‘You can write whatever you want’: Exploring the relationship between student self-concept and creative writing practices

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When we write realistic fiction, we're asking the reader to believe in something that could be real. When we write fantasy, we're asking them to go a step further, to believe in something that couldn't be real, whether that is a door to another world, a superpower or a dragon. Science fiction is a more specific area of the unreal; it is a genre that wonders. Not content to present a reality that doesn't exist, it demands the reader to ask 'What if?'

(McGann, 2020: 1)

Abstract

This project sought to investigate whether guided creative writing processes can have an impact on students' self-concept in domains related to the topics about which they are writing. To investigate this, a creative writing project focused on prose science fiction was designed and delivered to a class group of secondary school students in Dublin, Ireland. A second class group from the same school took part in a poetry writing project and served as the control group for this study. A questionnaire to measure self-concept in two domains (creative and scientific) was delivered to both groups before and after the intervention. Results were to be triangulated using semi-structured interviews with participants in the intervention group and the adult collaborators who worked with them but, as a result of the COVID-19 pandemic, these could not be completed. Due to the disrupted research, conclusions could not be drawn from the data collected. An evaluation of the intervention design, however, indicates that it satisfied most of the criteria suggested by the literature review and that a repeat investigation, when circumstances allow, is warranted.

Contents

Chapter One: Introduction

Ensuring a sufficient supply of workers with expertise in science, technology, engineering and mathematics (STEM) is a preoccupation of many governments and there are ongoing concerns about the challenge of persuading young people to pursue higher education as well as, later, careers in these areas (Bell et al, 2009; Archer et al, 2010; Mason et al, 2012; Archer et al, 2013; DeWitt et all, 2013; Archer et al, 2015). Despite this, only a small minority of adolescents report an interest in becoming scientists in their future (Archer et al, 2013). Over 90% of employers in the engineering sector in the Republic of Ireland, for instance, point to 'skills shortages as the main barrier to growth within the engineering sector' (Engineers Ireland, 2019). At the same time, schools are identified as responsible for 'generating a pipeline of talented scientists and innovators that will secure Ireland's position at the forefront of the ongoing worldwide technological revolution' (Department of Education and Skills (DES), 2018), an ambition which the DES expects will require excellence in both scientific and creative education. Ensuring the supply of scientists for European economies requires alternative approaches to simply persuading young people, their parents and teachers of the importance of these subject areas as science and mathematics education have enjoyed continued high status compared with other secondary school subjects since the end of the 19th century (Thistlewood, 2005).

The initial idea for my project was germinated by a presentation delivered by Professor Louise Archer, of King's College London, at a conference in 2016. Archer presented a summary of her research on science aspirations in secondary school students, and on the factors which most strongly predicted career aspirations among young people. Of particular importance, Archer argued, was the young person's understanding of who they were or who they were like, and what careers were open to, or suited, people like them. This sense of identity was a much stronger indicator of what professions or careers young people

expected to join than their track record of capability in a subject, or their assessment of their own intelligence. As a classroom teacher and subject leader listening to the presentation, Archer's research raised two key questions:

- How do teachers influence how young people see themselves, who they compare themselves to, and how they understand the value and potential of 'people like them'?
- If career aspirations are linked to the extent to which one imagines one might 'be the kind of person who becomes…', are there specific ways in which teachers of creative subjects can support young people to broaden their identified horizons.

These questions, Archer claimed, were particularly pertinent with regard to careers in the areas of science, technology, engineering, and mathematics (STEM). As a teacher of Design and Technology, Art and related subjects, I (along with my colleagues) was very often enlisted to work on the promotion of STEM with pupils, but often the brief was to make STEM fun, accessible and appealing. However, if the creative, innovative and imaginative skills nurtured in my subject areas could enable students to envisage a different relationship for themselves with the 'hard' sciences, then we would have the opportunity to support the promotion of STEM in a much more powerful and effective way than simply presenting fun, applied activities which could be linked to the theory taught by our colleagues in science.

This perspective on the potential of creative work to influence the aspirations of young people remained a factor in my planning and teaching after I moved from mainstream secondary education to a new educational context: a creative writing centre for children and young adults in Dublin. This centre offers a range of long-term programmes and one-off workshops promoting creative writing to students of all ages. These programmes are

primarily organised for the benefit of school groups and are free at the point of delivery. Founded in 2009, over the last decade 'the [centre]'s model has positively impacted on participants' personal, social and academic development … [and] improved confidence and self-esteem' (Lorenzi and White, 2013: 5). Working in this context, I began to experiment with ways to combine scientific knowledge with creative work. In the course of my role, I was invited to deliver a two-hour workshop at the Science Gallery in Dublin as part of their work experience programme for students with an interest in pursuing science. Staff members observing the workshop expressed delight at seeing the participants synthesise knowledge, speculation and narrative instinct into a compelling piece of science fiction. Based on the enthusiasm of both the participants and observers, I then developed the workshop into a four-day summer camp for adolescent participants held in collaboration with the World Science Fiction Convention in Dublin in summer 2019. Twenty-five teenagers took part in this summer camp, supported by the writing centre's staff and volunteers, together with writers and scientists from the World Science Fiction Convention and one of the city's universities. Inspired by the quality of the ideas and writing produced at that summer camp, I proposed extending the concept into a longer-term project and carrying out a more formal evaluation of the programme and its effects. Both the workshop in the Science Gallery and the summer camp had drawn participants from the upper half of secondary schooling. A Transition Year programme seemed the most appropriate context given the nature of Transition Year and where it is situated in a student's progression through secondary education in Ireland.

The Irish education system divides a pupil's time in secondary school into two cycles – the Junior Cycle, a three year programme culminating in a set of state examinations, and the Senior Cycle, a two year programme culminating in a final set of state examinations known as the Leaving Certificate (A-Level equivalent) examinations which generally determine a student's pathway in further education and training (admission to university,

for example, is often based exclusively on the results of these examinations). Transition Year occurs between the two cycles, when students are usually around fifteen or sixteen years old.

Transition Year was introduced to the Irish education system in the mid-seventies. The strength of vision on the part of the then-Minister for Education, Richard Burke, has had a profound impact on Irish education ever since. The emphasis in Transition Year is to 'stop the tread-mill and release … educational pressures for one year' in order to allow students 'to discover the kind of person he (sic) is' (Minister Richard Burke (Education), 1974, quoted in Jeffers, 2015: pp 97–98).

This optional year of secondary education has become a feature of adolescence for the majority of Irish students and Transition Year is the mechanism through which many sporting organisations, charities, and cultural organisations engage with pupils in the Irish secondary education system (Jeffers, 2015).

In the contemporary Irish education system, Transition Year can vary greatly from school to school and individual institutions have great freedom in designing the structure of their Transition Year programme. However, an increased emphasis on non-academic achievement (such as increased participation in sport or completing the GAISCE award, a programme similar to The Prince's Trust Achieve Programme in the United Kingdom), learning for pleasure (e.g. film studies, forensics, or creative writing) and work experience are common features in many schools. An emphasis on community engagement and charity work is also widespread. The writing centre where my research was based is a regular part of the Transition Year programme for many schools and is highly regarded by pupils, teachers and principals (Jeffers, 2015).

Irish students usually select their Leaving Certificate subject choices towards the end of Transition Year. In order to progress into the talent 'pipeline' the Irish Government aspires to create (DES, 2018), pupils would usually need to choose at least two science subjects for their Leaving Certificate, and many Irish university courses require at least one

science subject as a condition of entry. Thus, a positive attitude to science is an advantage for any student coming to the end of Transition Year. The scope for personal growth and creative exploration is a well-established part of Transition Year but there are also areas of weakness. Despite its many strengths, there remains confusion over the role of science during Transition Year: how it should be taught and what content is appropriate (Hayes, Childs and O'Dwyer, 2013). This is not inevitable, and it has been argued that Transition Year 'could be a crucial factor in the development of scientifically-literate citizens… if it were properly utilised' (Hayes, Childs and O'Dwyer, 2013: 739)

My study exploited the curricular freedom afforded to students and teachers in Transition Year in order to explore the potential of creative writing projects to impact upon students' self-perception and to intervene in their relationship to the sciences. In support of this concept, a review of the relevant literature is undertaken in Chapter Two. Here, the research carried out by Archer and her team is explored in more depth and the most relevant existing research on science-related school-based interventions is reviewed to identify factors which should be incorporated into a project of this type. To understand how school experiences influence student self-perception, theoretical perspectives on how students' views of themselves are formed and developed are identified and the most relevant construct for investigation examined. Informed by pre-existing research in relevant areas, and a deepened understanding of the constructs under investigation, appropriate research questions are proposed at the end of Chapter Two.

Chapter Three outlines the structure of the intervention, the recruitment of participants and the methodological choices made with regard to measuring the impact of the project, if any, on students' self-concept. The protection of participants' and collaborators' rights and wellbeing is considered, and the impact of the COVID-19 pandemic on the running of this research is accounted for.

Chapter Four gives a brief report of the data gathered during this intervention and reviews the design of the intervention in light of the relevant literature. Considerations for further investigation, and possible improvements which could be implemented in future research, are proposed in Chapter Four and concluding remarks on the project in its entirety are presented in Chapter Five.

Chapter Two: Literature review

In this chapter, an interrogation of the main concepts under consideration, as well as an overview of prior investigations into similar topics, is undertaken in order to contextualise how a creative writing project may affect the scientific self-concept of a group of Transition Year students.

As the starting point for this research can be directly linked to the ASPIRES study in the United Kingdom, those aspects of the ASPIRES study most relevant to the research undertaken for my project will be outlined. A broader review of the literature is then undertaken to understand and define the main areas of academic enquiry relevant to this study. Two constructs of the self commonly found in educational research are briefly evaluated for their applicability to my enquiry and the background theory and research supporting the selected construct, self-concept, is considered. The interrelationship between academic self-concept and academic achievement, that ever-present focus in educational research, is then reviewed. Next, the range of factors understood to affect self-concept are explored to better understand how a project aimed at impacting this phenomenon might be designed.

The work of other researchers in designing and testing interventions aimed at influencing students' relationships with science, creativity and self-concept is next explored. Research which provides generic guidelines intended for broad implementation is considered, along with particular case-studies of small-scale projects which are relevant to this study by virtue of focus or structure. Interventions based around science fiction were particularly sought and, as they are relatively rare, research concerning both the consumption of science fiction as well as the creation of science fiction is considered. Additionally, a number of perspectives on the cognitive similarities between scientific and

creative work are considered for their potential to enhance the design of the planned intervention.

Finally, a selection of attributes expected to impact upon student self-concept are proposed for the intervention, and justified in relation to the literature. Research questions developed in light of the literature considered here are put forward and a hypothesis proposed.

ASPIRES

The ASPIRES study is an ongoing, longitudinal research project investigating science and career aspirations in young people between the ages of ten and twenty-three (University College London, 2020). Completed phases of the research have documented in depth the relationship of post-primary students to science and their feelings about the sciences sector as a career path. A minority of adolescents expect science to feature strongly in their future studies or employment (Archer et al, 2010; Archer et al, 2013; Archer et al, 2015; Archer and McLeod, 2016; and Archer and DeWitt, 2017).

Research to date has found that career aspirations in young persons are relatively stable over time (University College London, 2020). Attitudes to science remain positive for longer in secondary school environments than previously understood, and it is aspirations which suffer, or remain low, during the period of middle adolescence (Archer and DeWitt, 2017). Although there is positive correlation between those who express the highest interest in science in school and those who aspire to become scientists, considerably fewer adolescents report an interest in becoming a scientist than report a positive regard for science and scientists in general (Archer et al, 2013). Science aspirations are higher amongst male students, amongst students in higher academic streams for science, and amongst those with 'high/very high levels of cultural capital' (Archer et al, 2013: 3). The extent to which pupils see themselves as 'scientists' or 'scientific' will have a significant bearing on whether

or not they pursue science subjects to the end of secondary school and into university (Archer and McLeod, 2016).

The ASPIRES research documented a significant correlation between science capital and pupils having science aspirations for their further studies and careers. In particular, the presence of science capital within families was a key factor in whether or not a young person expressed a desire to pursue a career in science (Archer et al, 2013).

The researchers define science capital as 'science-related qualifications, understanding, [and] knowledge' (Archer et al, 2013: 3). Later work considered science capital, rooted in the general conceptualisation of Bourdieu's cultural capital, within three broad areas – science-related cultural capital, science-related behaviours and practices, and science-related social capital (Archer et al, 2015). Science-related cultural capital includes 'scientific literacy', 'scientific-related dispositions/preferences' – for example, seeing science and science education as useful – and 'symbolic knowledge about the transferability of science in the labour market' (Archer et al, 2015: 929 – 930). Within the behaviours and practices category, Archer et al identified the 'consumption of science-related media' and 'participation in out-of-school science learning contexts' (2015: 930) as contributing positively to science capital. The social capital classification encompassed items such as 'knowing someone who works in a science job', 'talking to others about science' and 'future science affinity' (the extent to which a young person imagines themselves as someone who will continue to study or work within the sciences later in their life) (Archer et al, 2015: 931 – 932). The researchers advocated that the prioritisation of raising science *capital* rather than *interest* should be the goal of any initiative aimed at increasing participation in science education and careers (Archer et al, 2013).

Archer and DeWitt recommend that increasing science capital is a key factor in increasing science aspirations in young people. They advocate supporting young people to identify with science as 'not just "something that we do" but also part of "who we are"'

(2017: 153). Throughout the ASPIRES research, this identification, in conjunction with other factors, is referred to as science capital (Archer et al, 2013; Archer et al, 2015), and science self-concept is described as capturing how well students feel they did in science lessons (Archer et al, 2013). However, as is considered in greater depth elsewhere in this chapter, other researchers incorporate attitudinal factors clearly related to science capital as it is understood within the ASPIRES research, such as competence, interest, 'enjoyment and willingness to work hard' when assessing academic self-concept (Liu and Wang, 2005: 20). Thus, the ASPIRES recommendations in relation to increasing science capital as a means of influencing students' identification with science can be clearly related to self-concept. The contradiction that many young adolescents who find science engaging and interesting but yet do not identify with science as something they wish to do with their lives (Archer et al, 2010) suggests that self-concept may go to the heart of the ongoing struggle to persuade young students to 'be' scientists.

The ASPIRES study found that the three factors which had the most significant relationship to science aspirations were 'attitudes to school science, parental attitudes to science and a student's self-concept in science' (Archer et al, 2013: 12). Self-concept had the smallest effect size of the three (0.24 in year 9) but seemed the most appropriate and actionable focus for a classroom-based intervention not involving parental engagement, science teachers or the mainstream curriculum. The recommendations of the ASPIRES study repeatedly highlighted increasing science capital within families as an important means of raising science aspirations among young people (Archer et al, 2013). Nevertheless, their own research also found that positive parental attitudes correlated less strongly with positive attitudes to science in school than did the individual's positive self-concept in science (DeWitt et al, 2013). While family-focused interventions would likely have a positive impact on student self-concept, if it is possible for educational interventions to directly influence self-concept, this may be a more efficient and targetable route to intervening in

students' relationships with their academic subjects. Interventions in science self-concept, however, may represent a particular challenge, as a 2014 intervention designed by researchers involved in the ASPIRES study failed to elicit any significant change in students' relationship to science (Archer, DeWitt and Dillon, 2014) and Flowers, Raynor and White note that 'STEM courses are historically associated with negative academic self-concept in many students' (2013: 10).

Constructs of self

A large number of 'self-' constructs appear in research on education and psychology, and terms are often used interchangeably and inconsistently (Strein, 1995), rendering essential the careful framing and definition of any term intended for use in a particular piece of research. The most commonly occurring constructs of the self in research into academic motivation are self-efficacy and self-concept (Mason et al, 2012), although self-efficacy has a shorter lifespan in the literature (Bong and Skaalvic, 2003). While there is certainly an interrelationship between the two constructs, especially in relation to academic performance (Mason et al, 2012), self-concept has been accepted as differentiable for the purposes of research for a considerable period of time (Reynolds, 1988).

Self-efficacy and self-concept are centrally concerned with an individual's perception of their own competence in relation to a particular topic (Mason et al, 2012: 10) but both with a distinct focus. Self-efficacy reflects an individual's judgment of their ability to perform or accomplish an action, role or task (Mason et al, 2012, Bong and Skaalvic, 2003). For example, the belief that one can responsibly mind a child, lead a team, or lift a box of a certain weight is a self-efficacy judgement. Self-efficacy is informed by the experience of performance, either personal or vicarious, and is often strongly context-dependent (Bong and Skaalvic, 2003).

