each student should always receive the same grade for any assessment taken at that time. In this, the reality of the assessment is static and reliant on student's study time and teacher quality. As study time and teacher quality increases, the grade awarded will also increase.

Unlike high-stakes exams, teacher-assessment of soft skills would follow an interpretivist paradigm. In Smith's (2017) research, he explained that assessment of creativity needs to accept that each student's work will be unique to the student and the assessment strategy used also needs to embrace the uniqueness of each project. He accepted that human error and weakness will affect the assessment of the students and teachers may grade differently depending on many factors including personal preference of the student at the time of grading, emotional wellbeing, and even time of day. This was his reason for developing a grading rubric to try to avoid this bias. The ontological approach taken here was that reality is subjective and changing depending on many variables, which follows the interpretivist paradigm (Open University, 2020). He accepted that this is not the best paradigm for assessment grading though. Assessment by design should be objective, fair, and unbiased, similar to the high-stakes exam strategy. Therefore, his rubric was designed to try to set some rules and push the paradigm closer towards a positivist approach.

The use of peer assessment for soft skills development would shift the paradigm closer to positivism, provided that the data received by each of the peers does follow a trend. The conclusion of Zhang's (2012) research on peer assessment was that each data source within the team gave consistent results about the team's soft skills performance and that this was beneficial towards the development of soft skills. Interestingly though this was not the case when peer assessment was used for individual members of the group. Agreeing with Smith's (2017) research, it was stated that bias between peers was a likely concern. This research has provided a very interesting ontological paradigm, as individually there seems to be no ultimate truth and each peer may have different opinions on the assessment of the soft skills in the student in question. Once individuals are placed together into a group then an objective truth is observed within the soft skills development seen within the group. This means on the individual assessment, the ontological approach would be interpretivist, but once the individuals are working together in a team, the ontological approach shifts towards a more positivistic paradigm. One cannot help considering that this is similar to the radioactive decay of unstable particles seen in atomic physics (Open University, 2008). An observer cannot know the specific time that an atom may decay, but if the group is large enough the observer can know the percentage of decayed atoms expected at specific times. As a group gets larger the data will be more precise.

Within Nikolaou's et al. (2019) results that self-assessment of soft skills did not seem to benefit the development of them but did have a positive impact on the students' performance in high stakes exams, two ontological approaches can be considered, depending on the focus. If the focal point is the performance of the student within the high stakes exam, then a positivist paradigm would be seen. By using self-assessment strategies, a positive relationship is observed with the students' performance in these high stakes exams and therefore the truth is fixed, although a reason why this relationship could exist was not discussed. Whereas, if the focal point is the development of the students soft skills,

then a hard interpretivist approach is seen due to no observable relationship being identified. It would be interesting if another research project was conducted similar to Zhang's (2012) project, whether a group of students self-assessing their team would provide more objective data.

Considering all of these research papers, it seems that they all agree that the assessment of soft skills is subjective and sensitive to a myriad of variables, therefore as seen by Zhang (2012), Smith (2017) and Nikolaou et al. (2019) the reality would fit within the interpretivist paradigm side of the spectrum. Issues arise with this situation, as the whole point of assessments (particularly those providing quantitative data) is that it should be objective, fixed, and not sensitive to too many variables, similar to the traditional high stakes exam strategy. To be able to better improve these assessment strategies it would be beneficial to find tools that allow the researcher to make reality more fixed, and therefore move their ontological position within their research as far into the positivist paradigm as possible. This will be the approach taken in Chapter 4.

Epistemology

Epistemology focuses more on the observer and the reality observed (Corbetta, 2011). It asks, "what is the nature of knowledge?" (Open University, 2020). This word is made up from two Greek words; episteme, which means knowledge or understanding; and logia, which means study or science. It is concerned with how a researcher can gain knowledge of social reality (Grix, 2002). What set of rules must be used to gain this knowledge? Again, the two paradigms positivism and interpretivism will be used here. Positivism is focused on methods that advocate natural science methods of research, while interpretivism states that natural science and people are too different to use the same methods. This subsection will look at each paradigm in turn and analyse where each researcher from the previous subsection stands. A third paradigm, *post-positivism*, will also be introduced in this subsection,

The epistemological approach to high stakes exams, by default, clearly needs to fall into the *positivist* paradigm. An exam is set, with a clear mark scheme. A grade is determined depending on the amount of marks the student gets. The grade should reflect the students hard work and understanding of the course that they took. Once again, organisations like Cambridge Examinations (CAIE, 2021) and Edexcel (Pearson, 2021) work very hard to try to minimize any error margins for grading. To avoid bias, examiners are not permitted to mark any students that they personally know and if they find that they are marking an exam from a known student, they are required to inform their team leader that there is a conflict of interest. A percentage of exams are double graded to be sure that both examiners gave the same grade, and if an examiner is found to have incorrect grading, they are removed from live marking for either training, or dismissal. Any conflicting data found on an assessment is considered to be the fault of the examiner and not with the method. It is clear that Cambridge Examinations and Edexcel work very hard to keep their epistemological approach positivist with minimal room for error. It is much more problematic to do this when assessing soft skills, but researchers have been experimenting with more positivistic approaches to epistemology. In the example of teacher-assessed soft skills, Smith (2017) designed a rubric to use for assessing the students work. The rubric had a 6-point learning

outcome system, with 1 indicating a lack of basic ability and 6 being the level expected from university graduates. The outcomes were designed to identify key points within soft skills development. Similarly, Zhang (2012) designed a peer assessment scale to be used by students assessing the use of soft skills in other members of their group. He explained that the use of traditional forms of assessment is unlikely to work when focusing on soft skills (multiple choice and written exams), so a 5-point scale was designed focusing on seven different soft skills. Both Smith (2017) and Zhang (2012) explained that there are significant concerns with both of their assessment strategies, caused by the emotional and social attachments that students or teachers may have with the students affecting their grading. Despite the data in Zhang's (2012) research not being consistent, the tools used do follow a positivistic paradigm, due to their qualitative nature and the fact that they were designed to be used for comparison between different assessors. Nikolaou's et al. (2019) also used a 5 point scale rubric for students to self-assess their current ability level, and a series of cognitive tasks to assess a student's abilities, among other tests. Once again, quantitative data was collected on individuals. All these researchers seem to be following a positivistic paradigm within the data collection methods discussed, as the results collected will be quantitative. Simply by using a rubric or an assessment scale, the researchers are aiming at collecting standardized, non-biased data. However, many of the researchers also used different tools of data collection during their projects.

All the researchers mentioned in this chapter seem to accept that there is a need to accept the interpretivist epistemological paradigm within their research. In Smith's (2017) research, it is expected that additional qualitative feedback notes would also be provided for the student along with the graded rubric. Clearly the researcher is expecting some objectivism, or they would not ask for qualitative data to compare with the quantitative data collected from the rubric. The game-based design assessment used by Nikolaou's et al. (2019) asked students to play on a computer role-playing game. The way that the student played would inform the researcher about their current level of soft skills. This is different to Smith's (2012) approach to qualitative data collection as the source of data is coming from the researchers interpretation instead of the students. The additional request for qualitative feedback at the end of Zhang's (2012) research also suggests that the quantitative is not enough to fully understand the knowledge gained. Another technique for data collection would be in the use of journals, as utilised by Vogler (2018). This would allow students to collect data on themselves real-time during the project. Data collection in the form of interviews, feedback, journal entries or observations does suggest an interpretivist approach to research.

In the previous two paragraphs, it has been argued that each researcher has elements of both positivism and interpretivism within their epistemological position. At this stage it might be beneficial to introduce a third epistemological approach. Post-positivism is a belief that the world is objective but that it is also too complex for a researcher to fully understand (Groff, 2004). An example of this would be Giraldo's (2020) self-categorized post-positivistic research on language assessment literacy. He explained that post-positivism is more grounded on understanding probabilities, instead of overall truths. The concerns raised in this research on the assessment of language certainly resonated with the challenges of assessing soft skills development with STEAM projects, with an overreliance on traditional assessment methods that do not effectively capture the use of creativity in the students

work. Giraldo (2020) continued by explaining that interviews are not fit for purpose in a positivistic research project on literacy assessment due to excessive variables, but a post-positivist view does allow these. The use of such varied forms of different data collection techniques by Nikolaou's et al. (2019) does suggest that the researcher believes that one technique cannot give a complete picture. It seems to follow the post-positivist paradigm, by utilizing several different assessment techniques to collect quantitative data, as one alone is not sufficient. The data collection techniques used by both Smith (2017) and Zhang (2012) seemed to follow the same design. They both used a rubric or a sliding scale to collect their quantitative data, and then supplemented this using feedback and interviews. The use of these two approaches does suggest that the researchers believe that the world is objective, but that the quantitative data is not enough to fully understand the knowledge gained. This suggests that, like Giraldo (2020), the researchers are following a post-positivist epistemological paradigm.

It seems that the common epistemological approach here is post-positivist. This does make sense, as quantitative data collected with assessment that is not standardised to give equal, consistent and fair data is unlikely to be worthwhile. Concerns arise due to the subjective nature of soft skills, and whether it is actually possible to objectively assess them. The expression "beauty is in the eye of the beholder" gives a good example of the fact that creativity can be perceived in different ways depending on the observer. At this stage it is important to consider whether the use of assessment should be for collecting comparable quantitative data, or whether it would be better simply to provide qualitative opinionated feedback to help guide a student in improving their work. The epistemological approach for both of these situations are different. If an assessor is giving personalized and subjective feedback, then the epistemological paradigm could be either interpretivist or post-positivist, depending on the researcher's view of the results. It is not fully understood why, but simply giving opinions about the student's work is beneficial. Sedikides, Luke and Hepper (2016) researched the benefits of students receiving enhancing subjective feedback after completing a computer based project. The results showed an improvement in the student's optimism, self-esteem, perceived abilities, and resilience, regardless of what the teacher suggested to improve in their project. This is similar to Zhang's (2012) explanation that simply the process of peer assessment helped the students develop their soft skills. Remembering that the prime reason for education is to allow students to develop, then it would seem a waste to not include this subjective feedback within any STEAM assessment strategy used. It is possible that the simple act of trying to assess soft skill development itself is beneficial to the development, and this process of trying to assess is actually more important than the data it provides for successful development. This will be considered further in the methodology in this chapter and the research design in Chapter 4.

Methodology

This part of the research design asks how we can study the social reality (Corbetta, 2011). It is focused on the ways used to acquire the knowledge described by both the ontological and epistemological approach decided. It is focused on identifying what limitations or potential a procedure may provide for the research (Grix, 2002). This subsection will once again use the positivist, post-positivist and interpretivist paradigms.

In methodology, the positivist paradigm uses scientific methods for study. There is a clear dependent and independent variable, and all other variables are controlled. It aims to prove a particular hypothesis. Within the social sciences, this research design is known as Experimental (Open University, 2021). The use of Randomised Control Trials (RCT) can further extend the research into the positivist paradigm by minimizing any unintentional bias or interference by researchers (Cohen et al. 2017). Although this was disputed by Bonell et al. (2018) who argued that RCT's cannot be fully positivist and would fit more into the more post-positivist view of "realism". In any case, the use of RCT certainly helps move the research further away from the interpretivist side.

The post-positivist paradigm, believing that despite the world being objective it is still too complicated to fully understand, focuses more on trying to disprove a hypothesis as this is more possible than proving one. It still uses the same tools and procedures as *Experimental Design*, but with additional tools included. The *Case Study* methodology is likely to be suitable here, as the researcher can produce a hypothesis and try to disprove it with the use of a case. A Case Study is "the study of the particular and complexity of a single case, coming to understand its activity within important circumstances" (Stake, 1995).

The final paradigm is interpretivist, which focuses on trying to understand the views of the focal group through communication and interaction (Open University, 2021). The research design found to be the best suited for this would be Ethnography, which would allow the researchers previous knowledge of their student's ability, understanding and culture to help assess their soft skills development (Cohen et al. 2017).

Once again, it seems that the best approach to the research of soft skills in STEAM would be using the post-positivist Case Study approach. This approach would allow the research to still use tools provided by both Experimental and Ethnographical design in their studies. Additionally, it was mentioned in the previous subsection that the act of assessment may actually be more important towards the development of a student's soft skills than the data that it provides. A Case Study approach will allow this interesting consideration to be given more attention.

Chapter 4 – Research proposal

As explained in Chapter 2, the criteria for a successful STEAM project are not on providing a completed project, but on the development of a student's soft skills. A team of students may not complete their STEAM project to the level that they want, but if they developed their soft skills, then the project can be seen as a success. Unfortunately assessing soft skills is problematic. Traditional assessment cannot accurately measure soft skill development (Zhang, 2012). In this and the succeeding chapter 5, we will attempt to design a research tool to assess a student's soft skills development during STEAM projects.

Initially, this research was titled "Collecting quantitative data on the development of soft skills through STEAM-based learning in Secondary school students" (McGuinness, 2020). This was likely related to my background as a natural scientist and a personal view that finding a positivistic approach to quantitative assessment is required. Over this academic year my understanding of other paradigms developed. This led to accepting that assessment

of soft skills cannot ignore the reality formed within the student's perception of success. This made this research evolve to accept and embrace the interpretivist side of soft skills. Articles such as Bonell et al. (2018) questioning whether RCT's are truly positivist, plus Zhang (2012) and James (2017) acceptance that soft skills assessment cannot ignore bias and subjective grading made this research question whether quantitative data would be accurate, comparable or even useful. Eventually it was decided that quantitative data could still be collected, but it would also require qualitative data to better understand the reasons why students graded themselves where they did. Reading the works of Vogler (2018) and Barak (2012) whom both argued that the process of reflecting in itself is beneficial for learning development, also evolved this research. It was decided that simply the process of trying to self-assess using quantitative data would be beneficial to the student's development as it encouraged reflection within these skills. The act of developing soft skill by reflecting on them was decided to be more important than collecting accurate quantitative data.

The final research question was already stated in Chapter 1.