In contrast, the judgement that one is a good parent, a skilful leader, or a physically strong individual is a reflection of one's self-concept. Self-concept is concerned with who we think we are, and our perceived relative status and role in comparison to others in our social groups (Mason et al, 2012, Bong and Skaalvic, 2003). Self-concept also encapsulates an emotional component – the extent to which one feels motivation or enjoyment in relation to an activity, subject or role (Mason et al, 2012).

Both self-efficacy and self-concept were initially considered as possible frameworks through which to examine the effects of a creative writing intervention on students' sense of self. Given the focus on improving identification with science in the recommendations from the ASPIRES study, and their identification of self-concept as one of the three most pertinent factors affecting science aspirations among post-primary students (Archer et al, 2013, Archer and McLeod, 2016, Archer and DeWitt, 2017), self-concept was identified as the most relevant construct on which to focus this research.

Self-concept

Self-concept is the perception an individual has of themselves, informed by their experiences and interactions in the environment in which they exist (Bong and Skaalvic, 2003; Liu and Wang, 2005; Liu, Wang and Parkins, 2005; Mason et al, 2012).

Earlier work on self-concept, particularly through the 1960s and 1970s, treated self-concept as unidimensional (Liu, Wang and Parkins, 2005; Harter, 2012). Self-concept assessments generated a single score for global self-concept which represented an individual's general concept of the self which 'could be related to a variety of other constructs, outcomes, or indicators' of an individual's academic progress, personal development or social relations (Harter, 2012: 1). Self-concept research from this period has been critiqued for its utilisation of measurement instruments which were of inadequate quality and which lacked a strong theoretical basis (Marsh and O'Neill, 1984). As the field of enquiry developed, it became

evident that perceptions of self, even in children, were more complex. Thus, an all-encompassing score for self-concept obscured or over-simplified the nuances of an individual's understanding of themselves (Liu, Wang and Parkins, 2005; Harter, 2012).

Progressing from the initial understanding of global self-concept, researchers increasingly recognise its multidimensional aspect and explore 'domain-specific self-concepts' (Bong and Skaalvic, 2003: 4; see also Marsh, Smith, and Barnes, 1983; Marsh and O'Neill, 1984; Liu,Wang and Parkins, 2005; Harter, 2012). More contemporary research strongly supports the use of a multi-domain approach to self-concept, and the relative independence of the different domains of self-concept (Strein, 1995; Bong and Skaalvic, 2003). A range of terms for these more narrowly specified components of self-concept can be found in the literature, including facets (Marsh and O'Neill, 1984), scales (Marsh et al, 2005) and domains (Marsh, 1990; Ma and Kishor, 1997; Bong and Skaalvic, 2003; Corbière et al, 2006; Mason et al, 2012). As a particularly commonly used term in the literature, and in the interest of clarity, the term domain will be used throughout, regardless of the term adopted by individual researcher(s) whose work is being referenced.

The existence of different domains of self-concept is supported by the fact that '[self-]perceptions are differentiated clearly across different content areas and … relate only to relevant outcomes in the same content area and not to those in different areas' (Mason et al, 2012: 17). However, self-concept is still considered to be a hierarchical construct, where distinct self-evaluations in highly-specific domains (e.g. French) will nonetheless have a relationship with the more generic domains (e.g. languages) in which they are encompassed (Mason et al, 2012).

Academic self-concept has been a field of particular interest to many educational researchers and, within the domain of academic self-concept, differing self-concept evaluations in more specific subject areas have been repeatedly demonstrated (Marsh, 1990, Mason et al 2012). Self-concept research universally privileges self-evaluation, often without

providing the individual with specific criteria against which to evaluate themselves (Mason et al, 2012). Thus, self-concept is informed by the environment in which an individual finds themselves, by their own identification and evaluation of relevant criteria (including experiences with significant others) and by their emotional relationship with the domain under investigation (Corbière et al, 2006; Mason et al, 2012). Interactions with others are understood to be an important source of self-knowledge for students, as individuals 'shape their academic self-concept in part on the basis of their impressions of how their parents, teachers, and peers appraise their academic ability' (Mason et al, 2012: 16, see also: Preckel et al, 2013). Scheirer and Kraut specified particular considerations which combine to inform an individual's self-concept: 'descriptive categorization of self in terms of social roles and personality traits, evaluation of the self-attributes according to social desirability, comparison of qualities through which individuals determine their "ranking relative to other people on a specific dimension," and emotional attitudes toward the self' (1979, in Mason et al, 2012: 11).

Academic self-concept can be summarised as the internal expression of a learner's understanding of their own academic abilities, interests and strengths and their position within the social structures and hierarchies of an academic environment (Corbière et al, 2006; Matovu, 2014), as well as their emotional and motivational relationship with academic work (Marsh 1990, Mason et al, 2012). It is therefore possible that a student who enjoys – and feels a strong affinity for – a particular school subject, and who receives positive evaluations of themselves from teachers, classmates or important persons not present in the classroom, such as family members, may have a higher self-concept in that domain than a student who routinely out-performs them in test conditions.

Self-concept and achievement

There is some debate as to whether high academic self-concept contributes to academic achievement, or to what extent high achievement contributes to self-concept. Many investigations have satisfied the researchers involved that academic self-concept 'directly affects' academic achievement (Ordaz-Villegas, Acle-Tomasini and Reyes-Lagunes, 2013: 118; see also Chen, Chiu and Wang, 2015; Cabaguing, 2018), as well as correlating positively with student strategies for learning (Chen, Chiu and Wang, 2015). Those who are more cautious about a causal relationship will acknowledge that it is probable that the two concepts are in a reciprocal relationship (Ma and Kishor, 1997; Mason et al, 2012; Matovu, 2014).

Mboya (1986) found that academic self-concept had a significantly stronger bearing on academic achievement than global self-concept, and that the correlation between achievement and self-concept is strongest when the measures focus on related areas or within specified domains (e.g. science self-concept is a better predictor of achievement in science than mathematical self-concept, but both are better predictors of science achievement than a general academic self-concept measure). The strength of this relationship is greatest with pupils in post-primary education (Marsh and O'Neill, 1984) as older students accommodate a greater number of domains in which they have discrete self-concept (Ordaz-Villegas, Acle-Tomasini and Reyes-Lagunes, 2013). The existence of domains of academic self-concept which are particular to specific subjects is strongest amongst secondary students (Reynolds, 1988). Academic self-concept is also intercorrelated with academic interest (Corbière et al, 2006) and with a range of other positive academic indicators – achievement, motivation and self-confidence (Cabaguing, 2018) – but it does not correlate with measures of innate ability (Reynolds, 1988). Students' academic self-concept tends to decline from early adolescence to middle adolescence (Matovu, 2014; Cabaguing, 2018) and then recovers or stabilises in late adolescence (Liu and Wang, 2005).

Affecting change in academic self-concept

Self-concept usually appears in research as a measure, a way of capturing individuals' understanding of themselves. It is less common for research to focus on the evaluation of factors affecting self-concept, despite proposals that increased self-concept is a desirable outcome of interventions in its own right (Marsh, Smith, and Barnes, 1983; Mason et al, 2012). It is possible, however, to identify from existing research the factors which are pertinent to self-concept and some of the ways in which they interrelate.

Several authors note the importance of social feedback in the formation of self-concept. This social feedback includes an individual's sense of how others evaluate them as a person in relation to a particular domain, and how an individual evaluates the relative quality of their own performance in comparison to others in their social group (Rogoff, 1995; Mason et al, 2012; Preckel et al, 2013).

Although not explicit in the available research, factors affecting cognition and development more generally can be applied to self-concept. Vygotsky (1978) has proposed that children's cognitive development is strongly influenced by their interactions with other members of their social group who already have well-developed knowledge of the intellectual norms, practices and tools of the society in which they live. This can be related to the idea of the 'significant other', a person whose judgement is valued and deemed informed by an individual, which is prevalent in definitional work on self-concept (Bong and Skaalvik, 2003; Liu and Wang, 2005; Corbière et al, 2006). The importance of teachers in the formation of self-concept in academic domains is an example of this type of influence on self-concept (Mason et al, 2012; Preckel et al, 2013).

Considering the relationship between educators and learners, Rogoff argues that in an interconnected social environment 'it is incomplete to assume that development occurs in one plane and not in others (e.g., that children develop but that … their cultural communities do not) or that influence can be ascribed in one direction or another' (1995:

141). Thus, we can see that a significant other may find their own self-concept(s) changed as a result of their role influencing others. Rogoff argues against a focus on individual factors (the student, the teacher, or the environment) as 'the basic units of analysis' (1995: 139) and provides three models through which socially-supported development may be understood – apprenticeship, guided participation and participatory appropriation – in order to move away from compartmentalised approaches to understanding cognitive development. The apprenticeship model involves 'active individuals participating with others in culturally organized activity that has as part of its purpose the development of mature participation in the activity by less experienced people' (1995: 142). Guided participation is less focused on learning passing from person to person but rather the way in which prevailing social and cultural norms guide the behaviours of those participating in a particular community or event. Participatory appropriation is 'the process by which individuals transform their understanding of and responsibility for activities through their own participation … through participation, people change and in the process become prepared to engage in subsequent similar activities' (Rogoff, 1995: 150).

As well as interactions with others in their social and cultural circles, the framing of ambition and goal-formation can also have an impact on self-concept. Different types of goals have discrete effects on different constructs of the self: mastery-approach goals have a positive effect on self-efficacy, and performance-approach goals have been found to positively affect self-concept (Mason et al, 2012). Performance-avoidance goals (the motivation to avoid being seen to fail, or lack knowledge) increase in later adolescence (Mason et al, 2012) – the same period in which student self-concept generally decreases (Matovu, 2014; Cabaguing, 2018). Performance-avoidance goals are consistently demonstrated to be counterproductive to any measure of student outcomes (Mason et al, 2012).

Increased knowledge has also been found to have an indirect positive effect on self-concept, and the ways in which knowledge is accrued by students is understood to impact

on self-concept (Mason et al, 2012). The authors go on to note that '[e]mphasizing one or other aspect of knowledge and knowing makes a difference' (Mason et al, 2012: 71) in whether students consider a particular domain of knowledge and learning to be constructed, and therefore changeable (availing beliefs), or fixed (less availing beliefs). More availing beliefs are associated with students' openness to new ideas and learning, and their understanding that knowledge within a given discipline is discoverable and mutable (Mason et al, 2012; Depaepe, De Corte and Verschaffel, 2016). An availing cognitive relationship with academic learning, one in which knowledge 'does not reside in omniscient authorities' (Mason et al, 2012: 51), is more likely to facilitate positive changes in self-concept in a given domain.

Identifying factors for successful science interventions

The Committee on Learning Science in Informal Environments (Board on Science Education, USA) was established to evaluate the potential of non-school environments and activities as sites for promoting science knowledge and education. This 2009 study examined in depth how these environments contribute to scientific learning and concluded that, amongst other factors, 'structured, nonschool science programs can feed or stimulate the science-specific interests of adults and children, may positively influence academic achievement for students, and may expand participants' sense of future science career options' (Bell et al, 2009: 3). The authors developed a range of recommendations and identified six strands which 'illustrate how schools and informal environments can pursue complementary goals and serve as a conceptual tool for organizing and assessing science learning' (Bell et al, 2009: 4).

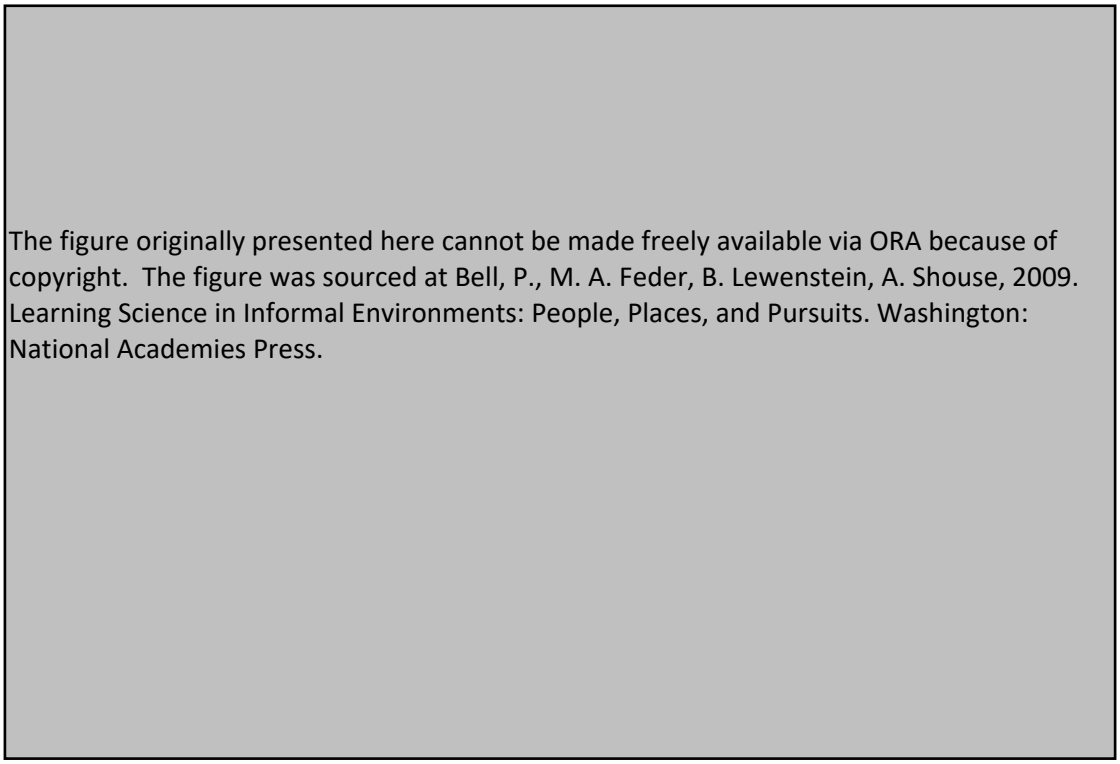
In their findings, Bell et al recommended that building and strengthening relationships between 'science-rich institutions' (2009: 301) and communities represented an area for possible investment which would likely yield positive returns, although the

authors acknowledge that these relationships are not always easily initiated or maintained. Working with scientific institutions was likely to prove particularly beneficial for young people from non-dominant groups and for those from gender, socio-economic or ethnic groups which are historically under-represented in academia and the sciences. The researchers recommend that interventions sited in non-formal learning environments benefit from integration into the specific history or context of the local community or institution and emphasised the importance of establishing and incorporating the interests, knowledge and *prior experience* of the young persons involved in such programmes. The refreshing implication in their recommendations is that all young people will have a pre-existing relationship with science, in some form, and that the onus is on educators to guide participants to re-contextualise their knowledge, interests and ideas as relevant and connected to scientific knowledge. Young people should be encouraged to create their own connections, combining their pre-existing knowledge with the scientific world of the programme or intervention. The authors refer to this as 'border-crossing', bringing 'their own everyday-world culture into the subculture of science' (Bell et al, 2009: 300). The authors further argue that it is particularly incumbent on those involved in non-formal science education to facilitate the 'prior interest and identity' (Bell et al, 2009: 297) of young people and their communities, on the grounds that these factors are 'as important as prior knowledge for understanding and promoting learning' (Bell et al, 2009: 297).

This recognition of interests and identity as a cornerstone of increasing participation in science aligns with recommendations from the ASPIRES study (Archer and DeWitt, 2017) and both pieces of research propose complementary visions of the structure and role of non-school science education (Bell et al, 2009; Archer et al, 2015). However, while numerous pieces of research from the ASPIRES study have promoted 'participation in out-of-school science learning contexts' (Archer et al, 2015: 930), the Committee on Learning Science in Informal Environments has more effectively identified the factors and design

elements of science education required for the development of 'positive science-related attitudes, emotions, and identities' (Bell et al, 2009: 294).

Bell et al propose a framework of six 'strands of science learning' that exploits the specific potential of non-formal learning environments to promote science education with young people (2009: 4). While these strands recognise the requirements of the science curriculum (for students and educators in the USA), they consider non-formal science learning to be complementary rather than supplementary to the curriculum, and instead focus on the opportunities for inter-disciplinary, participatory and community-based learning. The strands identified are as follows:



The first and final strands are of particular relevance to this study, as their focus is on the ways in which individuals increase their levels of comfort and confidence with science, and identify with the concept of being scientific or with the role of scientists. The authors do not recommend that every non-formal opportunity for science learning should encompass each of these strands but rather that programmes should be designed with specific goals in mind and matched to one or more of the strands listed above.