Research design

Students will conduct a STEAM project. They will be told what the learning objectives are before starting the project, and how the focus of development is on soft skills. They will be given a rubric (Appendix 1) with clear success criteria for different stages of development within the soft skills to allow self-assessment of their current level. Interviews will be conducted at the end of the project. The soft skills that will be focused on will be resilience and creativity. This is not a complete spectrum of soft skills that are developed in STEAM, but to focus on all of them would be beyond the scope of this investigation. These skills are two of the nine chosen by a team of educators from several of the schools within our group and staff at Massachusetts Institute of Technology (MIT, 2021) during a series of meetings while developing our STEAM program. Their inspiration for choosing these skills was the work of Seymour Papert's *constructionism* and Jean Piaget *constructivism*. Additionally, previous research was found during the literature review section of this report on the assessment of both creativity (Smith, 2017) and resilience (Quinlan et al. 2016), which would be beneficial in the design of this EP. Having two soft skills assessed would also allow comparison.

This research also changed from a Small-Scale Investigation to an Extended Project in the last month due to COVID restrictions within the school and fears on how this would affect the data collected.

Chapter 5 – Research design

This chapter will discuss the setting of the research, ethical considerations, the epistemological and ontological stance, and how the data can be analysed.

Research setting

Investigating the assessment of soft skills development within STEAM based learning EMA – E822

The school where this research will take place is an international school in Southeast Asia. The school is small with less than 100 students in the Secondary Department. Students are a mix of children from affluent local families and expat communities. The school is very inclusive and has a high volume of students with special educational needs. It is single form entry, so there is no division of classes using ability grouping. Despite this, there is a strong culture of achieving high grades from both the students and the parents.

The research group will be the students in Year 9. This year group was chosen for ethical reasons as it is the oldest year group that has not started any high-stakes exam courses (IGCSE or A level). They will be given a STEAM project to work on for 2 days in groups of three. There are currently 16 students in Year 9 and will be divided up into random groups of no more than three students in each group, and no less than two. The number three was chosen from personal experience that if students are in larger groups, often one student will not do as much work as the rest of their team.

The project design will be one provided by Massachusetts Institute of Technology (MIT, 2021). This project was chosen due to MIT's reputation on supplying quality STEAM educational projects. The name of this project is "The Curiosity Challenge". Students simply need to research anything that they are curious about and then share their findings to their peers in the most creative way. Teacher intervention will be minimal, but students will be expected to show their progress at key points to be sure that they are keeping on task.

It is recommended that this project is conducted during week 5 of the first academic term. This has been chosen as there will be less student "burn-out" which is a typical situation experienced at the end of the academic year (Edutopia, 2014). Students and teachers will be less concerned about upcoming end-of-year assessments if the research is done at the beginning of the year. Week 5 was chosen to allow any administrative work that may need completing for the first 4 weeks to be done. Additionally, it allows enough time for the students to acclimatise to their new year group.

Ethical considerations

The age group of the students was chosen to avoid giving any additional workloads or burdens to students preparing for high-stakes exams. Written consents will be given to all students and parents who will be involved in this research (appendix 2). The principal, Head of Secondary and the research Gatekeeper will also provide written consent. All stakeholders will be informed that they could withdraw from the research at any time that they choose. As this research was designed to fit into classroom activities, students who opted out of the research or did not return written consent were still allowed to join in the STEAM projects.

Students with SEN status will need to be provided the information about the research in a way that they can understand. Parents and gatekeeper participation during the explanation of the research would be strongly recommended. Any students that either the researcher, parent or gatekeeper deems as not fully understanding the research will not be permitted to participate.

Research design

The ontological approach that will be taken in this research is *positivistic* (Open University, 2020). It is considered that by providing STEAM education, the student will develop their soft skills, or at least believe that they are. This is following the ontological *objectivist* paradigm. Grix (2002) stated that objectivism is “an ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors” (pg 177). As STEAM is focused on student-led projects, it would make more sense that the students would be the best for knowing how successful they have been within their plans. This may suggest that reality is formed inside of a student’s mind, which does contradict the positivistic paradigm and move closer towards the interpretivist by stating that the human behavior and experiences can affect the data. This research cannot ignore the idea that a student’s mind creates the reality needed to assess their soft skills development but will take the stance that this is only possible when being provided with the correct tools provided from STEAM education. Therefore, the act of participating in a STEAM project has a stronger influence on the assessment grade than the student’s perception does. A *post-positivistic* epistemological approach would be a better solution in this situation, which would allow additional research to provide qualitative data on how the students felt about their own skills development

The use of self-assessment does contradict suggested STEAM assessments from articles that have already been mentioned in this report. Smith (2017) researched using an instructor/teacher to assess the student’s creativity, while Zhang (2012) believed that peer assessment would be most beneficial. The objective of this report is not to disagree with these researchers, but to simply provide an additional assessment tool that may also be useful to the STEAM educator. It is hoped that the act of students self-reflecting on their STEAM work may also be motivational for them and give them more direction in future projects by allowing them to self-regulate their learning.

Both Smith (2017) and Zhang (2012) recommended the use of a rubric in assessing soft skills. The use of a rubric will be helpful to minimize reliability issues raised from the emotional effect caused by self-assessment. It is possible that students may be biased towards their own development, depending on their own positive or negative self-beliefs. They may also not have the same level of understanding about soft skills as their peers or teacher. The use of a rubric may help reduce these concerns by creating structure and clarity for the assessment of soft skills with clear success criteria and expected outcomes (appendix 1). Fletcher (2021) researched the use of rubrics for self-assessment in Australian students’ literacy and numeracy development. Results showed that rubrics have potential to be a powerful self-assessment tool to provide student-centred formative feedback. Although Fletcher (2021) suggested that this tool should be used in combination with teacher assessed feedback. Further research would be recommended on the use of both strategies used together. The rubric suggested for use can be found in the appendices section below.

This rubric should be given to the students before they start the STEAM activity, so that the success criteria is clear from the beginning. This is particularly important in STEAM, due to the possibility of confusion on what skills they are focusing on. The students can reflect on where they are within their learning journey at key points during the project. In Fletcher’s (2021)

paper, she designed a self-assessment sheet that was to be used at the beginning, the middle, and the end of the project. This would allow the students to plan what soft skills they wish to work on, assess themselves during the project if they are making the correct amount of progress, and then reflect at the end on whether they successfully made the correct progress. This will provide the quantitative data for this EP.

A control group would also be required to compare the data with (Allen, 2017). This control group will include students from the same age group and school. They will also receive the rubric at the end of the STEAM activity but will not have access to it before. The division of students into focus and control group will be done randomly. It is expected that the group that is provided the rubric before the STEAM activity will have a clearer understanding of the skills that need to be developed and therefore will focus on this more during the activity. The results expected are that both groups should show development of their soft skills, but the group that are provided the rubric before the activity should show an overall higher improvement. This will be evident on their self-assessment placing within the rubric at the end.

Concerns with using a self-assessment rubric to provide quantitative data is that each student may have a different idea on what development evidence would demonstrate each level on the rubric (Andrade, 2008). Standardisation for each level on the rubric will be problematic due to each student having their own calibration believe on what work would be considered acceptable for each level. Many other variables could affect where they score themselves, including time of day, confidence levels, and perceived teacher/peer opinions on their work (Smith, 2017). Unfortunately, this is unavoidable, but does suggest that another form of data collection would be beneficial to better understand each individual score provided by the students.

As this research does accept that the students will be using their own reality to assess their progress, it is possible that quantitative data may not be enough to provide a full picture of their beliefs (Zhang, 2012). For this reason, interviews will also be conducted (appendix 3) with all participating students to better understand how they graded themselves, what evidence they used for grading, if they felt that the STEAM project helped develop their soft skills, and whether they felt getting a rubric before the project was/would have been beneficial to the development.

The collection of both quantitative and qualitative data means that a mixed method research (MMR) design would be required here. The qualitative data can be used to help understand why the student graded themselves where they did on the rubric. In this, both the qualitative and quantitative data is equally important. The student will initially provide the quantitative data and then explain their qualitative reasons for scoring themselves where they did and whether a change in the STEAM intervention might benefit their quantitative score. This stance of MMR is *dialectic* (Creswell, 2010) meaning that each data type is equally important and useful insights can be obtained by comparing them.

Clearly, one of the research designs being used in this MMR is *experimental*. There is an independent variable (when the student receives the rubric) and a dependent variable (the score given by the student on the rubric). Experimental research design is considered the gold

standard of designs due to its demonstration of causality (Cohen et al. 2017), although this could be disputed with the acceptance of the interpretivist slant within the grading. The use of RCT does cause ethical considerations though that the students in the control group may not receive the same opportunity for development than the focus group. It would be recommended that the control group has the same opportunity as the focus group in later STEAM projects. The other consideration is that human emotion is too difficult to control and will certainly affect their self-assessed grades. This means that another research design is required to help understand why the students graded themselves the way they did.

The other research design that will be used to collect the qualitative data is *case study*. Students will be interviewed after completing their self-assessments. This allows for a rich and vivid description of how the students decided on their grading. Case studies accepts that there are many variables that affect a person's reality and allows them to describe this in their own words. The data can still demonstrate a cause and effect and will certainly complement the quantitative data to help provide valid insights. The type of case study that will be used is *evaluative* (Cohen et al. 2017), which will allow the interviewees to explain and judge both their own grading and the benefits of the rubric intervention. Concerns may arise if their perception does not match the qualitative data provided from the experimental design but could lead to interesting and unexpected insights.

The time and setting that the interview takes place is very important for the student to feel relaxed and ready to share their experience (Marvasti & Freie, 2017). Interviews will take place within 24 hours of the students grading themselves. This will avoid the students forgetting key information. They will be conducted in a classroom with a "do not disturb" sign outside to avoid any interruptions. It was considered that the interviews could happen in my office, but the classroom was deemed a more sensible choice for safeguarding reasons. The classroom has very large windows and people passing by will easily see, but not hear the interviewer/interviewee, which is beneficial for safeguarding both parties. Also, students may feel more comfortable in a familiar environment. Interviews will be audio recorded to allow better analysis. For safeguarding and data security, names should not be mentioned during the recording. A number system will be used to identify each student interview with their prospective rubric results. Interviews will be very open ended and simply ask why they scored themselves where they did, what evidence did they use, and did they feel it was/would have been beneficial to see the rubric before conducting the project.

Personal information about the students will also need to be collected. This will include gender, SEN status, financial status, and ethnic group. This will allow an analysis on whether STEAM can be used as a tool for inclusion, and if there are any trends with specific groups scoring themselves lower than other groups. This may cause an ethical consideration as some students or parents may not wish this information divulged. Parents will be reassured that all data will be held in confidence but will be offered an opportunity to opt out of providing this information. As the gatekeeper's key role is mediating the relationship between children and researcher (Collins et al. 2016), a discussion with the gatekeeper will be required to decide how the data can be kept safe and secure. Initially, the data will be written on paper. This paper can then be stored in my office inside a locked cabinet. The data can then be uploaded onto a secure cloud server, but without providing names to the students and simply numbering them. A personal cloud server would be safer than using the

school's business one, as certain key people may automatically have access to anything uploaded onto the school's cloud.

The first step in analysing the data will be to listen to the interviews, while checking the grading rubric and see if there are any anomalies or trends in the results when interview notes and rubric grading is compared (Burton & Bartlett, 2005). An example may be that a student is very unhappy with their resilience but graded it very high. Anomalous results will be removed from the quantitative data but can still be used for the qualitative analysis. Next, the quantitative data could be compared with personal information to see if there are any positive or negative trends relating to gender or minority groups. Finally, an analysis of the interviews would be conducted to see whether students felt that STEAM did benefit their soft skills development or not.

In this chapter, a research design for assessing STEAM was proposed. The school setting was explained, and ethical considerations was discussed. It was decided that an MMR design using both experimental and case study would be the best solution for this research. Ways of keeping data safe and confidential both online and physically was also reviewed. Finally, analysis of both qualitative and quantitative data was recommended.

Postscript – Narrative critical reflection

This university module has been successful in developing my understanding of research skills outside of traditional scientific methods with a positivist paradigm approach. My academic and professional background for the last 10 years was natural sciences before working in education. During that time, it was critical that none of the data collected was subjective. This was strictly enforced, and certainly had a residual effect on my perception of research in the social sciences during my masters study.

The first time I realised that there were other paradigms that researchers can use was in module EE831 – Unit 10. Here I was introduced to *interpretivism*. My initial consideration was that this was something to be avoided within research. I felt that it was too susceptible to bias, emotion, and (not surprisingly) interpretation. This was not data that I felt would ever be useful within the scientific community.

My initial choice of research in Module E822 was to find a way to quantify the development of soft skills within STEAM. This, again, demonstrated my personal view that anything interpretive needs to be assessed positivistically. This started to change as I realised that there was no way I could collect truly standardised data on a person's level within their soft skills development. What one person may consider a grade "1", another person could just as likely grade it at "2" or "3". This realization was the start for me to accept the need for interpretivism within my research.

My understanding was that interpretivism can be used to understand how a person feels emotionally about a topic. Within soft skills, this may be the most important element for development. If a person believes that they are a good communicator, then the simple fact that they believe it can be what makes them good at communicating. The same could be

said for both resilience and creativity. Additionally, the student themselves will likely know their top level of soft skills better than anybody else, as they are the ones inside their own head. When I considered this argument, I started to not only accept the need for interpretivism, but even embrace it as a required tool for soft skills development.

Another area that I felt I developed well in this module was my critical writing. Very early in the module after TMA01, my tutor recommended that I start to utilise PEEL paragraphs in my work. In a feedback session, my tutor explained that there are different types of PEEL sentences that can be used, depending on what educational level you are on. He explained that at masters, we are most concerned with the “evaluative” part. He continued to explain that this would require at least two articles to cite and compare within each paragraph. This instruction was incredibly helpful to move my writing away from being descriptive and closer into the critical writing required, and the process of evaluating also helped me gain a better understanding of the concepts described in each article.