As mentioned previously, the researchers involved in the ASPIRES study have advocated that prioritising an increase in science capital rather than interest should be the goal of any initiative aimed at increasing participation in science education and careers (Archer et al, 2013). Of the eight areas of focus for policy and investment proposed by the ASPIRES study, the two of most particular relevance to the design of the intervention for my project were: first, working to help adolescents see science as 'possible and personally relevant for their own futures' (Archer et al, 2013: 5), and second, challenging the image of the scientist as superlatively intelligent and as a career only for the most elite of academic performers (Archer et al, 2013).

In interviews with 10–11 year old students, Archer et al uncovered a considerable appetite, particularly among boys, for 'dangerous' science — things which explode, burn or poison:

> The children's discursive demarcation between school science (as "safe") and "real" or adult science (as "dangerous") highlights a real dilemma for educators
>
> (2010: 636)

This interest in dangerous experiences with science is justifiably difficult to satisfy with the equipment, chemicals and necessary safety precautions present in science classrooms. The realm of imagination and the mode of fiction, however, remove the need for safety goggles and allow space for young people to explore science on the terms in which they understand it and relate to it.

The consumption of science fiction, through books, television or film, has been found to significantly improve scientific self-efficacy and achievement in young people (Ho, 2010) and consuming science fiction in the classroom has been explored, and recommended, as a tool for learning about science (Luokkala, 2014; Colson, 2019). Despite this, interdisciplinary approaches to science and science fiction in the classroom are rare (Vrasidasa et al, 2015). A USA intervention based on the classroom reading of science

fiction, inspired by findings from the European Union initiative called "Science Fiction in Education", aimed to make science more attractive to pupils. The project incorporated science fiction into classroom settings, providing tools and resources to support teachers to achieve this goal. Reviewing the project, the researchers report positive feedback from teachers who participated in the study, but do not comprehensively report on student perspectives. The authors suggest that much of science fiction will not appeal to girls (although they do not supply any evidence for this) but nevertheless conclude that the use of science fiction in science education has the potential to generate 'motivation, immersion, and a sense of agency' (Vrasidasa et al, 2015: 211) and, further, may be an effective method of achieving the 'substantial reforms' required to improve the numbers of students who go on to engage in science in higher education and as a career (Vrasidasa et al, 2015: 201).

Creating science fiction has been documented as a tool for assessing the science knowledge of students (Barra, 1998), and as beneficial for developing writing skills and teamwork (Rish, 2011). Creative writing projects have been used to develop student self-esteem and to explore identity (Chandler, 1999; Muse, 2019). Smith, Shen and Jiang (2019) provide an overview of a project they designed – Project IF – where students were encouraged to work in teams to create multimedia projects which explore socioscientific challenges. The project was carefully scaffolded over time to support creative engagement with science knowledge, rather than simply adding a creative writing exercise to a planned sequence of science lessons.

> First, they experience disciplinary sessions to learn more about various socioscientific issues, including web-based science units, hands-on activities … and field trips (e.g., university science labs and botanical garden). Second, students read and analyze sci-fi mentor texts to understand the genre and gain inspiration for their own narratives. Third, students participate in a variety of sessions where they learn from "experts"—ranging from practising scientists (e.g., marine biologists, geophysicist, medical scientist) to sci-fi authors, filmmakers, and professional game designers.
>
> (Smith, Shen and Jiang, 2019: 51)

Student teams were given a range of suggested roles that members might adopt (writer, scientist and designer are listed), but were also free to adopt roles of their own devising (e.g. manager, engineer). Participants were also given the freedom to select the tools and media with which they constructed their narratives. There were multiple opportunities for participants to get feedback from their peers while the work was being developed, and opportunities were sought for participants to share their final work with as broad an audience as possible (dissemination is identified by the authors as 'imperative' for students) (2019: 54).

The authors contend that creating narratives can support students to 'better understand the complex and dynamic relationship between organisms and their environment' (Smith, Shen and Jiang 2019: 50) and argue that this mode of exploring science learning is particularly effective for areas of socioscientific enquiry such as humanity's response to climate change. Some anecdotal accounts of students' self-concept manifesting in fictional characters in the creative work are included but these descriptions are not developed.

Science and creativity

While it may at first glance appear that combining science and creative writing is interdisciplinary work of the broadest sort, it is worth noting that creativity is deeply embedded within science – even if it is not always described as such. Neither science nor creativity are independent of the cultural and social context in which they emerge (Chan, 2013). While scientific progress has been understood historically as the uncovering, connecting or remembering of knowledge, more contemporary views of science recognise that within even the most disciplined of scientific enquiry, a certain amount of human creativity is needed to understand connections, try new ideas and support scientific progress (Klausen, 2013). In science, creativity is more often framed as innovation (Miettinen, 2013).

Mumford et al propose eight stages which they consider to be core to the creative process: '(1) problem definition, (2) information gathering, (3) information organization, (4) conceptual combination, (5) idea generation, (6) idea evaluation, (7) implementation planning, and (8) solution monitoring' (2010: 260). Ordaz-Villegas, Acle-Tomasini and Reyes-Lagunes define creativity as a '[p]rocess which generates sensibility to problems, deficiencies, or gaps in knowledge, leading to identify difficulties, and find solutions and make decisions strategically' (2013: 121). Out of context, either of these models could as easily be attributed to the scientific process, suggesting that the deep divide often perceived between science and creativity derives not so much from applied practice as from cultural assumptions.

Conclusions

The range of papers which have been published in relation to the ASPIRES study highlights the importance of identification with science and scientists as a key aspect of improving a student's likelihood to pursue scientific education and work in the future. Archer and DeWitt's (2017) findings on the changes in student attitudes to science over time correlates with findings on academic self-concept in middle adolescence (Liu and Wang, 2005; Matovu, 2014; Cabaguing, 2018), which further support the proposals that an intervention in science capital and self-concept has a greater chance of being efficacious than an intervention aimed at achievement, interest or knowledge (Archer et al, 2013).

<u>Attributes identified for inclusion in the planned intervention</u>

Based on the research available on affecting and developing self-concept, an intervention aimed at improving student self-concept in an academic domain should ensure participants benefit from the positive appraisal of their work by others involved in the project, particularly from any collaborators viewed by the participants to have relevant expertise

(Rogoff, 1995; Mason et al, 2012; Preckel et al, 2013); consider how intervention objectives are framed, given the possible impact of performance-approach goals on self-concept (Mason et al, 2012); and, provide opportunities for participants to increase their domain knowledge in a way which supports the development of availing beliefs about the domain (Mason et al, 2012).

The review of pre-existing interventions documented in the literature, as well as guidelines produced for informal and extra-curricular programmes, would indicate that this intervention should, if possible, build connections between the participants and one or more 'science-rich institutions' (Bell et al, 2009: 301); incorporate participants' prior knowledge of, and relationship with, science (Bell et al, 2009); facilitate the exploration of dangerous and exciting science (Archer et al, 2010); provide well-scaffolded opportunities for participants to develop their ideas and learning over time (Smith, Shen and Jiang, 2019); and promote the dissemination of any creative output at the end of the project (Smith, Shen and Jiang, 2019).

It can thus be hypothesised that an intervention which satisfied the criteria could be expected to positively impact on the academic self-concept of a group of students and, more specifically, within the domain of science.

As has been noted earlier, domains within self-concept are relatively independent of one another, and therefore investigating the impact on only one domain may inadvertently leave the researcher blind to comparative and interrelated domains. Thus, a second domain, appropriate to the planned intervention, is proposed for parallel consideration: creative self-concept. This domain was selected as pertinent to the study because the pre-existing structure of the writing centre's programmes is predicated on the presumption that participation promotes creativity, although this has yet to be evaluated in any formal manner. Consequently, any findings relating to creativity would be of profound interest and value to the hosting organisation. Additionally, there are areas of similarity in creative and

scientific thought, and science fiction is both a scientific and creative endeavour. Therefore, the potential for change in both domains should be investigated equally lest the research produce a perspective on the project which captures an unduly narrow picture of the intervention.

The general hypothesis for this intervention, therefore, supported by the points summarised above, is that a thoughtfully structured creative writing intervention, focused on science fiction, will have a positive impact on both the creative and science self-concepts of students.

In testing this hypothesis, this research sought to answer the following questions:

1. In what ways is the science self-concept of Transition Year students affected by participation in a science fiction writing project based outside their normal school environment?

2. In what ways is the creative self-concept of Transition Year students affected by participation in a science fiction writing project based outside their normal school environment?

3. What specific features of the intervention design or environment can be identified as positively or negatively contributing to any effects?

Chapter Three: Methodology

This chapter will outline the design of the intervention; the recruitment of participants and collaborators; adaptations made to prior project designs; methodological approach; the selection and development of measurement instruments; procedures for data analysis; ethical considerations pertinent to the study; and, finally, a summary of the impact of COVID-19 and the changes to planned procedure that it necessitated.

Intervention design

The proposed intervention was comprised of thirteen two-hour sessions between January and April 2020. During these sessions, participants had the opportunity to partake in a range of workshops, activities and talks designed to support their personal exploration and creation of short pieces of fiction. Their writing was supported by volunteer writing mentors, science specialists from the participating university, and professional services from the publishing industry. A collection of final stories, one from each participant, would be printed as an anthology and a book launch was to be held at the school in May.

Recruitment of participants

The participants in this study were Transition Year students from an all-boys secondary school in the Irish public education system located in West Dublin. The school draws its pupils from 'diverse social and economic backgrounds' (DES, 2013) in an area which is categorised as below average for almost all criteria on the Pobal Deprivation Index (2019). The project was offered to the school because of a good pre-existing working relationship between the writing centre and the school's teaching staff and because of an existing request from the school that their students be offered the opportunity to take part in one of the writing centre's programmes during the year. There was no financial cost or reward to the

school for taking part and the programme was free at the point of delivery to students. Having had both the project and research plan approved by the Principal, the year head and the English teacher then selected the intervention group.

The experimental design used in this project was a 'quasi-experimental pretest-post-test design' (Edwards and Talbot, 1994: 42) which required identifying a minimum of two comparable groups – the experimental group, which would participate in the intervention, and a control group (Edwards and Talbot, 1994). The realities of the public education system, where students are assigned to groups based on a range of factors affecting the timetable of the entire school, precluded students being assigned to the control or experimental groups randomly so, instead, two pre-existing classes in the school were selected as the experimental and control groups. The participants for the intervention were one class group of twenty-three students who were together for both English and Science lessons, and who were not streamed in either subject; the control group was another class in the same year. Working with two similar groups in the same school reduced as many variables as possible. Additionally, pre-test results could be used to confirm that the experimental and control groups were appropriately homogeneous for the variables under exploration (Edwards and Talbot, 1994).

Collaborators

While there is a strong argument to be made that self-concept can only be observed and measured from within, it is directly affected by others. Therefore, managing the environment in which the participants experienced the project was very important. In addition to their peers, with whom they were familiar, participants interacted with a number of adults during the intervention with whom they had no previous relationship. All collaborating adults were individually invited to, and briefed specifically for, this project.

Volunteer writing tutors: These tutors monitored participants' engagement, offered feedback on workshops and collaborated on planning the timings for the project and individual workshops.

Science specialists: Two science specialists, lecturers at the university, offered their input during the planning stages of the project (summer 2019) and also read drafts of participant work. One attended the majority of workshops and stayed afterwards to discuss his thoughts on the science and learning he observed in each workshop.

Education Director: The Education Director of the writing centre was involved in planning all parts of the project and also attended most of the workshops.

Industry professionals: The professional production of the anthology was supported by input from a commissioning editor (feedback on drafts), graphic designer (cover design) and an established Irish writer of science fiction and fantasy (foreword). These professionals all read the work of the participants and gave enthusiastic and positive feedback to the young writers.

Teachers: The project was enthusiastically supported by the intervention group's form teacher and their English teacher as well as a variety of other teachers at the school. Teachers did not participate in any of the workshops but were present for supervisory purposes.

Adaptations from prior projects

This intervention was based on the writing centre's Book Project model, an annual project where a single group of Transition Year students from one school participate in a range of writing workshops and, over the course of the academic year, write and publish an anthology of their collected work. The project was shortened from its normal length of a full academic year to just five months in order to allow for the additional preparations required to carry out the research. The writing centre does not normally seek to have experts in its volunteer teams: however, professional writers and scientists were recruited to this project in order to

meet the recommendations that participants interact with those whom they would recognise as having relevant expertise (Rogoff, 1995; Mason et al, 2012; Preckel et al, 2013). To fulfil the necessary attributes for the intervention identified in Chapter Two, the sessions were located in the participating university, a 'science-rich' institution (Bell et al, 2009: 301), instead of the writing centre where programmes are normally located. Finally, while workshops and activities in the Book Project would normally be designed to afford participants experience of as broad a range of genres and topics as possible, the workshops for this project were designed to draw out the prior knowledge of participants (Bell et al, 2009) and help them connect their knowledge with the broader world of science (McGregor, 2007). A central tenet of all workshops and projects at the writing centre – 'you can write whatever you want' – was preserved.

Methodological approach

Given the attendant complexities of measuring self-concept, quantifying changes over time requires a multi-faceted approach. The research aim – assessing the impact of a specific intervention on a group of students – indicated an experimental research design, the only approach that can 'test for causation' (Edwards and Talbot, 1994: 29). However, self-concept is understood to be 'inherently phenomenological' (Strein, 1995: 1, see also: Marsh and O'Neill, 1984; Marsh, Smith and Barnes, 1983). Phenomenology is a qualitative theoretical framework for observing and understanding the world as something which is 'lived by a person' or persons, rather than something which is independent of the individual or objectively true (Webb and Welsh, 2019: 171). Thus, while quantitative methods to measure self-concept were indicated by research questions one and two, more qualitative methods would have to be used to explore any changes associated with the intervention and to elucidate any contradictions as required by the third research question.

Selection of main measurement instrument

In self-concept research, self-reporting questionnaires with a Likert-type rating scale are the most common instruments (Strein, 1995, Mason et al, 2012). Checklists, Q-sorts, free-response statements and methods where participants identify which of two statements more accurately describe them are also commonly used (Strein, 1995; Mason et al, 2012).

Given the small scale of my research, the usefulness of being able to compare the design and findings of the study to other published research and the suitability of questionnaires for pre- and post-intervention testing, a self-reporting questionnaire using a Likert rating scale was selected as the most appropriate primary research instrument in this study.

Instrument design

Liu, Wang and Parkins (2005) acknowledge the challenges of translating the construct of self-concept into an operational term and reference a variety of approaches by other researchers. The development of a new instrument requires extensive piloting (Liu, Wang and Parkins, 2005) which was deemed impractical for a study of this scale. The complete cohort was so small that piloting an instrument with 10% of the population that the survey was intended for (as indicated by Edwards and Talbot,1994) would have resulted in pilot data from less than five participants. Further, given the limited access to the groups involved in the study, incorporating a pilot study would also have been excessively disruptive to the host school or would have significantly depleted the time available for the planned intervention while the students were on the university campus. Instead, existing instruments which were well-piloted and validated, and aligned with the research goals of this project, were sought.

There is ample evidence in self-concept research of existing instruments being successfully adapted for new research (for example, Marsh and O'Neill, 1984; Corbière et

al, 2006; Mason et al, 2012; Chen, Chiu and Wang, 2015; Cabaguing, 2018; Vikas, 2019). Based on the examples and guidance from these researchers, the questionnaire for this research project was developed from the items used to measure self-concept in the ASPIRES study (Archer and DeWitt, 2017), and the full range of questions found in both the Self-Description Questionnaire III (SDQ III) (Marsh and O'Neill, 1984) and the Academic Self-Description Questionnaire (ASDQ) (Marsh, 1990) (see Appendix 1).

The ASPIRES researchers developed their survey instrument from pre-existing instruments with adaptations reflecting the specific areas of their enquiry, interviews with a sample of the target group and relevant literature. (DeWitt et al, 2013). The ASPIRES study used seven items to measure self-concept using a Likert-type scale with five points ranging from 'strongly agree' to 'strongly disagree' (Archer et al, 2013, DeWitt et al, 2013).

The SDQ III measures thirteen domains of self-concept with ten to twelve questions per domain (see Appendix 1 for relevant items). Roughly half the questions are negatively-worded and responses are recorded on an eight-point Likert-type scale (Marsh and O'Neill, 1984). It was designed to measure nine domains of academic self-concept and four non-academic domains, and was developed and evaluated for secondary school students with a median age of sixteen years (Marsh and O'Neill, 1984), making it highly appropriate for use with a Transition Year group.