References

- Andrade, H. L., Du, Y. and Wang, X. (2008) 'Putting Rubrics to the Test: The Effect of a Model, Criteria Generation, and Rubric-Referenced Self-Assessment on Elementary School Students' Writing'; *Educational measurement, issues and practice*; 27(2); pp. 3–13
- Allen, M. (2017) 'The sage encyclopedia of communication research methods (Vols. 1-4)' Thousand Oaks; CA: SAGE Publications; Inc
- Au, W. (2016) 'Meritocracy 2.0: High-Stakes, Standardized Testing as a Racial Project of Neoliberal Multiculturalism'; *Educational Policy* 2016; 30(1); pp. 39 – 62
- Banerjee, P. A. (2017) 'Does continued participation in STEM enrichment and enhancement activities affect school maths attainment?'; *Oxford review of education*; 43(1); pp. 1–18
- Beghetto, R. A. (2005) 'Does Assessment Kill Student Creativity?'; *The Education Forum*; 69
- Black, P; Harrison, C; Lee, C; Marshall, B; Wiliam, D (2003) '*Assessment for Learning*' Maidenhead; McGraw-Hill Education
- Blamires, M; Peterson, A. (2014) 'Can creativity be assessed? Towards an evidence-informed framework for assessing and planning progress in creativity'; *Cambridge Journal of Education*; 44(2); pp. 147-162,
- Bonell, C., Moore, G., Warren, E. et al. (2018) 'Are randomised controlled trials positivist? Reviewing the social science and philosophy literature to assess positivist tendencies of trials of social interventions in public health and health services.' *Trials* 19; 238
- Burton, D. & Bartlett, S. (2005) 'Questionnaires and interviews'; *Practitioner research for teachers*; SAGE Publications, Ltd; pp. 101-128
- Cairns, R. (2020) 'Exams tested by Covid-19: An opportunity to rethink standardized senior secondary examinations'; *Prospects*
- Cambridge Assessment (2020) 'Our commitment to equality, diversity and inclusion' Available at: <https://www.cambridgeassessment.org.uk/news/our-commitment-to-equality-diversity-and-inclusion/> (accessed 13th July 2021)
- CAIE (2021) 'Exam administration' Available at: <https://www.cambridgeinternational.org/exam-administration/> (accessed 13th July 2021)
- Cambridge Assessment (2021) 'Programs and qualifications' Available at: <https://www.cambridgeinternational.org/programmes-and-qualifications/cambridge-upper-secondary/cambridge-igcse/grade-threshold-tables/> (accessed 14th Aug 2021)
- Catteral, L. (2017) 'A Brief History of STEM and STEAM from an Inadvertent Insider'; *STEAM journal*; 3(1)
- Cohen, L., Manion, L., & Morrison, K. (2017) 'Research methods in education'; ProQuest Ebook Central

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

Collings, S., Grace, R. and Llewellyn, G. (2016) 'Negotiating with Gatekeepers in Research with Disadvantaged Children: A Case Study of Children of Mothers with Intellectual Disability'; *Children & Society*; 30(6); pp. 499–509

Conradty, C. Bogner, F. (2018) 'From STEM to STEAM: How to Monitor Creativity'; *Creativity Research Journal*; 30(3); pp. 233-240

Conradty, C; Sotiriou, S A; Bogner, F. X. (2020) 'How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation'; *Education sciences*; 10(3); pp. 70

Corbetta, P. (2011) "Paradigms of Social Research"; *Social Research: Theory, Methods and Techniques*; SAGE Publications, Ltd; pp. 8-29

Creswell, J. (2010) 'Mapping the developing landscape of mixed methods research'; *SAGE handbook of mixed methods in social & behavioral research*; SAGE Publications, Inc; pp. 45-68

Dewi W, Sri U. and Murtono (2021) 'STEAM (Science Technology Engineering Art Mathematic) Based Module for Building Student Soft Skill'; *Journal of physics: Conference series*; Bristol: IOP Publishing

Edutopia (2014) "End of Year Burnout: How to Finish the Marathon in Stride"; available at: <https://www.edutopia.org/blog/end-of-year-burnout-how-to-finish-stride-maurice-elias> (accessed online 28th Aug 2021)

Erricker, K (2014) 'Taking risks with literature: an exploration into the resilience of pupil responses to the study of a challenging text at GCSE'; *Literacy (Oxford, England)*; 48(2); pp. 86–94

Ferguson et al. (2017) 'Innovating Pedagogy 2017: Exploring new forms of teaching, learning and assessment, to guide educators and policy makers'; *Open University Innovation Report 6*; The Open University

Fletcher, A. (2021) 'Australia's National Assessment Programme rubrics: An impetus for self-assessment?'; *Educational Research*; 63:1; pp. 43-64

Freud, S. (1923) 'The ego and the id'; 19; pp. 1-66

de la Garza, A. (2021) 'Internationalizing the Curriculum for STEAM (STEM + Arts and Humanities): From Intercultural Competence to Cultural Humility'; *Journal of Studies in International Education* 2021; 25(2); pp. 123 – 135

Giraldo, F. (2020) 'A Post-Positivist and Interpretive Approach to Researching Teachers' Language Assessment Literacy'; *PROFILE issues in teachers' professional development*; 22 (1); pp. 189-200

Glennie, E. Mason, M. Dalton, B. (2016) 'The role of STEM High Schools in Reducing Gaps in Science and Mathematics Coursetaking: Evidence from North Carolina'; *RTI Press publication No. RR-0025-1603*

Graham, M. (2020) 'Deconstructing the Bright Future of STEAM and Design Thinking'; *Art Education*; 73(3); 6-12

Grinis, I. (2019) 'The STEM requirements of "Non-STEM" jobs: Evidence from UK online vacancy postings'; *Economics of education review*; 70; pp. 144–158

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

Grix, J. (2002) 'Introducing Students to the Generic Terminology of Social Research', *Politics*, 22(3), pp. 175–186

Groff, R. (2004) *Critical realism, post-positivism and the possibility of knowledge*.

Hattie, J. (2012) 'Visible Learning for Teachers – Maximizing impact on learning'; Routledge

Hattie, J. (2017) www.visiblelearning.com (accessed online 14th August 2021)

Heckman, J. Kautz, T. (2012) 'Hard evidence on soft skills'; *Labour Economics* 2012; 19(4); pp. 451-464

Herranen, J. Cyrus Fooladi, E. Milner-Bolotin, M. (2021) 'Promoting STEAM in Education'; *LUMAT Special Issue* 2021; 9(2); 1–8

Herro, D. Quigley, C. (2017) 'Exploring teachers' perceptions of STEAM teaching through professional development: implications for teacher educators'; *Professional development in education*; 43(3); pp. 416

Hofweber, T. (2021) 'Logic and Ontology'; *The Stanford Encyclopedia of Philosophy*

Jacobson, L (2018) 'STEAM approach increases elementary students' scores in science'; *K12 Dive*, available at: <https://www.k12dive.com/news/steam-approach-increases-elementary-students-scores-in-science/522958/> (accessed online 15th July)

James, M (2006) 'Assessment, Teaching and Theories of Learning'; *Assessment and Learning* (First Edition); London: Sage; pp. 47-60

Kaliszewski, M. Fieldsend, A. McAleavy, T. (2017) 'England's approach to school performance data – lessons learned'; *Education Development Trust*; Available at: <https://files.eric.ed.gov/fulltext/ED586972.pdf> (accessed online 13th July 2021)

Kang, N. H. (2019) 'A review of the effect of integrated STEM or STEAM (science, technology, engineering, arts, and mathematics) education in South Korea'; *Asia Pac. Sci. Educ*; 5(6)

Latifi, S. Bulut, O. Gierl, M. Christie, T. Jeeva, S. (2016) 'Differential Performance on National Exams: Evaluating Item and Bundle Functioning Methods using English, Mathematics, and Science Assessments'; *SAGE open*; 6(2)

Lave, J. Wenger E. (1991) 'Situated Learning', Cambridge University Press

Learn It By Art (2021) 'Why STEAM education?', Available at: <https://www.learnitbyart.com/why-steam> (accessed 15th July 2021)

Marvasti, A. & Freie, C. (2017) 'Research interviews'; *The BERA/SAGE Handbook of educational research*; SAGE Publications Ltd; 2; pp. 624-639

McGuinness, O (2020) 'TMA01'; Open University E822 assessment task

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

Mejias, S. et al (2021) 'The trouble with STEAM and why we use it anyway'; Science Education (Salem, Mass.); 105(2)

MIT (2020) "STEAM Learner Ambitions"; Internal Document from within our group of school.

MIT (2021) "Curiosity Challenge", Available at: www.curiosity.mit.edu (accessed 24th July 2021)

Nikolaou, I., Georgiou, K. and Kotsasarlidou, V. (2019) 'Exploring the Relationship of a Gamified Assessment with Performance'; The Spanish journal of psychology; 22

Open University (2008) 'Quarks to Quasars'; Exploring Science: Book 7; Milton Keynes

Open University (2020) 'E822 Research paradigms', Available at: https://learn2.open.ac.uk/pluginfile.php/3090397/mod_resource/content/2/E822%20Research%20paradigms.pdf (accessed 31st July 2021)

Open University (2021) 'Masters: Education, Childhood and Youth', Available at: <https://learn2.open.ac.uk/course/view.php?id=206856> (accessed 9th July 2021)

Pearsons (2021) 'Exam Guidance', Available at: <https://qualifications.pearson.com/en/support/support-topics/exams/examination-guidance/conducting-exams.html> (accessed 22nd Aug 2021)

Plaza, P. et al (2020) 'Educational Robotics for All: Gender, Diversity, and Inclusion in STEAM'; IEEE Learning With MOOCS (LWMOOCS) – 2020; pp. 19-24

Quinlan, A. E. et al. (2016) 'Measuring and assessing resilience: broadening understanding through multiple disciplinary perspectives'; The Journal of applied ecology; 53(3); pp. 677–687

Sedikides, C., Luke, M. A. and Hepper, E. G. (2016) 'Enhancing feedback and improving feedback: subjective perceptions, psychological consequences, behavioral outcomes'; Journal of applied social psychology; 46(12); pp. 687–700

Smaill, E. (2013) 'Moderating New Zealand's National Standards: teacher learning and assessment outcomes'; Assessment in Education: Principles, Policy & Practice; 20(3); pp. 250-265

Smith, J. (2017) 'Assessing Creativity: Creating a Rubric to Effectively Evaluate Mediated Digital Portfolios'; Journalism & Mass Communication Educator 2017; 72(1); pp. 24–36

Stackpole, B. (2019) 'Training Today's Workforce to Fill the Skills Gap'; *ProFood World*

Stake, R. E. (1995) 'The art of Case Study Research'; Thousand Oaks, CA; SAGE

Stopforth, S; Gayle, V; Boeren, E (2021) 'Parental social class and school GCSE outcomes: two decades of evidence from UK household panel surveys'; Contemporary Social Science; 16 (3); pp. 309-324

Succi, C. Canovi, M. (2020) 'Soft skills to enhance graduate employability: comparing students and employers' perceptions'; Studies in Higher Education; 45(9); pp. 1834-1847

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

Suto, I; Elliot, G; Rushton, N; Mehta, S (2012) 'Going beyond the syllabus: a study of A level Mathematics teachers and students'; *Educational studies*, 38(4); pp. 479–483

Tan, C (2020) 'Beyond high-stakes exam: A neo-Confucian educational programme and its contemporary implications'; *Educational philosophy and theory*; 52(2); pp. 137–148

Taylor, L. (2005) 'Washback and impact'; *ELT Journal*; 59 (2); pp. 154–155

Thuneberg, H. M. Salmi, H. S. Bogner, F. X. (2018) 'How creativity, autonomy and visual reasoning contribute to cognitive learning in a STEAM hands-on inquiry-based math module'; *Thinking skills and creativity*; 29; pp. 153–160

Tierney, J. (2013) 'Why teachers secretly hate grading papers'. The Atlantic. Retrieved from <http://www.theatlantic.com/national/archive/2013/01/why-teachers-secretly-hategrading-papers/266931/> (accessed online Aug 8th 2021)

Qureshi, S (2018) 'How Does the Washback of Two Different Formats of Assessment Impact Chemistry Postgraduate Students'; *Science Education International*; 29(4); pp. 227 – 237

Vogler, J. S. et al. (2018) 'The hard work of soft skills: augmenting the project-based learning experience with interdisciplinary teamwork'; *Instructional science*; 46(3); pp. 457–488

Wahono, B. Lin, P. L. Chang, C. Y. (2020) 'Evidence of STEM enactment effectiveness in Asian student learning outcomes'; *IJ STEM Ed*; 7(36)

White, D. Delaney, S. (2021) 'Full STEAM ahead, but who has the map for integration? – A PRISMA systematic review on the incorporation of interdisciplinary learning into schools'; *LUMAT Special Issue 2021*; 9(2), pp. 9–32

Widarwati, D. Utaminingsih, S. Murtono (2021) 'STEAM (Science Technology EGINEERING Art Mathematic) Based Module for Building Student Soft Skill'; *Journal of physics: Conference series*; Bristol: IOP Publishing.

Wiliam, D. (2018) 'Embedded formative assessment'; Second edition; Solution Tree

Zayyad, M. (2019) 'STEAM Education for Students with Specific Learning Disorders'; *Research Highlights in Education and Science 2019*; pp. 31 – 42

Zhang, Aima (2012) 'Peer Assessment of Soft Skills and Hard Skills'; *Journal of Information Technology Education*; 11; pp. 155-168

Appendices

1. Soft skills assessment rubrics

Creativity

Learners apply knowledge, skills and imagination to develop novel and innovative ways of thinking, expressing and making. Learners look beyond preconceived ideas to solve problems.

Attribute	Needs work	Acceptable	Proficient
Interpret a design brief independently, and consider a range of different media to respond to a problem.	Learners begin to interpret a design brief with assistance, and are prompted to consider a range of different media to respond to a problem.	Learners begin to interpret a design brief independently, and are beginning to consider a range of different media to respond to a problem.	Learners interpret a design brief independently, and consider a range of different media to respond to a problem.
Respond to detailed design briefs, drawing on growing experiences of different media, and different knowledge. Express these in a range of ways.	Learners respond to basic design briefs, drawing on the use of simple media, and expressing these in one of these ways.	Learners respond to more detailed design briefs, drawing on their growing experiences of different media, and different knowledge, and expressing these in a range of ways.	Learners respond to difficult design briefs, drawing on their own research of different media, and different knowledge, and expressing these in a new and unique way.
Experiment with unfamiliar approaches or forms and decide on the right ones for the right circumstances. Develop a sense of your own personal style in the work you create.	Learners experiment with familiar approaches or forms and are prompted on the right ones for the right circumstances. They start to show some development for sense of their own personal style in the work they create.	Learners experiment with unfamiliar approaches or forms and decide on the right ones for the right circumstances. They develop a sense of their own personal style in the work they create.	Learners experiment with unique and unfamiliar approaches or forms and choose the best ones for the right circumstances. They already have their own personal style in the work they create.
Demonstrate the confidence to express your work in an original form, considering the audience and overall purpose of the piece. Adopt a “thinking outside of the box” strategy to your work.	Learners are prompted to express their work in an original form, considering the audience and overall purpose of the piece. They are concerned about using anything outside of their comfort zone.	Learners demonstrate the confidence to express their work in an original form, considering the audience and overall purpose of the piece. They adopt a “thinking outside of the box” strategy to their work.	Learners have the confidence to show others how to express their work in an original form, considering the audience and overall purpose of the piece. Instead of “thinking outside of the box”, they throw the box away.