The ASDQ contains six-item sub-scales for each academic domain (Marsh, 1990). Parallel wording was used for items in all subject areas (Marsh, 1990; demonstrated in the adaptation by Corbière et al, 2006).

There was considerable overlap of items between the three instruments selected as most appropriate for this study. To arrive at an instrument of manageable length, items were first sorted by theme and then individual items with similar wording or meaning were pooled to ensure the widest coverage whilst avoiding repetition. A representative item from each pool was selected and the wording was adjusted to be as domain-specific as possible

because previous research into subject-specific self-concept research, which did not use adapted items, considered the lack of domain specificity in their questionnaire to be a limitation on the validity of their findings (Flowers, Raynor and White, 2013). In his own consideration of how the SDQ, and its related questionnaires, could be adapted by researchers, Marsh advises that '[r]esearchers specifically interested in self-concepts in particular academic subjects should measure self-concepts with scales specific to those subjects … [and recommends] this even more strongly for researchers interested in other school subjects such as physical education, art and music.' (1990: 635).

The six-point Likert scale used in ASDQ was selected for use in this study. It was preferred to scales with odd-numbered options (such as the one used in the ASPIRES research) as the even number meant there was no truly 'neutral' choice , prompting respondents to make a decision about each question, while also giving them options about the strength of their feelings in relation to that decision. The resulting instrument used eleven items for each domain (see Appendix 2), within the range of items per domain recommended by Marsh and O'Neill (1984).

Although Harter's self-perception questionnaire was discounted for this study due to its inflexibility (she explicitly cautions against shortening or adapting the instrument) and the lack of specificity to the domains of interest to this study, her guidance on administration of her questionnaire to groups was helpful. Portions of Harter's protocol, such as her direction to researchers to assure participants that the instrument is not an examination of any sort and her recommendation of a practice question to be completed aloud with the group, was adopted into the delivery of the questionnaire for this study (2012).

Instrument constraints

Questionnaires are useful as they enable the researcher to collect a substantial amount of data relatively quickly compared to other research instruments, as they easily accommodate the need for anonymity and results can be readily analysed and compared. Additionally, questionnaires are generally reliable instruments with 'a valuable descriptive and exploratory design' (Edwards and Talbot, 1994: 36).

Questionnaires are not without their disadvantages. Self-concept researchers should be aware of the limitations of the verbal/reading comprehension of those with whom they are working. Further, even quite young children will be aware that some responses are more socially acceptable than others and may adjust their answers to please adults (Strein, 1995). Harter criticises the Likert-scale approach as particularly 'susceptible to socially desirable responding' (2012: 5), but the majority of self-concept researchers appear satisfied with its application in their research (see, for example, Marsh, Smith, and Barnes, 1983).

Lengthy questionnaires are more reliable, but they have drawbacks in a live research setting as they require considerable periods of time to complete and participants can become fatigued or disengaged. Condensed instruments, developed to address these issues, have been criticised extensively for the standards of research produced (Marsh et al, 2005). Although the researcher must be mindful of the weaknesses of shortened instruments, their results can be used with confidence provided researchers respond only to those factors investigated by the reduced item list and do not attempt to generalise to the purview of the original instrument (Marsh et al, 2005). The items selected for this study were adapted from larger questionnaires and represent only a portion of the remit of the original questionnaires that they were drawn from. However, this enquiry is exclusively concerned with only a fraction of what the progenitor questionnaires sought to measure and, thus, the questionnaire adapted for this study can be expected to be valid for the consideration of science and creative self-concepts. However, it would be inappropriate to generalise from

those findings to make statements about the global or general academic self-concepts of the students.

It is recommended that a proportion of items are worded negatively and reverse scored to 'disrupt response biases' (Marsh and McDonald Holmes, 1990: 93). Consequently, four of the eleven items for both of the domains investigated in this study were worded negatively. Negatively-worded items are not generally problematic in research amongst this age-group (Marsh and McDonald Holmes, 1990). Nevertheless, the practice question, which participants were guided through by the researcher and in the presence of their teacher, was also worded negatively to ensure no participant was misdirected by these questions.

While questionnaires are a relatively simple method of capturing a snapshot of a situation, they are by themselves ill-equipped to support the researcher to determine any causation and cannot illuminate factors which may have influence on the subject of investigation (Edwards and Talbot, 1994). To address these weaknesses, a number of other methods were identified which could be used to triangulate a self-reporting questionnaire.

Triangulation

Edwards and Talbot identify that triangulation may be achieved in research design by introducing a multiplicity of inputs in any part of the research: multiple methods, multiple subjects or multiple researchers (termed 'methodological triangulation', 'participant or hierarchical triangulation' and 'researcher triangulation' (1994: 46–47). They propose that in applied settings 'mixed triangulation' is most often appropriate, 'in which at least two methods are used to get information on three perspectives on the event' (1994: 47).

To complement the use of a self-concept measurement via questionnaire before and after the intervention, it was planned to undertake semi-structured interviews with selected participants and collaborators towards the end of the project. While all participants were to be included in the questionnaire, stratified sampling would be used to identify participants

to be invited to the semi-structured interviews. The researcher would have identified the desired strata, the class teacher could identify groups of students in those strata, and one or two individuals invited at random from each group. Thus, in such a small group, the risk of sampling a group of excessively similar students was mitigated. This small number of interview participants would provide qualitative data with which to interrogate those aspects of the project not well-investigated by highly-structured questionnaires. Interviews with a selection of the collaborators working with the participants, writing samples from workshops, examples from the completed anthology, and observations in a researcher journal would be used to provide multiple further perspectives with which to understand the quantitative data collected through the questionnaire. Thus, any conclusions drawn from the study would be robustly supported by data from a range of different sources.

It should be noted that interviews with the adults involved with the participants were not intended to be used to verify the findings of either participant interviews or questionnaires but rather to help illuminate possible causes of or connections between issues raised by the participant interviews or questionnaires. Both self-reporting and perceptions of others have been used to measure self-concept (Marsh, Smith and Barnes, 1983; Marsh and O'Neill, 1984). It has been proposed that both these measures should produce valid measures of self-concept, if self-concept of an individual is considered simply to be the subject's perception of how others view them, and it has been suggested that self-concept instruments given to individuals who know the subject could be used to validate self-concept reporting (Marsh, Smith and Barnes, 1983). However, Marsh has repeatedly argued that there is a phenomenological difference between internal and external perspectives of the self, and the extent to which the subjects' and outsiders' reporting agree is indicative of how well the non-subject respondent knows the subject, rather than indicative of the strength of the instrument or the accuracy of the reporting (Marsh, Smith and Barnes, 1983; Marsh and O'Neill, 1984). Empirical support for the argument that

outside perspectives can validate self-concept self-reporting is weak (Marsh, Smith and Barnes, 1983; Strein 1995).

Considering sources of convergent validity for student self-concept self-reporting on academic domains, Marsh, Smith, and Barnes argue that 'teachers who spend the entire day with the same group of students should be able to serve as one indicator of student self-concept' (1983: 344). Based on this logic, excepting highly unusual schools or special provision, no secondary teachers in an Irish context are adequately familiar with the students they teach to be used to validate their students' self-reporting on self-concept. It would certainly exclude, as a triangulation method, the adults collaborating on this project who met with pupils for no more than two hours a week over half an academic year. While their perceptions may have been illuminating in terms of the interactions and behaviours demonstrated, any judgements on participant self-concept put forward by these adults would not be an adequately valid measure to either support or contradict the participants' self-reporting.

Academic self-concept can be expected to correlate with academic achievement (Reynolds, 1988; Ordaz-Villegas, Acle-Tomasini and Reyes-Lagunes, 2013; Chen, Chiu and Wang, 2015). This would indicate that changes to student test results across the year could be used to triangulate changes in self-concept during the project. However, the extraneous variables which could impact on student test results in science classes contraindicated this as a reliable validation measure. Additionally, the agreement with the school was that they would release the students to take part in the project on a weekly basis and facilitate two brief visits to the school before and after the intervention. Placing an additional burden on the science department and curriculum time would exceed this agreement. Incorporating a science test into the time allocated to the project would have undermined the ethos of the project and could potentially 'violate participants' expectations about learning in informal settings' (Bell et al, 2009: 310). Finally, while science is a subject where there are a range of

pre-existing tests for all ages of student, these have been identified as inadequate for measuring the impact of non-school science interventions (Bell et al, 2009), and there are significant issues in finding a generally accepted test which can measure creativity (Miettinen, 2013; Simonton, 2013; Steers, 2013).

Data analysis

Questionnaire

Average self-concept scores for each domain were found by adding the total score for the eleven items in that domain and dividing the total by the number of items. Average scores for each item were calculated by adding the score from each participant, divided by the number of participants who responded to the item. Each item was scored from one (false) to six (true). Consequently, the highest possible self-concept score for an individual or group average was six, and the lowest was one. For the purposes of discussion, numbers were rounded to two decimal places. In the event that a particular item in a questionnaire was skipped, illegible or had multiple answers selected, that item would be excluded and the formula for averaging the response for science or creative self-concept for the participant adjusted to reflect the number of questions answered.

In this way, science and creative self-concept scores could be generated for each participant, and for the overall cohort, as well as trends in responses to particular items. In the interests of completeness, the overall group scores for pre- and post-intervention questionnaires were calculated using all available data. In order to facilitate more valid comparisons between pre- and post-intervention data, the individuals who responded to both questionnaires was identified and discrete calculations were carried out to identify pre- and post-intervention averages for this group.

Semi-structured interviews

Interviews with participants and collaborating adults were to be audio-recorded and transcribed, with interesting, illuminating or challenging comments highlighted for analysis. Both agreement and disagreement between participants would be sought. As the questionnaire was the main measurement instrument, there were no plans to code the interviews for any quantitative analysis. Rather, qualitative findings would be used to illuminate the quantitative findings (or issues not identified quantitatively), indicate possible causes for changes measured by the questionnaire, and identify any relationship which the participants perceived between their experiences on the project and their feelings about science or creativity.

Other data sources

Additional evidence from the intervention sessions themselves would be collected to illustrate, corroborate, or contrast aspects of the intervention highlighted in the interviews. This would include samples of participant writing from exercises, photographs of activities and written contributions from collaborators. As with the interviews, the purpose of collecting this data was to aid interpretation of effects observed in the questionnaire data or reported in participant interviews and as such would not be coded independently.

Ethics

This research was supervised by a university in the United Kingdom but undertaken with educational institutions and individuals in the Republic of Ireland. Consequently, ethical guidance promulgated in both jurisdictions is applicable to the planning and execution of this research. The three key documents underpinning the ethical considerations of this project were the *Ethical Guidelines for Educational Research* (British Educational Research Association [BERA], 2018), the *National Policy Statement on Ensuring Research Integrity in*

Ireland (Irish Universities Association, 2014) and the *Children First National Guidance for the Protection and Welfare of Children 2017* (Department of Children and Youth Affairs, 2017). Prior to undertaking any research or intervention for this project, university ethics procedures were fully engaged with and, on ethical approval for the research being granted, routinely reviewed throughout the project. Key considerations, and some issues arising during the project, are outlined below.

Justification for research

As outlined in the introduction to this study, there is considerable societal concern about the lack of young people pursuing science as a career. A review of the existing literature in Chapter Two suggested that an intervention of the type planned for this project could reasonably be expected to enhance students' identification with science. Examining existing research had not unearthed any examples of very similar studies previously conducted and, thus, it was deemed that the demand on participants' and collaborators' time and trust was justified (BERA, 2018). In view of the likelihood that this study would not, due to its small scale, produce a social benefit which would outweigh even the most minor risks of harm, the safety, rights and wellbeing of participants and collaborators were treated as paramount over the research aims for the duration of this research (BERA, 2018).

Student opportunity

As participants in a two-term project with the writing centre, the intervention group benefitted from an experience which is in high demand and has only been available to a handful of schools over the last decade (the majority of school groups are restricted to standalone workshops). Thus, they had an educational advantage not available to the control group. For parity, the other half of the cohort (the control group) were invited to a

standalone workshop with the writing centre in the first term and participated in a poetry project in the second term which was facilitated by a separate organisation.

Informed participant consent

There is an inherent imbalance of power in any situation where some are cast in the role of 'teacher' or 'expert' and others as the 'learner' or 'student', no matter how carefully one tries to minimise this disparity. The addition of the role of researcher, one who will record and interpret the actions and thoughts of others, has the potential to exacerbate this. While this issue cannot be entirely eradicated, it can be acknowledged and minimised within a group provided 'each respects the other and keeps [their] promises' and all concerned know exactly what the agreement to participate means for both researcher and participants (Sabar, 2005: 118). It was imperative that the school Principal, participants' parents and participants were fully informed of the intended research in adequate time to consider the proposal, ask any questions and have any concerns addressed. The Principal's verbal consent had been obtained a number of months in advance and detailed written information about the study with directions on how to withdraw from the study was supplied to the school to be shared with the Principal, families and participants a month in advance of the project start date (see Appendix 3). In keeping with the guidelines from the Department of Education at Oxford University, positive parental consent for participation was not sought as the research did not stray outside the normal remit of classroom practice and was carried out by a qualified teacher. Of course, parents and students had the option to withdraw from the research and received clear instructions on how to exercise that right.

The day before the intervention was due to start, visits to both intervention and control groups were arranged, a verbal overview of the information which they had received in writing was given and questions or comments invited. It was re-emphasised that there was no requirement to partake in the research, and that they could withdraw at any stage.

Participant experience

The experience of the participants was prioritised in planning and in all interactions. With the exception of some industry professionals, whose interactions with the group were one-off or remote, all the adult collaborators had been vetted by An Garda Síochána (the national police service) and trained by the writing centre, and all adults, including all industry professionals, had been selected and briefed specifically for this project. As the ethos of the host organisation is deeply egalitarian and not assessment-based, it was important that the requirements to measure and assess the impact of the project did not excessively impinge on the principles underpinning the intervention and the participants' experiences (Bell et al, 2009). Any questions about the research or overall project were answered candidly throughout the project.

Had interviews proved possible, the intention had been to interview the participants in pairs in order to ensure their maximum comfort and to allow them a peer with whom to respond to questions and tease out their ideas. There may be a risk that pupils who would rather not take part in the research would feel obliged to take part due to the power imbalance between themselves, as young adults, and the people making the request. Pupils were reassured that participation in the workshops was not contingent upon their participation in the research, and that they could change their mind at any point during the project if they wished. A number of ways to withdraw consent were identified to them. The teachers at the school were reassured that pupil cooperation was not a condition of the project being offered to the school and that there was no reason for concern if a pupil, or their parents/guardians, chose to opt out.

As the research focuses on self-concept, there was a chance that the investigation may touch on issues which a pupil may find stressful if they have very low self-esteem in relation to either of the domains under investigation. It is vital that the researcher be

mindful of this during questionnaires and interviews, and open to changing any interview or research plan should they appear to cause discomfort for any participant.

When working with young people in the area of science fiction, climate change and environmental catastrophe are common themes in writing and discussion. Especially over a longer-term project, the team involved needed to be mindful of the anxiety this could cause some project participants (even if they were the ones choosing to explore these issues).

Anonymity and data storage

Consent forms and paper-based questionnaires were stored at the researcher's home in a locked file box, barring periods of time needed to transport, organise or extract data, as per the plans laid out in the ethics submission made to the university. The exception to this was when the documents were handled in the school by the class teachers. Information and consent forms were handed to, and collected from, pupils by school staff before being passed to the researcher. As schools regularly collect and handle personal or consent data similar to the consent being collected here, their normal procedures were more than adequate for administering these forms.

Digital data with identifiable information, such as audio recordings, were to be stored in password-protected folders on the researcher's laptop, with a backup copy on an encrypted drive stored with the physical records.

Due to the small number of participants, first names (with an initial of surname in the event of multiple first names in the group) would be used to identify interview data in its raw form. This was to enable data to be identified and destroyed if any participant withdrew consent and no longer wished to participate in the study. It was deemed important to the validity of the questionnaire that responses not be identified by name. However, to facilitate pairing pre- and post-intervention questionnaires, and to ensure correct data could be removed from the study upon request, participants were guided to create a four digit

identifying number for their responses, which they recorded in the back of their homework journals. These numbers were not shared with the researcher or teachers.

All data would be anonymised for the purposes of discussion and conclusions. As the work of participants involved in the project would be published and promoted, it was possible that individuals might be otherwise identified as being part of the group with whom the research was conducted. Adult collaborators, thanked in the book's acknowledgements, might also be identified with the research project in this way. However, whether individuals gave consent and were represented in the research (as opposed to the writing project), would not be public knowledge. Therefore, no participant could be absolutely identified as having contributed to the research. Due to the small population involved in the project, it could be possible to identify anonymised individuals where there is only one of a type, such as the education director. As the focus of the research was not personal for the adults involved, and as they were not a vulnerable population, it is unlikely that such identification would pose a risk to them or their wellbeing. Nonetheless, the potential for identification – and any possible personal or professional impact – was noted as requiring consideration for those adults who consented to participate in interviews.