Resilience

Learners persist in findings solutions to problems in spite of setbacks in the learning journey. They feel the freedom to fail and are confident in their ability to learn from these experiences.

Attribute	Needs work	Acceptable	Proficient
Demonstrate awareness of your strengths and weaknesses. Beginning to develop confidence in attempting tasks outside	Learners need guidance to identify their strengths and weaknesses. They may attempt simple tasks outside their comfort	Learners are aware of their strengths and weaknesses and are beginning to develop confidence in attempting tasks outside	Learners are well aware of their strengths and weaknesses and have developed confidence in attempting tasks outside

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

<p>your comfort zone. Understand that failure is the first step in learning. Start to push past obstacles independently.</p>	<p>zone. They are still concerned that failure is something to be avoided at all costs.</p>	<p>their comfort zone. They understand that failure is the first step in learning and are starting to push past obstacles independently.</p>	<p>their comfort zone. They understand that failure is critical in achieving the most success and push past obstacles with ease.</p>
<p>Confidently approach new and unknown situations, seeing them as a challenge to be faced. You see setbacks as a tool for self-motivating them to revisit the problem and learn from the failure they experienced. You can work for sustained periods of time and can identify distractions which might affect their work.</p>	<p>Learners passively approach new and unknown situations, seeing them as work. They see setbacks as obstacles that may or may not be solved. They can work for a period of time, but may get distracted.</p>	<p>Learners confidently approach new and unknown situations, seeing them as a challenge to be faced. They see setbacks as a tool for self-motivating them to revisit the problem and learn from the failure they experienced. They can work for sustained periods of time and can identify distractions which might affect their work.</p>	<p>Learners help others approach new and unknown situations, seeing them as a challenge to be faced together. They see setbacks as essential for success. They can work for sustained periods of time with strong discipline.</p>
<p>Show an ability to jump in and work on complex problems even when not entirely sure of the outcome, and demonstrate a confidence to tackle problems that are not typically popular. You are able to identify the possible risks you may face and can consider how to tackle them responsibly. You begin to develop resolve which allows you to overcome setbacks effectively in order to conquer an important challenge.</p>	<p>Learners show some ability to jump in and work on complex problems when not entirely sure of the outcome, and demonstrate an attempt to tackle problems that are not typically popular. They are able to identify some basic risks they may face and can consider how to tackle them.</p>	<p>Learners show an ability to jump in and work on complex problems even when not entirely sure of the outcome, and demonstrate a confidence to tackle problems that are not typically popular. They are able to identify the possible risks they may face and can consider how to tackle them responsibly. Learners begin to develop resolve which allows them to overcome setbacks effectively in order to conquer an important challenge.</p>	<p>Learners show an incredible ability to jump in and work on highly complex problems even when not entirely sure of the outcome, and demonstrate an unbreakable confidence to tackle problems that are not popular. They are able to identify all risks they may face and can tackle them responsibly. Learners demonstrate resolve which allows them to overcome setbacks effectively in order to conquer an important challenge.</p>
<p>You are prepared to take risks, and apply a trial and error attitude towards problems posed. You are able to proactively respond to failure with limited reassurance, and you learn from the experience in order to move learning forward to a resolution. You appreciate the power of reflecting and reacting to setbacks positively in order to achieve the desired outcome.</p>	<p>Learners are prompted to take risks, and try to apply a trial and error attitude towards problems posed. They able to respond to some failure with reassurance, and they learn from the experience with assistance. They attempt reflecting and reacting to setbacks positively in order to try and achieve the desired outcome.</p>	<p>Learners are prepared to take risks, and apply a trial and error attitude towards problems posed. They able to proactively respond to failure with limited reassurance, and they learn from the experience in order to move learning forward to a resolution. They appreciate the power of reflecting and reacting to setbacks positively in order to achieve the desired outcome.</p>	<p>Learners regularly take risks, and apply a trial and error attitude towards problems posed. They able to proactively respond to failure with no reassurance, and they learn from the experience in order to move learning forward to a resolution. They embrace the power of reflecting and reacting to setbacks positively in order to achieve the desired outcome.</p>

Collaboration

Investigating the assessment of soft skills development within STEAM based learning

EMA – E822

Learners are keen to work with others to solve problems. They accept criticism of their work and are willing to negotiate changes. They communicate effectively and can harness the skills, perspective and expertise of others to improve the overall outcome.

Attribute	Needs work	Acceptable	Proficient
You are confident to share your ideas with a group and understand the importance of being open-minded and taking on the ideas of others. You are beginning to bring these ideas together to build on and improve initial suggestions. checks for understanding with peers.	Learners begin to share their ideas with a group and attempt being open-minded and taking on the ideas of others. They are trying to bring these ideas together to build on and improve initial suggestions.	Learners are confident to share their ideas with a group and understand the importance of being open-minded and taking on the ideas of others. They are beginning to bring these ideas together to build on and improve initial suggestions.	Learners excel at sharing their ideas with a group and understand the importance of being open-minded and taking on the ideas of others. They bring these ideas together to build on and improve initial suggestions.
You can clearly articulate your own ideas and can listen to the ideas of others, reinterpreting them in your own words. You can begin to see the advantage of working in groups.	Learners can explain the basics of their own ideas and can listen to the ideas of others.	Learners can clearly articulate their own ideas and can listen to the ideas of others, reinterpreting them in their own words. They can begin to see the advantage of working in groups.	Learners understand that listening to other ideas is more important than giving their own. They thrive in working in groups.
Learners present confidently to others in the group, and the class widely. They recognise the role of others in the development of those ideas and start modelling collaboration skills to younger students. They see the advantage in collaborating.	Learners explain to others in the group. They start to recognise the role of others in the development of those ideas and start modelling collaboration skills to younger students.	Learners present confidently to others in the group, and the class widely. They recognise the role of others in the development of those ideas and start modelling collaboration skills to younger students. They see the advantage in collaborating.	Learners present with quality to others in the group, and the class widely. They embrace the role of others in the development of those ideas and start modelling collaboration skills to younger students. They thrive in collaborating.
You demonstrate the ability to identify the need and seamlessly take on different roles within a group in order to achieve an effective dynamic. You are able to communicate in a manner to minimize conflict, and are flexible to possible change or compromises required to benefit the wider community.	Learners demonstrate some ability to identify the need and take on different roles within a group in order to achieve. They are able to communicate with the team, and are somewhat flexible to possible change or compromises required to benefit the team.	Learners demonstrate the ability to identify the need and seamlessly take on different roles within a group in order to achieve an effective dynamic. They are able to communicate in a manner to minimize conflict, and are flexible to possible change or compromises required to benefit the wider community.	Learners have the ability to seamlessly take on different roles within a group as needed in order to achieve the best dynamic. They are able to communicate in a manner to stop any conflict, and are flexible to all changes or compromises required to benefit the wider community.