Ethical issues arising during the study

The number of organisations involved in this research project added a layer of complexity to managing the associated ethical responsibilities. Although the teachers involved at the participating school were excellent collaborators overall, issues arose which highlighted the difficulty for researchers of relying on others to implement procedures. Despite the researcher providing the information and consent forms for both groups to the school four weeks in advance, the class teacher initially did not share the letters intended for the control group, instead only passing on the information intended for the intervention group. When the letters were eventually supplied to the control group, once the error had been identified,

parents and participants did not have adequate time to consider the request in advance of the first questionnaire and there was no option to delay the questionnaire due to a single opportunity to visit the group being made available on the part of the school. Although no members of the control group, or their family, expressed concern at any point before or after the questionnaire, it was a less-than-optimal interpretation of the planned procedure. Additionally, the information and letters for parents of participants in both groups were given to the students to bring home (as is common in post-primary education) and, as direct communication with families would have been inappropriate for the researcher, there was no way to ascertain that families had received the letters from their children. However, the overall procedure was sound and participants and families did appear to read and keep the communication, and one email was received during the course of the study double-checking the details of a procedural matter.

From the outset, minimising stress on the main classroom teacher was a priority in the management of the project. As the key link between the writing centre and the school, it was unavoidable that some additional work would fall to her. The majority of this was normal administrative work which would be required of any teacher whose class is involved in an extra-curricular or off-site project but the research aspect of this intervention necessarily created some extra work for the teacher (collecting consent/opt-out forms, identifying pupils for stratified sampling). Throughout the project, the teacher was regularly contacted to ensure she felt she had adequate support for these aspects of the project.

In compiling the data from the post-intervention questionnaire it became evident that a number of students in the intervention group had received the questionnaire intended for the control group. While there were multiple possible explanations (e.g. the closing questionnaire was completed online and the link may have been shared among friends between the two groups), it again highlighted the vulnerability of the study procedures to miscommunication and errors, although there is no doubt but that

communication with students and families is always more appropriately managed by the participating school than by the researcher.

COVID-19 and changes to planned procedure

Upon the implementation of COVID-19 restrictions in Ireland, the decision was taken to pare back the requests made of the liaison teacher to the absolute minimum. In the interests of continuity for the students, and support for the school, it was judged most ethical to continue the intervention to its conclusion online rather than to abandon the project, and the assistance of the teacher in facilitating this is gratefully acknowledged. However, in light of the increased stress across the population during this time (Central Statistics Office, 2020) and the complete transformation of working life for teachers and school leaders (Carroll and McCoy, 2020) it was judged inappropriate to request additional administration or support for any aspect of the project that did not directly support students or the school. While the link to a closing questionnaire was provided online for the intervention and control groups towards the end of the summer term (as part of an email communicating a number of updates about the conclusion of the project) no request was made of the teacher to exhort pupils to complete the questionnaire or to issue follow-up reminders in the event of very low levels of response. Additionally, the complexity of establishing the communication channels necessary to conduct interviews online would have required procedures far beyond the original scope of the initial ethics proposal for this research. In light of these facts, interviews for this research were not pursued with either participants or adult collaborators (many of whom were working in education and subject to the same stresses as teachers at the school).

The decision to disseminate the post-intervention questionnaire online, discussed in advance with my research supervisor, was a break from the intended procedure laid out in the original ethics proposal. However, given the extraordinary novelty of the situation,

and the fact that the questionnaire was optional, collected no personal data, and did not require students to engage with any technology not already in use for the purposes of completing the intervention, this was deemed to be an acceptable deviation in circumstances which could not reasonably have been anticipated. Furthermore, this approach did not expose the participants' personal data to the internet (BERA, 2018: 25).

Chapter Four: Analysis of research undertaken

This chapter will outline the changes to the intervention design and data collection as a result of the COVID-19 pandemic, report the available results from the data collection which was completed, reflect on the potential effectiveness of the intervention in light of the literature, and outline considerations for future research.

The closure of schools during this intervention had a detrimental impact on the structure and delivery of the intervention, as well as disrupting planned data collection, to the extent that an argument for the reliability or validity of the data cannot be made. In recognition of this, a summary of the data collected is reported in this chapter but an in-depth analysis is not attempted.

Changes to intervention design and data collection

Changes to the intervention

Seven two-hour workshops were conducted between January 1st 2020 and 6pm March 12th 2020, when all schools in Ireland, from pre-schools to higher education institutions, were closed as part of the public health response to the pandemic (Department of Education and Skills, 2020). These workshops comprised:

- Facilitator-led workshops on specific themes common in science fiction
- Self-directed individual writing time with adult support in a ratio of three students: one adult
- Group exercises exploring relevant themes and developing individual ideas
- Students reading work aloud to peers and group discussion of work

The participating students had completed a first draft of their stories in the days before Irish schools closed. Thereafter, all teaching, support and guidance was delivered through email

communication sent to their classroom teacher who subsequently emailed it on to the students. As the writing centre was an outside organisation, it would not have been appropriate for the researcher to engage directly with the class through online communication channels. Many of the adult collaborators involved with the project continued to volunteer their time remotely, reading drafts and writing up feedback to be shared with the writers via their teacher. The following planned aspects of the intervention were delivered remotely through email, Google forms, Google drive and Dropbox:

- Editorial and scientific feedback on drafts
- Submission of final drafts for publication
- Group brainstorming and voting on anthology title
- Group voting on anthology cover design options
- Students reviewing publication proof online
- Professional publication of an anthology of student work

Although as much of the project as possible was delivered remotely, the following features of the intervention were abandoned or postponed:

- The participating students did not meet with the editor, designer or foreword writer in person
- The book launch was postponed until late Autumn at the earliest
- The group did not receive a copy of their publication before end of term

Changes to planned data collection

Of all the planned methods of data collection described in the previous chapter, only the pre- and post-intervention self-concept questionnaire aspect was carried out, due to the disruption caused by the COVID-19 pandemic. As will be detailed later, the administration of the post-intervention questionnaire was so problematic that, effectively, useful

comparative data could not be extracted. Nevertheless, this chapter will detail the key indicators from the data collected (a complete data set is available in Appendix 4).

The pre-intervention questionnaire was administered in a classroom environment and only available to students for the class period during which the researcher was present. As the post-intervention questionnaire took place after school closures, circumstances necessitated that it was administered remotely and without any direct communication from the researcher to ensure participants understood the instructions or that every participant had received the survey. The post-intervention survey questionnaire was left open for a period of two weeks to maximise the opportunity for participant's responses.

Results

Pre-intervention survey

The initial survey was completed by nineteen participants from the intervention group and sixteen participants from the control group out of twenty-three possible respondents in each group. Participation rates reflect school attendance on the day the survey was carried out – no student present on the day declined to take part. Each item had six response choices (*false, mostly false, more false than true, more true than false, mostly true* and *true*) and these were converted to numerical scores for calculations and comparison. The lowest possible score for any item was one (*false*) and the highest was six (*true*).

The pre-intervention survey demonstrated that the two groups were broadly similar on key measures (Figure 1) and thus were appropriate cohorts with which to investigate the impact of the intervention. Edwards and Talbot indicate that a minimum response rate of sixty per cent is required in order to consider your findings valid and argue that '[a] lower figure would raise questions about the appropriateness of the survey design, the representativeness of the sample or the overall research process' (1994: 34). The high response rate to the initial survey would suggest that the research design was appropriate for

the setting although, given the small scale of the study, the results could not be generalised even in the event of the intervention being completed as originally planned.

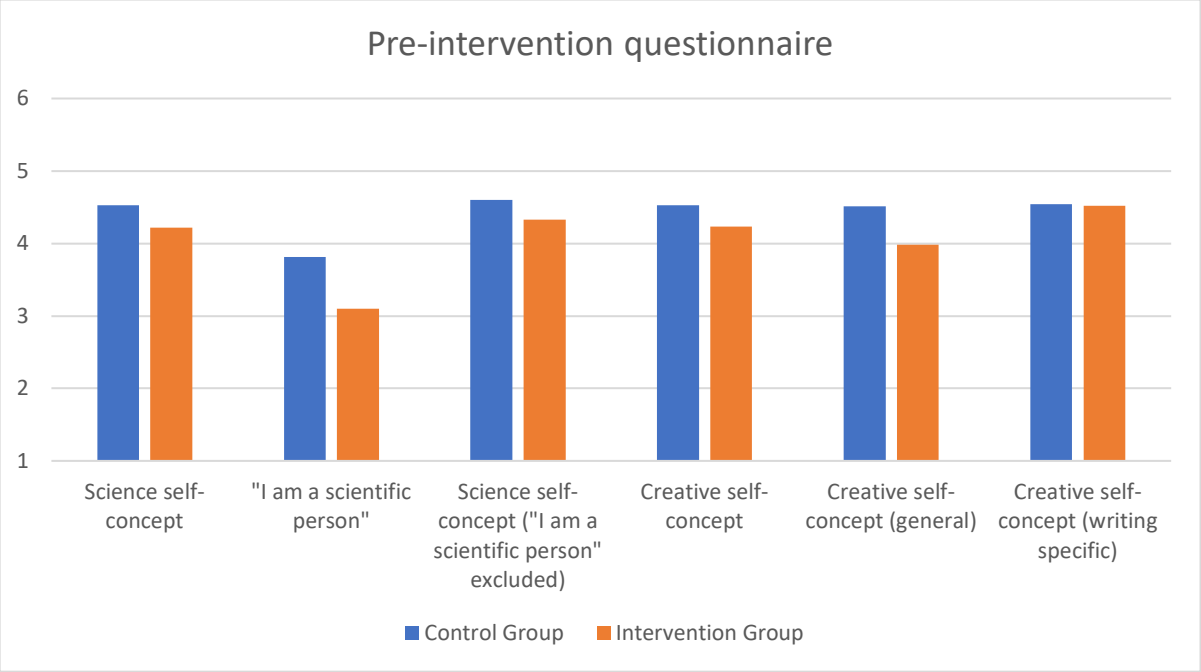


Figure 1: Pre-intervention questionnaire results

Control group responses

All respondents completed all questionnaires fully. Three respondents had an average science self-concept score below 3.00, and the remaining thirteen had science self-concept above 3.01. No students in this group had a creative self-concept score of below 3.01. The average science self-concept score was 4.53 and the average creative self-concept score was also 4.53.

'I am a scientific person' was the statement which produced the lowest average score in the group among the science self-concept items (3.81). The average of all science self-concept items excluding 'I am a scientific person' was 4.60.

The creative self-concept items were divided into those which explicitly reference writing and those which do not. The average self-concept score for items specific to creative writing was 4.54, and the average self-concept score for creativity more generally was 4.51.

Intervention group responses

The majority of respondents completed all items. Two respondents skipped some items.

One participant had a science self-concept score of just 1.00, the other 18 students reported science self-concept scores in the range of 3.01 to 6.00. Two students reported a creative self-concept score of 3.00 or less, and the remaining 17 students reported creative self-concept scores above 3.00. The average science self-concept score with the intervention group was 4.22 and the average creative self-concept score was 4.23.

'I am a scientific person' again produced the lowest average score among the science self-concept items (3.10). The average of all science self-concept items excluding 'I am a scientific person' was 4.33.

The average self-concept score for items specific to creative writing was 3.98, and the average self-concept score for creativity more generally was 4.52.

Post-intervention survey

The second questionnaire was completed by twelve participants; six from the intervention group, two from the control group and four which could not be attributed to either group due to the absence of identifying numbers submitted with the questionnaire (each participant's identifying number had been recorded in their homework journals, books they would normally access daily but by May had perhaps not been used for two months). In anticipation of participants no longer having access to their journals, a separate online survey was created for each group, so that non-identified respondents could be included in average group responses in the event that individual results could not be paired to their pre-intervention responses. However, as the research could not be directly administered, links to the surveys had to be disseminated through the class teachers. It became obvious when compiling the results that there had been some contamination between the two surveys as

several intervention group responses were submitted via the control group survey. As a result, all responses without an identifying number had to be excluded.

The small number of responses render any numerical analysis of the post-intervention questionnaire meaningless. Nevertheless, the self-concept scores were calculated in the same way as described for the pre-intervention survey for the sake of accounting fully for the work undertaken and to illustrate how the results, had they been meaningful, would have been presented.

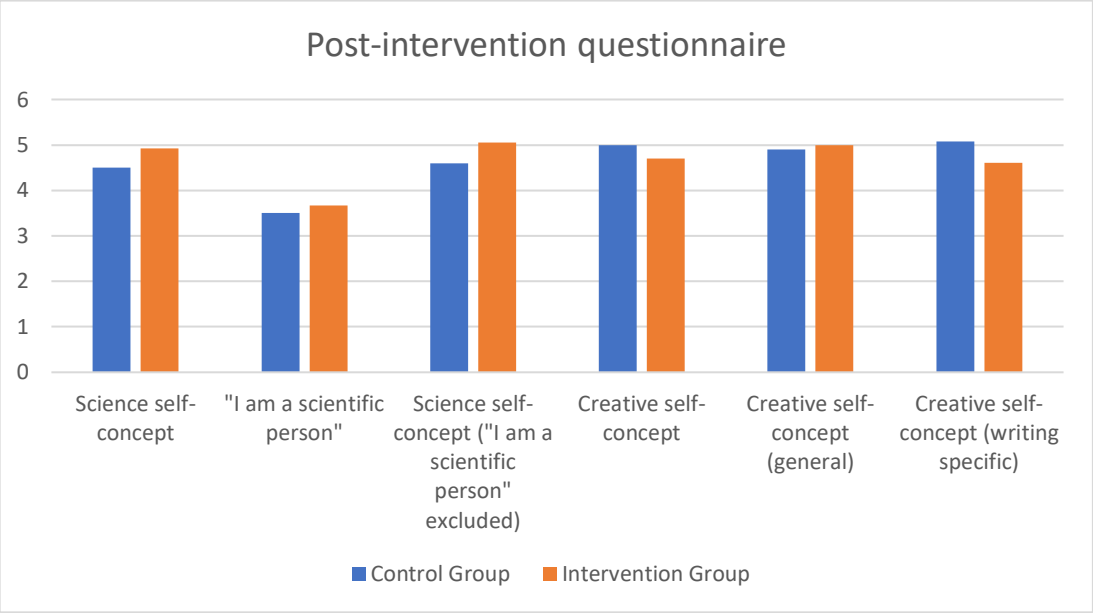


Figure 2: Post-intervention questionnaire results

Control group responses

Both respondents completed all items fully. Neither one had a science self-concept score or a creative self-concept score below 3.00. The average science self-concept score was 4.50 and the average creative self-concept score was 5.00.

'I am a scientific person' again produced the lowest average score among the science self-concept items (3.50), jointly with 'Work in science classes is easy for me'. The average of all science self-concept items excluding 'I am a scientific person' was 4.60.

The creative self-concept items were divided into those which explicitly reference writing and those which do not. The average self-concept score for items specific to creative writing was 5.08, and the average self-concept score for creativity more generally was 4.90.

Intervention group responses

All six respondents completed all items on the questionnaire. No respondent had a science self-concept score or a creative self-concept score below 3.00. The average science self-concept score was 4.92 and the average creative self-concept score was 4.70.

'I am a scientific person' again returned the lowest average score in the group among the science self-concept items (3.67). The average of all science self-concept items excluding 'I am a scientific person' was 5.05.

The average self-concept score for items specific to creative writing was 4.61, and the average self-concept score for creativity more generally was 5.00.

Comparable scores

Pre- and post-intervention responses were calculated separately for the reduced cohort which had responded to both questionnaires and provided their identification number on both occasions, allowing their questionnaires to be matched (Figures 3 and 4). This group of students was a significantly lower number, in both the intervention group and the control group, than responded to the pre-intervention questionnaire. The significantly lower number of respondents render the data insignificant for the purposes of evaluating the intervention, but is presented here to illustrate how the results would have been processed and presented had the study been conducted as designed. Given the much smaller number of participants in both these cohorts, the significant differences between the averages calculated for all respondents pre- and post-intervention (Figures 1 and 2) and these cohorts is expected.

Measures of the relevant domains of self-concept were relatively stable for both. The largest change evident in a specific domain with either group was the increase in self-concept for science self-concept ("I am a scientific person" excluded) with the intervention group. Were the data more reliable (a larger number of respondents contributing to the post-intervention data, and in the absence of the disruption caused by the pandemic) this would have been a very positive indicator of the potentially beneficial impact of the intervention and would warrant further investigation.

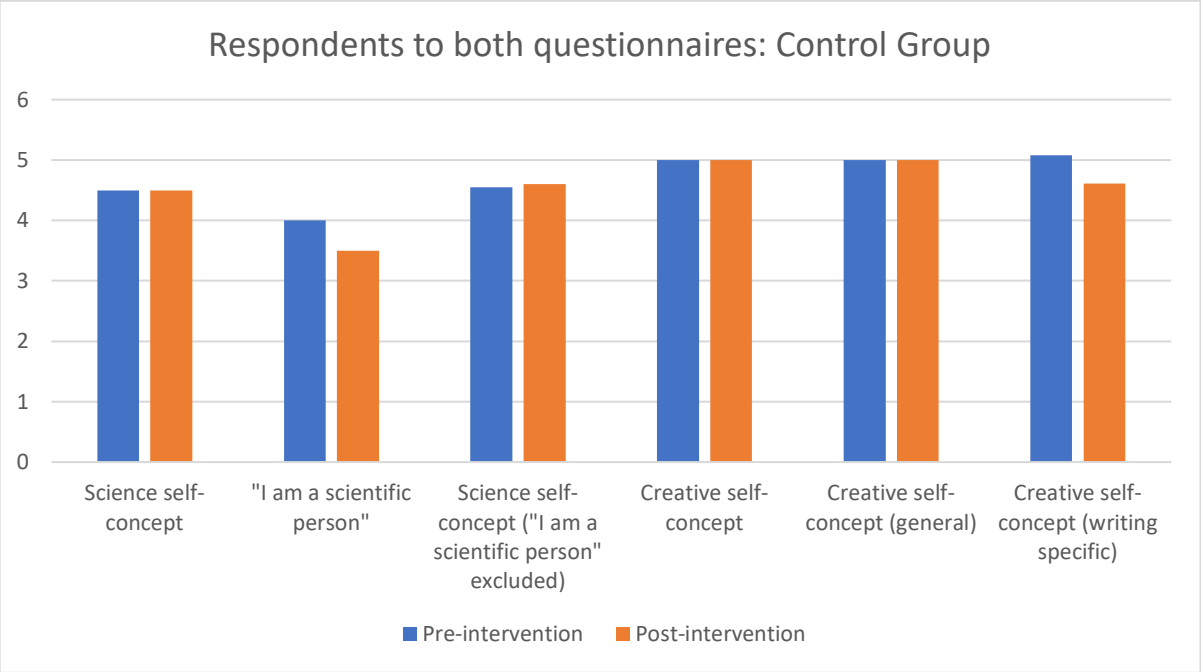


Figure 3: Paired questionnaire results, Control Group

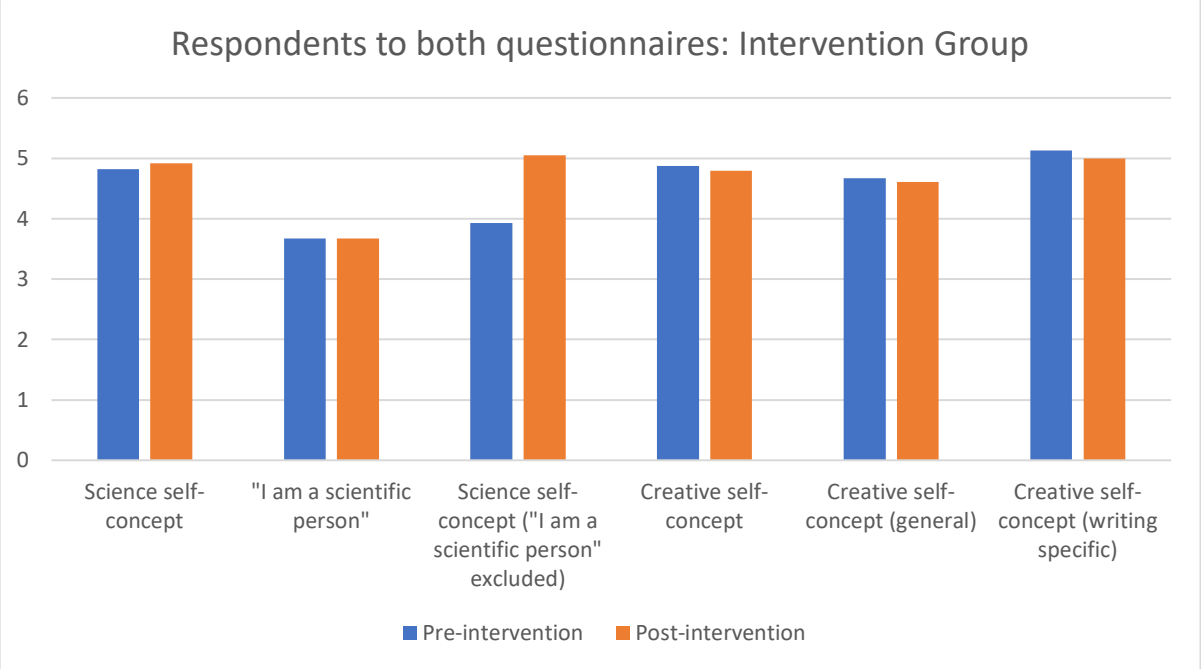


Figure 4: Paired questionnaire results, Intervention Group

Measures of internal validity

Two pairs of items were included in the questionnaire to test the internal reliability of the instrument. Those items were 'Creative writing is easy for me' paired with 'I find creative writing difficult' (Figure 5), and 'Work in science classes is easy for me' paired with 'I find science difficult' (Figure 6). The average score from all completed questionnaires was similar in both pairs, indicating a promising degree of internal validity for the principal instrument selected. However, for both the creative self-concept questions and science self-concept question, the reverse scored item produced a higher average score. It may be that students are less likely to label themselves as 'bad' at something than they are to confidently class themselves as 'good' at something. The creativity pairing was much more similarly scored than the science pair, which possibly indicates that even a slight change in wording ('science', an area of knowledge vs 'work in science classes', a context) can have a real impact on how students assess their capability and performance. This highlights the issues associated with generalising any broader conclusions about the groups beyond precisely the questions to

which they responded and, were the research to be attempted in future, work might need to be done to refine the wording of the pair of science questions used to assess internal validity.

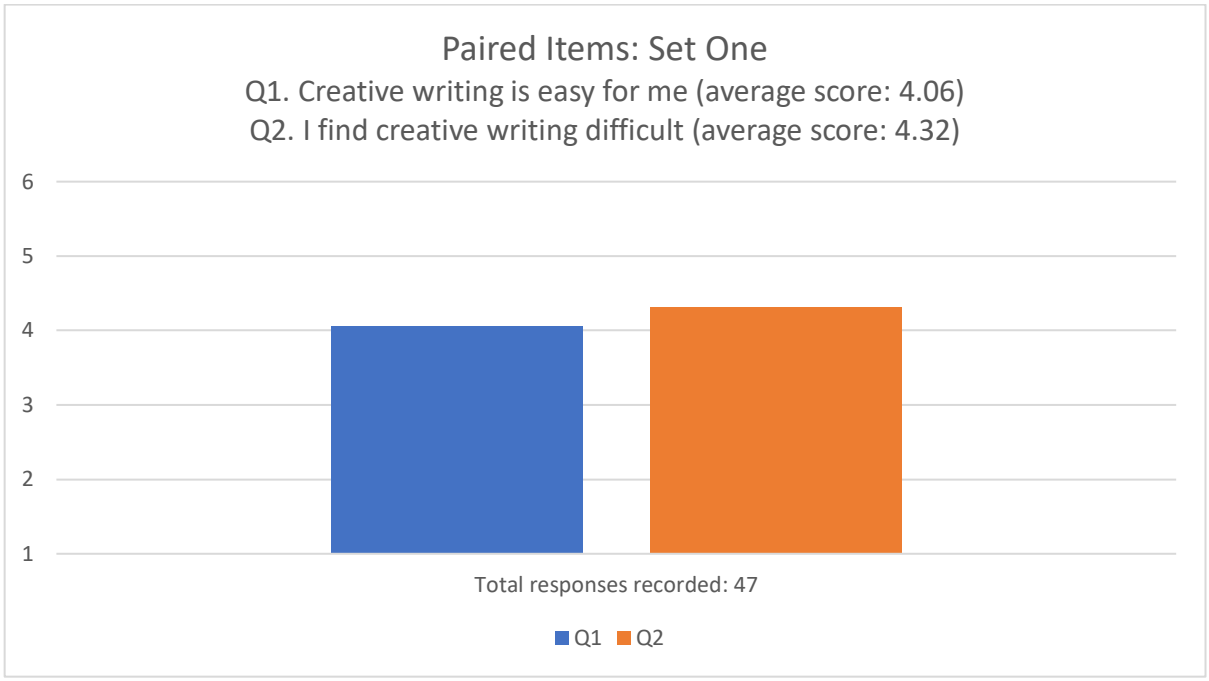


Figure 5: Paired items for creative self-concept

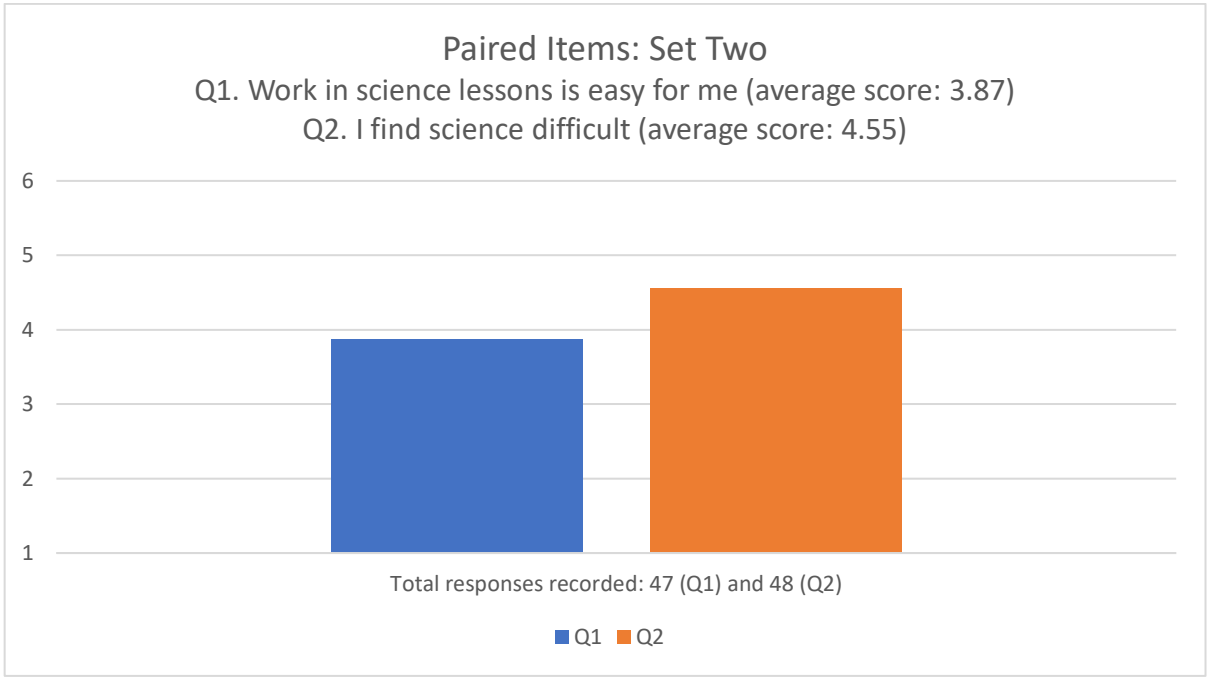


Figure 6: Paired items for science self-concept

Reflection

Limitations of available data

Only the pre-intervention questionnaire, carried out in advance of the pandemic, can be considered as having captured any reliable data about the participants. While it represents a snapshot of these students, interpretation should not be attempted given the absence of qualitative data or post-intervention data with which to contextualise the responses. In addition to, and partly as a result of, the extraordinary confounding variable which was the impact of the COVID-19 pandemic on schools, the number of participants who responded to the post-intervention survey was too small to produce data worthy of any scrutiny. Consequently, the best available tool for analysis is to reflect on the design and nature of the intervention, in light of what is documented in the literature.

Intervention design evaluated against the literature

A range of factors were identified in the literature review which were expected to positively impact on student self-concept if present in the intervention. Those factors are revisited here and the extent to which they were embedded in the intervention is evaluated.

Positive appraisal of work

Positive feedback on participant work was identified in the literature review as a promising approach to affecting positive change in student self-concept (Rogoff, 1995; Mason et al, 2012; Preckel et al, 2013), particularly if the feedback came from individuals who were understood by the participants to have expertise relevant to the work they were assessing (Bong and Skaalvik, 2003; Liu and Wang, 2005; Corbière et al, 2006). Positive support is a key tenet of the writing centre's model for all projects, and each adult collaborator was

trained and practised in promoting an environment of encouragement and creative optimism:

> Our philosophy at [the writing centre] is that hard work, not magic and thunderbolts, makes good writing. All writers need to revise and even the most problematic story can be fixed with good editing and diligent re-writing. If a student knows little about punctuation or grammar but has an ear for language, then focus on that as your writer's strength. "I love the sound of that," you might say. "Let's see how we can get it onto paper." If the story is not coming to life, say something like, "The plot is going well. Let's get to the end, then go back over it and add the details and the dialogue. We can make it even better".
>
> ([Writing Centre], 2020: 3)

In addition to the mentoring provided by volunteer tutors, who were present on a weekly basis, relevant experts also provided encouragement and guidance in a positive manner. Each participant received specific and personalised supportive feedback from the editor, which constituted the most formal feedback process in the project, and also received scientific feedback on their story, a process supported by the science lecturers involved in the project. The latter enabled the participants to understand where their stories connected to the main body of scientific knowledge and provided additional resources on the topic should the participant wish to pursue or extend any aspect of the science content in their story. In both cases the feedback was framed to participants as potential ways to build upon an already promising start – even significant inaccuracies in the science content were not identified as problems that required correction – and feedback focused more on highlighting positives in the work than identifying potential areas for improvement.

Positive appraisal also formed a part of the publication process for the project. A professional author, Oisín McGann, read the collection in advance of publication and wrote an appropriate foreword for the book. The foreword reflected the participants' work back to themselves, but also illustrated to the participants how others might be expected to read and understand their work.

> Science fiction questions. It wants to know. And in doing so, it is less a means of predicting our future than it is a lens through which we examine our world and our lives as they are now, slightly removed from reality, for the sake of some clarity and objectivity... The writers who have contributed to this book have produced a diverse, curious and imaginative collection of stories, and in them, I see the same hunger for understanding and the struggle to shape it into words – whether it is an understanding of the world around them, or a need for that world to understand them.
>
> (McGann, 2020)

Use of performance-approach goals

The formation of performance-approach goals – the desire to be seen to perform better than those around you – is associated with positive changes in student self-concept (Mason et al, 2012). The intervention for this project was nonetheless designed to be non-competitive, with no objective measure for participants to compare their performance to others. The emphasis on practice, iteration and experimentation, together with the provision of supports for personal improvements, had more in common with mastery-approach goals than performance-approach goals. It was judged that the mastery-approach to goals better supported the design of the project, and the overall ethos of the writing centre, whereas the promotion of performance-approach goals would have unacceptably undermined other aspects of the project. Additionally, while the intervention could be designed to support either mastery-approach or performance-approach goal formation, sources of motivation vary between individuals and attempting to promote the formation of performance-approach goals within the group could have led to a number of the participants developing performance-avoidance goals, which have been found to impact upon self-concept negatively (Mason et al, 2012).

Acquisition of domain-specific knowledge in a manner which supports the development of availing beliefs about the domain

Adopting approaches to improving participants' skills and work which supported participants to develop availing beliefs about the domains of knowledge they were investigating, was expected to promote positive changes in self-concept (Mason et al, 2012; Depaepe, De Corte and Verschaffel, 2016). The two primary methods of knowledge acquisition were through small group discussion with peers and mentors, and the sharing of writing tasks. As a result of the considerable expertise in the room (published writers, experienced tutors of writing and lecturers in science), individual issues and questions could be addressed as a group, in keeping with the writing centre's model for all programmes, and solutions were arrived at through more experienced adults sharing their knowledge or experience, through discussion of ideas, and through participants being supported to find and parse relevant information from online sources.