2. Participation Consent form

Dear Parents,

As your children may have recently informed you, I am currently conducting a research project for my master's in education dissertation with the Open University. The research question is to find out whether giving assessment grades for STEAM based learning is motivational or not for the students to develop soft skills (creativity, resilience and communication).

I would like to include your child in this research with your permission. As a participant, they will be asked to complete two different STEAM projects. One of these projects will be assessed, while the other will not. Please be aware that this assessment grade is purely for my research and will have no effect on the students' reported academic grades for the year. Once the project is done, the students will complete a short anonymous interview that will be used by me to assess the efficiency of assessment grading on STEAM.

Please be aware that participation is optional, and you will have a right to withdraw at any time during the project. If you decide that you do not wish to include your child in this research or withdraw after starting, it will have no effect on any reported "attitude to learning" grades.

All participants will be able to receive a copy of the report once completed if requested.

If you have any questions regarding this research, please do not hesitate in contacting me via email or arranging a time that we can meet virtually.

Please return the slip below or email me before **April 14th** if you are happy for your child to participate in this.

Dear Mr. McGuinness

I would/would not be happy for my child to participate in your research.

Regards

3. Interview Questions

- 1) How did you find the project?
- 2) Did you understand the importance of reflecting on your soft skills development while participating in the project?
- 3) Can you talk me through the grades that you scored yourself on the rubric?
- 4) What soft skill did you find developed most during this project?
- 5) What soft skill do you feel was neglected? Why do you think that was?
- 6) Did you find the rubric useful in keeping the soft skill development in focus during this project?
- 7) What strategies do you think you will take away from this project to use elsewhere?

Ethical Appraisal Form

E822 Ethical Appraisal Form

Masters: Education, Childhood and Youth



NB: it should be noted that The Open University is unable to offer liability insurance to cover any negative consequences students might encounter when undertaking 'in-person' data collection. It is therefore very important that you follow appropriate research protocols not least in seeking Gatekeepers' permissions to undertake any data collection within your setting and adhere to ethical principles for the safety of yourself and your participants.

Because ethical appraisal should precede data collection, this form should be included with TMA02 for those developing a Small-Scale Investigation and included as part of the submission for the EMA for those submitting an Extended Literature Review and Research Proposal.

Fill in section 1 of this document with your personal details and brief information about your research.

For section 2, please assess your research using the following questions and click yes or no as appropriate. If there is any possibility of significant risk please tick yes. Even if your list contains all "no" you should still return your completed checklist so your tutor/supervisor can assess the proposed research.

Section 1: Project details

a.	Student name	Oliver McGuinness
b.	PI	
c.	Project title	<i>Investigating the use of assessment grading STEAM projects for soft-skills development in student</i>
d.	Supervisor/tutor	C. E. Elhaggagi
e.	Qualification	Masters in Education <input checked="" type="checkbox"/>
		Masters in Childhood and Youth <input type="checkbox"/>

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

f.	MA pathway (where applicable)	SSI
g.	Intended start date for fieldwork	May 21st
h.	Intended end date for fieldwork	May 30 th
i.	Country fieldwork will be conducted in <i>If you are resident in the UK and will be conducting your research abroad please check www.fco.gov.uk for advice on travel.</i>	Philippines, Cambodia, Vietnam

Section 2: Ethics Assessment		Yes	No
1	Does your proposed research need initial clearance from a 'gatekeeper' (e.g. Local Authority, head teacher, college head, nursery/playgroup manager)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Have you checked whether the organisation requires you to undertake a 'police check' or appropriate level of 'disclosure' before carrying out your research? ¹	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Have you indicated how informed consent will be obtained from your participants (including children less than 16 years old, school pupils and immediate family members)? Your consent letters/forms must inform participants that they have the right to withdraw from the study at any time. ²	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Will your proposed research design mean that it will be necessary for participants to take part in the study without their knowledge/consent at the time (e.g. covert observation of people in nonpublic places)? If so have you specified appropriate debriefing procedures? ³	<input type="checkbox"/>	<input checked="" type="checkbox"/>

¹ You must agree to comply with any ethical codes of practice or legal requirements that maybe in place within the organisation or country (e.g. educational institution, social care setting or other workplace) in which your research will take place. If required an appropriate level of disclosure ('police check') can be obtained from the Disclosure and Barring Service (England and Wales), Disclosure Scotland, AccessNI (Northern Ireland), Criminal Records Office (Republic of Ireland), etc.

² This should normally involve the use of an information sheet about the research and what participation will involve, and a signed consent form. You must allow sufficient time for potential participants to consider their decision between the giving of the information sheet and the gaining of consent. No research should be conducted without the opt-in informed consent of participants or their caregivers. In the case of children (individuals under 16 years of age) no research should be conducted without a specified means of gaining their informed consent (or, in the case of young children, their assent) and the consent of their parents, caregivers, or guardians. This is particularly important if your project involves participants who are particularly vulnerable or unable to give informed consent (e.g. children under 16 years, people with learning disabilities, or emotional problems, people with difficulty in understanding or communication, people with identified health problems). There is additional guidance on informed consent on the Masters: Education and Childhood and Youth website under Project Resources.

³ Where an essential element of the research design would be compromised by full disclosure to participants, the withholding of information should be specified in the project proposal and explicit procedures stated to obviate any potential harm arising from such withholding. Deception or covert collection of data should only take place where it has been agreed with a named responsible person in the organisation and it is essential to achieve the research results required, where the research objective has strong scientific merit and where there is an appropriate risk management and harm alleviation strategy.

Investigating the assessment of soft skills development within STEAM based learning
EMA – E822

5	Does your proposed design involve repetitive observation of participants, (i.e. more than twice over a period of more than 2-3 weeks)? Is this necessary? If it is, have you made appropriate provision for participants to renew consent or withdraw from the study half-way through? ⁴	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	Are you proposing to collect video and/or audio data? If so have you indicated how you will protect participants' anonymity and confidentiality and how you will store the data?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	Does your proposal indicate how you will give your participants the opportunity to access the outcomes of your research (including audio/visual materials) after they have provided data?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8	Have you built in time for a pilot study to make sure that any task materials you propose to use are age appropriate and that they are unlikely to cause offence to any of your participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9	Is your research likely to involve discussion of sensitive topics (e.g. adult/child relationships, peer relationships, discussions about personal teaching styles, ability levels of individual children and/or adults)? What safeguards have you put in place to protect participants' confidentiality?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10	Does your proposed research raise any issues of personal safety for yourself or other persons involved in the project? Do you need to carry out a 'risk analysis' and/or discuss this with teachers, parents and other adults involved in the research?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11	Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
12	Will the study involve recruitment of patients or staff through the NHS or the use of NHS data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'yes' to questions **12**, you will also have to submit an application to an appropriate National Research Ethics Service ethics committee (<http://www.nres.npsa.nhs.uk/>).

⁴ Where participants are involved in longer-term data collection, the use of procedures for the renewal of consent at appropriate times should be considered.