> In brief: do not just give the answer, help the student arrive at the answer for him or herself. In an ideal situation, you will sit next to a student and together you can work on the piece.
>
> ([Writing Centre], 2020: 3)

Examples include a short story based on the idea that the tourist season on Mars is dictated by the brief period where the orbits of Mars and Earth would be close enough to facilitate consumer travel, and a separate and protracted discussion in which two participants enlisted the support of one of the science lecturers (a physics specialist) to work out the mechanics of laying *LUAS* rails to the Moon (the *LUAS* is a light-rail public transport system in Dublin). More abstract discussions on the nature of consciousness and time also arose during this intervention. Similarly, when students were unable to construct a cohesive pathway through their narrative, or struggled to invent satisfying solutions to conflicts arising within their piece of fiction, they had the wisdom of experienced writers to draw upon and the

reassurance that these issues were not shortcomings but instead the quotidian experience of being a writer.

Not needing to know the precise science in order to speculate on aspects which affected characters, societies or objects in stories freed students from the fear of not knowing and instead guided them towards an idea of knowing enough to make sense. Likewise, a focus on each participant's story and its development removed the need for an in-depth understanding of literary techniques or conventions of story structure. Accordingly, their knowledge of the domains in question was extended in a manner which ensured participants were untroubled by the existence of greater knowledge than they had and which encouraged participants to believe they could master other knowledge and skills at the point at which they would need them.

Build connections between the participants and one or more 'science-rich institutions'

The Committee on Learning Science in Informal Environments promotes the benefits for science-related interventions of creating connections between 'science-rich institutions' (Bell et all 2009: 301) and communities of learners. During the course of the intervention, each passing week evidenced the increased comfort and enjoyment that the participants felt on the campus of the university, and this was most clearly demonstrated by the participants arriving earlier and earlier to have their lunch amongst the university students in the library cafeteria each week. The data available does not facilitate speculation on the extent to which the participants felt that they had a connection with the institution beyond the project, nor on their level of awareness that it was a science-rich institution.

Incorporate participants' prior knowledge of, and relationship with, science

The aim of the majority of writing workshops with the group was to identify existing knowledge as a basis for story-creation, rather than the teaching of new scientific knowledge.

Consequently, the design of this intervention adopted fully the advice of Bell et al to centre and elevate the prior knowledge of the participants in learning activities (2009). Workshops in the first month focused on drawing out the participants' prior knowledge and incorporating what they knew – or could surmise – into writing exercises. Prior knowledge, examples from the media and participant perspectives were collected in small-group and whole-group exercises (Figure 7) and used as the basis of the workshops rather than knowledge being transmitted by a teacher-figure.

> Today we looked at the 'Robots and Technology' workshop. At the start I collected ideas from them - what films or media did they know based on robots and tech, were they optimistic or pessimistic? Then I broke students into groups of 2–3 and asked them to come up with definitions for 'robot' and 'technology'. These were recorded in their notebooks and then shared with the group. The group were also invited to challenge and question one another's definitions. Some of them got very into it, and there were a few dominant voices – but I'm happy that the small group exercise with adults beforehand allowed everyone to have a say.
>
> I was struck by the contrast between the homogeny of the robots/tech they had consumed in media – robots soldiers, wars, humanoids etc – and the subtlety with which they approached their own definitions (almost all neutral in judgement, and carefully thought out). They are more sophisticated thinkers about science than the media aimed at them assumes … Afterwards I sat down with [the physics specialist] to discuss his view of the workshop. He was very enthused by the workshop as a model for teaching science (previously he had anticipated the workshops would help him demonstrate to trainee science teachers how to incorporate writing into their lesson).
>
> (Extract from project research journal, 19th January 2020)

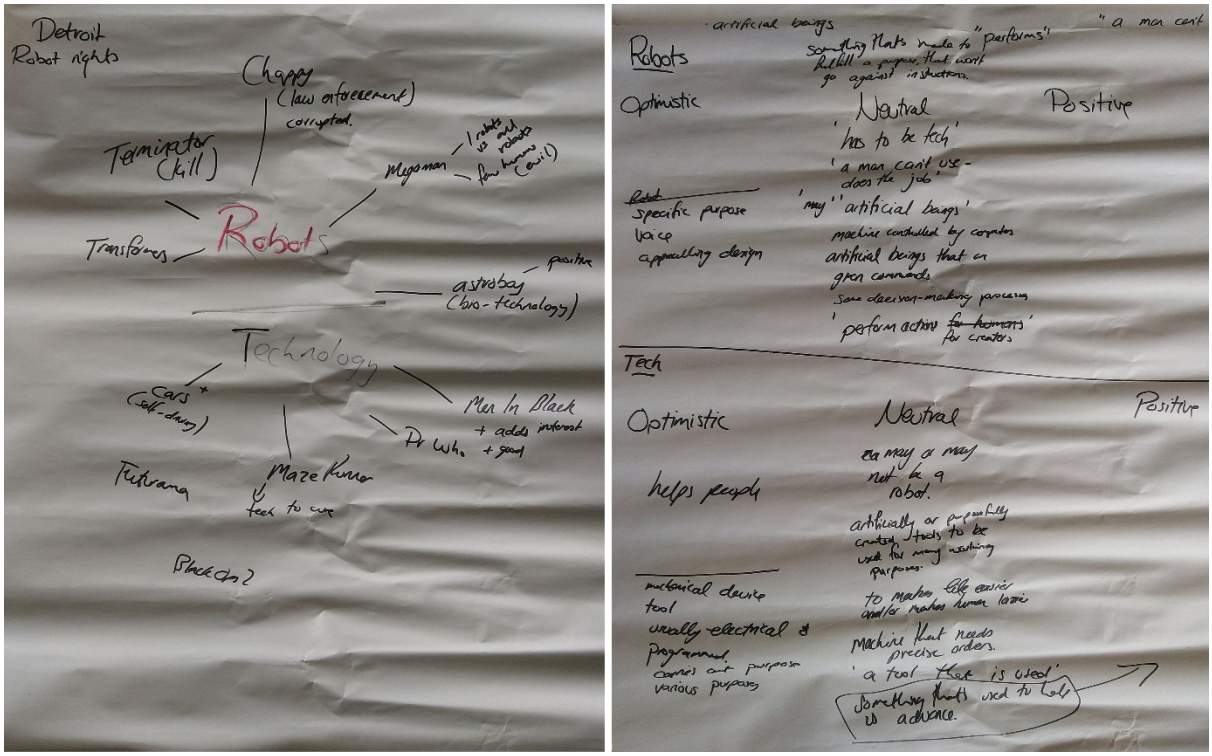


Figure 7: 'Idea capturing' sheets. Left: the media the participants associated with robots and technology (e.g. Transformers, Men In Black, Dr. Who). Right: The participants own definitions for these terms (e.g. Technology: 'Artificially or purposefully created tools to be used for many working purposes'.)

Facilitate the exploration of dangerous and exciting science

The enthusiasm for explosive, life-threatening science documented in the ASPIRES study (Archer et al, 2010) was evident amongst the participants. Given the relative safety of experimenting with such phenomena in writing only, the group were free to consider the extreme implications of climate change, space travel, nuclear power and even consciousness. Of the twenty-three stories in their final book, twenty-one involved extreme peril for the characters involved, or humanity as a whole.

Provide well-scaffolded opportunities for participants to develop their ideas and learning over time

The initial four sessions were heavily structured workshops aimed at building participants' confidence with the act of writing and at facilitating their use of pre-existing knowledge for the production of science fiction, as advocated for by Smith, Shen and Jiang (2019). After that, each participant began work on a story which they developed, with the support of peers

and tutors, over a number of months. Approaches to idea formation and development were modelled and participants had the opportunity to practise story formation in a supported manner. The task of writing a story for professional publication was broken into stages and an overall aim indicated in each session to help participants manage their work. Difficult points were supported by the addition of extra resources, such as feedback from outside experts to help identify a starting point for the second draft, rather than expecting participants to identify their own story's strengths and weaknesses at the start of the redrafting process. The primary method of scaffolding was the careful attention that each individual received. There was an approximate 1:3 ratio of collaborators to participants at each session and this allowed the provision of personal guidance and support for all participants at each step of the way.

Opportunities for the dissemination of any creative output at the end of the project

The project was due to culminate with the publication and formal launch of an anthology of the participants' work. Although the book was produced and printed before the end of the academic year (Figure 8), the pandemic prevented a book launch from going ahead. The book launch (where participants would hold their book in their hands, hear speakers laud their achievements and witness members of the public buying copies of their work) was a hugely important part of the design of this intervention and its delay may have significantly impacted upon the participants' overall experience of the project. In the initial planning of the research, the closing questionnaire was not due to take place until after participants had experienced the book launch, as it was expected to have an impact on their perceptions of the work they had undertaken (Smith, Shen and Jiang, 2019).

Figure 8: The published book
(Information which may allow participants or organisations to be identified has been redacted)

Extraneous and confounding variables

The dependent variable in this study was students' self-concept in the domains of science and creativity. The hypothesis, set out in Chapter Two, proposed a purpose-designed non-school educational programme as the independent variable. However, as with any research carried out in a live, social setting, extraneous and confounding variables can be expected

to have been present throughout the project. While it might be preferable to remove or reduce as many extraneous variables as possible (Edwards and Talbot, 1994), in a school setting it is both impractical and, if disruptive to their education, unethical. Thus, it is incumbent on the researcher to identify and acknowledge the main extraneous variables acting upon self-concept in adolescents, to be mindful of them when examining research results and to exclude those research instruments most vulnerable to the impact of extraneous variables.

There are more extraneous variables acting on student self-concept than can be readily accounted for in this research. As was demonstrated in the literature review, personal experiences along with social relationships, interactions and comparisons constantly influence the development of self-concept. For the participants in this study, it is likely that their pre-intervention self-concept in the domains of science and creativity were formed by their experiences in the formal schooling environment, through their examination results in science, maths and creative subjects, through relationships with their teachers, in reaction to their parents' and peers' attitudes to these subject areas and their achievement within them, through personal interest, by their media consumption and through participation in any relevant extra-curricular activities. All of these experiences and interactions will have been ongoing throughout the intervention and all are significant extraneous variables. Additionally, it is possible for any of the above variables to have become confounding variables and, within the design of this study, it would have been very difficult to identify that this had occurred.

An unanticipated confounding variable, which prevented the collection of adequate data and, had sufficient data been collected, would have corrupted the validity of any data gathered, was the COVID-19 pandemic. The significant impact of a pandemic on the educational experiences, lives and stress-levels of teenagers throughout Ireland (Foróige, 2020; Young Social Innovators, 2020) is such that, even if a full data-set had been gathered

at the end of the intervention period, any findings would perhaps have been as likely to measure the impact upon students of remote-schooling and a dislocation from normal routines as it would the impact of the intervention.

Considerations for future investigation

When items for the instrument were being selected, it was intended that the questionnaire would only provide an overall science self-concept score and an overall creative self-concept score. However, as the intervention and associated research was interrupted, leaving little data for any analysis, reflection on the planned research indicated some possible oversights in the design and some suggestions for further development in the event that the project could be re-run at a future date.

As the ASPIRES research indicated, self-identification with 'being' a scientist was a barrier to students forming science-related career aspirations (Archer and McLeod, 2016). To explore whether this issue was present with the participants of this study the responses to 'I am a scientific person' was separated from all other science items. Analysis of the data for both groups supplied by the pre-intervention questionnaire supports the findings of the ASPIRES study (Figure 9). Given the central importance of the issues of students identification with science in influencing careers aspirations, the retention of this question from the ASPIRES study in any future research would be essential in order to evaluate the impact of the intervention in connection with the ASPIRES research and recommendations.

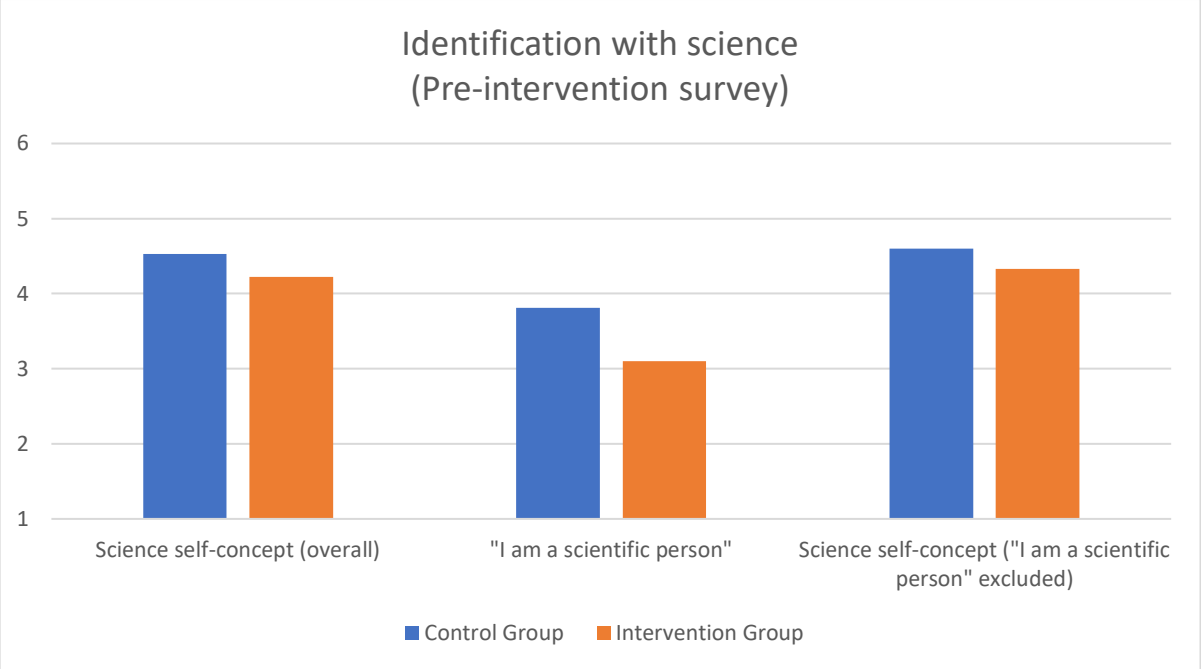


Figure 9: Participant identification with science

A separate area for further investigation is the possibility that the creative self-concept items, while appropriate to the intervention designed, seek to measure two domains which are interlinked but discrete: creative writing and creativity. Six items explicitly refer to creative writing, and the remaining five investigate creativity in general. Given the self-assessing nature of self-concept, it is possible that respondents were drawing on a much broader range of influences for their responses on creativity – their imagination, constructions in computer games, an affinity for music, film or art, etc. – than purely creative writing. The existence of two domains within the one in this questionnaire may not be a drawback. Indeed, it would be interesting to know if an intervention targeted at one particular domain of creativity influenced creative self-concept more generally. However, before re-using this questionnaire in any further investigations, deeper consideration of the implications of the co-existence of these domains would need to be considered.

A final consideration for research design, should the opportunity to revisit the research questions of this study arise in the future, is that the impact of educational and learning experiences is not always directly observable and may not manifest itself immediately.

> It is commonly believed that even participants who do not demonstrate increased knowledge as measured in pre-post assessment designs take away the potential to learn later. Do participants whose interest is sparked go on to learn more in the months that follow? Do they seek out other, related learning experiences? Does their relationship to science and science learning fundamentally shift? There is a need for studies to investigate how interest, future learning, and identity develop through informal science learning experiences over long time spans.
>
> (Bell, 2009: 31)

Thus, were a similar investigation being planned again, it would be useful to include a third questionnaire some months after the end of the intervention to ascertain if further changes could be identified, or if changes observed in the second questionnaire were quickly lost.

Chapter Five: Conclusion

This study sought to explore the relationship between student self-concept and creative writing practices and, in particular, the impact of a purposefully-planned intervention on specific domains within self-concept. It was anticipated that this research would facilitate the description of the ways in which the creative and scientific self-concepts of students is affected by participation in a science fiction-focused creative writing project which takes place outside of their normal school environment, and the identification of characteristics of the creative writing programmes which may contribute to these effects.

Available research demonstrates that science is positively viewed by young people and their parents, who perceive that scientists are highly intelligent and that science is important and consequential in the world in which they live (Archer et al, 2013). The work, therefore, is to persuade any individual student that they belong among that group of highly intelligent people who are engaged on a daily basis in the understanding and the transformation of the world around us.

Given the remarkable circumstances in which educators and students found themselves in 2020 it is regrettable that I could not draw any conclusions from the intervention and research carried out during the academic year 2019–2020. Nonetheless, the science fiction writing project described appears to have the potential for a significant positive impact in students' lives when the proposal is reviewed in light of the available literature, and could help address the twin concerns of promoting creative and scientific thinking, both essential for the futures of knowledge-based economies (DES, 2020). Additionally, the interrelationships between science and creativity are, perhaps, much greater than many people instinctively assume and can be presented in tandem very successfully.

> 'Science is a highly complex phenomenon, and the conditions of creativity are likely to be equally complex.'
>
> (Klausen, 2013: 33)

Given the enthusiasm with which creative education is embraced in Transition Year programmes, emphasising this relationship may be one of the keys to unlocking the potential of science in more informal or student-led contexts.

> Those who teach knowledge as a matter of memorizing forget that it is the product of past creativity and should be presented as such. Those who teach creativity to the neglect of knowledge should remember that past creativity is preserved and brought into continuity with present creativity by knowledge well learnt.
>
> (Steers, 2013: 171)

The scale of disruption to this study and to the world in 2020 indicates, more emphatically than any research findings could, the importance of helping young people forge a relationship with scientists and their expertise; if not because they will join them in future – although it is to be hoped that many do – but because understanding of, trust in, and an ability to relate to the work of scientists will continue to be increasingly essential in the life of any citizen on our planet. The conviction that drove the design of this study was that a simple act of imagination is sufficient to allow individuals to transcend their self-imposed boundaries and to find new places of belonging; amongst societies formed in far-distant galaxies, in the spaces between the smallest of atoms, and amongst – most alien of all – scientists. The experience of designing and running this intervention, and the wealth of related research knowledge previously produced, has only strengthened this conviction. This project has usefully highlighted some refinements to the research design, suggested in Chapter Four, and it is hoped that it will be possible in the near future to deliver a similar project to completion and to test this hypothesis with deserved rigour.

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Please note that, in order to maintain confidentiality of participants, the names of some sources and sections of URLs have been altered to conceal the name of the school, writing centre and university involved in this research. Such alterations are indicated by the generic term in square brackets where the name of the institution should appear: e.g. [Writing Centre]. An unaltered reference list can be made available to examiners on request.

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Appendix 1: Source questionnaires

ASPIRES: The seven items used in the ASPIRES study to measure scientific self-concept were:

> I do well in science.
>
> I learn things quickly in science lessons.
>
> I get good marks in science.
>
> I understand everything in my science lessons.
>
> I am just not good at science.
>
> I find science difficult.
>
> I feel helpless in science lessons.
>
> (Archer and DeWitt, 2017: 55)

Academic Self Description Questionnaire (ASDQ): The wording for the items in the ASDQ was based on the SDQI and SDQII. Five of the items were positively worded and one negatively. The sub-scale items were:

> "Compared to others my age I am good at [a specific school subject]"; "I get good marks in [a specific school subject]"; "Work in [a specific school subject] classes is easy for me"; "I'm hopeless when it comes to [a specific school subject]" (reverse scored); "I learn things quickly in [a specific school subject]"; and "I have always done well in [a specific school subject]."
>
> (Marsh 1990: 626)

Self-Description Questionnaire III (SDQ III): The SDQ III examines a number of self-concept domains (including mathematics and problem-solving/creativity) making it a good model for the domains investigated in the study (with adaption).

Sample of questions from the questionnaire which served as relevant models for this research:

I find mathematical problems interesting and challenging
I have trouble expressing myself when trying to write something
I can write effectively
I hate studying for many academic subjects
I have hestitated to take courses that involve mathematics
I enjoy doing work in most academic subjects
I have generally done better in mathematics than other courses
I have a poor vocabulary
I like most academic subjects
I wish I had more imagination and originality
I have trouble with most academic subjects
I am an avid reader
I enjoy working out new ways of solving problems
I am quite good at mathematics
I have trouble understanding anything that is based upon mathetmatics
Relative to most people, my verbal skills are quite good
I am not particularly interested in most academic subjects
I have always done well in mathematics classes
I learn quickly in most academic subjects
I am not very original in my ideas, thoughts and actions
I never do well on tests that require mathematical reasoning
I am good at expressing myself
I hate most academic subjects
I am an imaginative person
At school, my friends always come to me for help in mathematics
In school I had more trouble learning to read than most other students
I get good marks in most academic subjects
I have never been excited about mathematics
I could never achieve academic honours, even if I worked harder

(Marsh and O'Neill, 1984: 168 – 172)

Appendix 2: Questionnaire used

A. Selected Items

The individual items selected for this research are listed below (parenthesis indicates the pre-existing instrument where the specific wording used originates).

Science self-concept:

I get good marks in science. (ASPIRES) (ASDQ)

I learn things quickly in science lessons. (ASPIRES) (ASDQ)

I find science difficult.* (ASPIRES)

I do well in science. (ASPIRES)

I am a scientific person. (SDQIII)

I have never been excited about science.* (SDQIII)

Work in science classes is easy for me. (ASDQ)

Compared to most people my age, I'm good at science. (ASDQ)

I'm hopeless when it comes to science.* (ASDQ)

I find science interesting and challenging. (SDQIII)

I hate science.* (SDQIII)

Creative self-concept:

I do well in creative tasks. (ASPIRES)

I have never been excited about creative writing.* (SDQIII)

I am not very original in my ideas.* (SDQIII)

Compared to most people my age, I'm good at creative writing. (ASDQ)

I am an imaginative person. (SDQIII)

I'm hopeless when it comes to creativity.* (ASDQ)

I find creative problems interesting and challenging. (SDQIII)

I hate creative writing.* (SDQIII)

I get good marks for creative writing. (ASPIRES) (ASDQ)

Creative writing is easy for me. (ASDQ)

I find creative writing difficult.* (ASPIRES)

**items which are reverse scored*

B. Participant questionnaire

Student Questionnaire

Date:_____

ID Number:_____

(The last four numbers of a phone number you know well)

Sample question:

	false	mostly false	more false than true	more true than false	mostly true	true
I would never put pineapple on pizza.	○	○	○	○	○	○

Questionnaire:

	false	mostly false	more false than true	more true than false	mostly true	true
I do well in creative tasks.	○	○	○	○	○	○
I get good marks in science.	○	○	○	○	○	○
I have never been excited about creative writing.	○	○	○	○	○	○
I learn things quickly in science lessons.	○	○	○	○	○	○
I am not very original in my ideas.	○	○	○	○	○	○
Compared to most people my age, I'm good at creative writing.	○	○	○	○	○	○
I find science difficult.	○	○	○	○	○	○
I am an imaginative person.	○	○	○	○	○	○
I do well in science.	○	○	○	○	○	○
I am a scientific person.	○	○	○	○	○	○
I'm hopeless when it comes to creativity.	○	○	○	○	○	○
I have never been excited about science.	○	○	○	○	○	○
I find creative problems interesting and challenging.	○	○	○	○	○	○

	false	mostly false	more false than true	more true than false	mostly true	true
I hate creative writing.	○	○	○	○	○	○
Work in science classes is easy for me.	○	○	○	○	○	○
I get good marks for creative writing.	○	○	○	○	○	○
Compared to most people my age, I'm good at science.	○	○	○	○	○	○
I'm hopeless when it comes to science.	○	○	○	○	○	○
Creative writing is easy for me.	○	○	○	○	○	○
I find science interesting and challenging.	○	○	○	○	○	○
I find creative writing difficult.	○	○	○	○	○	○
I hate science.	○	○	○	○	○	○

Thank you.

c. Questionnaire adapted for online use: Example items

(Note: Name of school and researcher are redacted)

Student research: [redacted]

Dear writers,

Just before you started your creative writing project with Fighting Words in DCU, I visited your class and asked you to complete a survey. I am writing to you now (in May 2020) to invite you, along with the rest of your class, to complete the second (and last) part of this research.

You are invited to complete this questionnaire about how you feel about subjects such as creativity, science and English. The same ethical guidelines guide this questionnaire as the one you completed in January - if you have misplaced the information that was given to you and your parents/guardians at that point you can contact me for a copy at [redacted]@education.ox.ac.uk

Your school has agreed to participate in the research but taking part in this research is completely voluntary. You are free to choose not to participate, or to withdraw from the research at any point, and this would not affect your education in any way.

I will make the data I collect in the study anonymous. Data will be stored securely by myself and your school will not have access to the data. If I wanted to use the data for any other purpose, I would have to contact you and obtain your permission. At the end of the study, personal data will be destroyed.

If you choose to take part again, you will need your respondent number. This is probably the last four digits of a phone number you know well, and you wrote it in your homework journal on January 6th 2020.

Thank you.

[redacted]

Respondent number (see guidance above if you've forgotten yours)

Short answer text

Practice question: I would never put pineapple on pizza.

- False
- Mostly false
- More false than true

I have never been excited about creative writing.

- ○ False
- ○ Mostly false
- ○ More false than true
- ○ More true than false
- ○ Mostly true
- ○ True

I learn things quickly in science lessons.

- ○ False
- ○ Mostly false
- ○ More false than true
- ○ More true than false
- ○ Mostly true
- ○ True

Appendix 3: Information letters

Note: Any information which could be used to identify the school, staff and researcher has been redacted.

1. Information for students: Intervention group
2. Information for students: Control group
3. Information for parents: Intervention group
4. Information for parents: Control group
5. Letter for Principal
6. Information sheet for adult participants

1. INFORMATION FOR STUDENTS: INTERVENTION GROUP

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

29 October 2019

Dear student,

My name is [redacted], and I am a research student at the University of Oxford. I am writing to invite you, along with the rest of your class, to take part in my research study investigating creative and scientific self-concept(s) of students.

By participating in the research, the school is contributing to a project that will deepen our understanding of how working with scientific content in a creative manner may help develop students' self-concept as scientific and creative individuals, as well as being a fun and rewarding creative experience for those students who are involved.

I hope that you are willing to take part in the research, but before you decide, it is important that you understand what it will involve. Please take some time to read through the information on the following page and I would encourage you to discuss it with your parents/guardians before making any decision.

Yours faithfully,

[redacted]
Oxford University Department of Education

What will you be asked to do?
You are invited to take part in a creative writing project with [redacted] The project will involve attending a series of two-hour workshops approximately once a week between January and May. During these workshops, you will work with a team of [redacted] volunteers to develop a collection of short stories.

As part of the research associated with this project, you will be invited to complete questionnaires, and a small number of pupils will be invited to be interviewed individually or in small groups. Samples of your writing will be recorded and photographs to show group layout, or activities, will be taken. If your face is accidentally photographed, the images will never be used for research. Things you say or do during workshops, which are relevant to the research, may be noted anonymously in the field notes. Your name will never be published in any part of this research.

Who is running the research?
I am a research student at the Department of Education, University of Oxford and I am also a fully qualified and experienced secondary teacher. A more experienced researcher, [redacted] supervises my research.

Ethics
Any research with young people needs to be conducted with care and sensitivity. My research will be consistent with the strict guidelines required by Oxford University. Your school has agreed to participate in the research but taking part in this research is completely voluntary. **You are free to say you do not want to participate**, or to withdraw from the research at any point, and this would not affect your education in any way.

I will make the data I collect in the study anonymous. Audio recordings, photographs, my notes, and all other data will be stored securely by myself and your school will not have access to the data. If I wanted to use the data for any other purpose, I would have to contact you and obtain your permission. At the end of the study, the recordings will be erased and personal data destroyed.

What do you do now?
If you are happy to take part, you do not need to do anything. If, for any reason, you do not want to be included in the research, please ask your parents/guardians to return the opt-out form stating this preference. The form should be returned to [redacted].
You can also withdraw from the research at any stage, or opt out of any research activity, simply by saying you do not wish to take part in the activity. If you choose not to consent to participate in this research, you will still be able to take part in the series or workshops with Fighting Words.

If you would like to ask any questions about the project before or during the study, I will be happy to talk with you in more detail at your school or during workshops.

2. INFORMATION FOR STUDENTS: CONTROL GROUP

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

29 October 2019

Dear student,

My name is [redacted], and I am a research student at the University of Oxford. I am writing to invite you, along with the rest of your class, to take part in my research study investigating creative and scientific self-concept(s) of students.

By participating in the research, the school is contributing to a project that will deepen our understanding of how working with scientific content in a creative manner may help develop students' self-concept as scientific and creative individuals.

I hope that you are willing to take part in the research, but before you decide, it is important that you understand what it will involve. Please take some time to read through the information on the following page and I would encourage you to discuss it with your parents/guardians before making any decision.

Yours faithfully,

[redacted]
Oxford University Department of Education

What will you be asked to do?
You will be invited complete a questionnaire about how you feel about subjects such as creativity, science or English. You will be invited to complete this questionnaire once in December 2019 or January 2020, and once again towards the end of the school year. Your name will not be published in any part of this research.

Who is running the research?
I am a research student at the Department of Education, University of Oxford and I am also a fully qualified and experienced secondary teacher. A more experienced researcher, [redacted], supervises my research.

Ethics
Any research with young people needs to be conducted with care and sensitivity. My research will be consistent with the strict guidelines required by Oxford University. Your school has agreed to participate in the research but taking part in this research is completely voluntary. **You are free to say you do not want to participate**, or to withdraw from the research at any point, and this would not affect your education in any way.

I will make the data I collect in the study anonymous. Date will be stored securely by myself and your school will not have access to the data. If I wanted to use the data for any other purpose, I would have to contact you and obtain your permission. At the end of the study, personal data will be destroyed.

What do you do now?
If you are happy to take part, you do not need to do anything. If, for any reason, you do not want to be included in the research, please ask your parents/guardians to return the opt-out form stating this preference. The form should be returned to [redacted].
You can also withdraw from the research at any stage, or opt out of any research activity, simply by saying you do not wish to take part in the activity. If you choose not to consent to participate in this research, your education will not be affected in any way.

If you would like to ask any questions about the project before or during the study, I will be happy to talk with you in more detail at your school or your parents/guardians may contact me with any questions.

3. INFORMATION FOR PARENTS: INTERVENTION GROUP

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

29 October 2019

Dear Parent or Guardian,

I am writing to invite your child, together with the rest of his class, to take part in my research study investigating creative and scientific self-concept(s) of students. You may be aware that your child's school has agreed to take part in a research study.

By participating in the research, the school is contributing to a project that will deepen our understanding of how working with scientific content in a creative manner may help develop students' self-concept as scientific and creative individuals, as well as being a fun and rewarding creative experience for those students who are involved.

I hope that your child will want to take part in the research, but before you decide, it is important that you understand what it will involve. Please take some time to read through the information on the following page.

Yours faithfully,

[redacted]
Oxford University Department of Education

What will your child be asked to do?
Your child will be taking part in a creative writing project with [redacted] The project will involve the students attending a series of two-hour workshops approximately once a week between January and May. During these workshops, the students will work with a team of [redacted] volunteers to develop a collection of short stories.

The research will include asking consenting pupils at different points in the project to complete questionnaires, and a small number of pupils will be invited to be interviewed about their experiences and thoughts about the project and related subject matter (such as ideas about creativity, science or English). Samples of student work will be recorded, and photographs will be taken to show group layout or activities. If your child's face is accidentally photographed, the images will never be used for research. Things your child says or does during workshops, which are relevant to the research, may be noted anonymously in the field notes. Your child's name will not be published in any part of this research.

Who is running the research?
I am a research student at the Department of Education, University of Oxford and I am also a fully qualified and experienced secondary teacher. A more experienced researcher, [redacted], supervises my research.

Ethics
Any research with young people needs to be conducted with care and sensitivity. My research will be consistent with the strict guidelines required by Oxford University. Your child's school has agreed to participate in the research. Taking part in this research is completely voluntary. You and your child are free to say you do not want to participate.

Your child will be free to withdraw from the research at any point, without giving any reason. This would not affect your child's education in any way.

I will make the data I collect in the study anonymous. Audiotapes, photographs, my notes, and all other data will be stored securely. I will also maintain confidentiality consistent with current law in the UK and Ireland. Your child's school will not have access to the data, and no one other than me, and my supervisor, will see the data. If I wanted to use the data for any other purpose, I would have to contact you and obtain your permission. At the end of the study, the recordings will be erased and personal data destroyed.

I will send a brief report on the research to your child's school at the end of the project, and you are welcome to see this. I will not identify the school, teacher or any students in any reports of the research.

This study has received ethics clearance through the University of Oxford's ethical approval process for research involving human participants.

What do you do now?
If for any reason you do not want your child to be included in the research, please return the form stating this and I shall not contact you again. You can also withdraw your child from the research at any stage. The form should be returned to Ms Corscadden.

If you or your child choose not to consent to participate in this research, your child will still be able to take part in the series or workshops with [redacted].

If you would like to ask any questions about the project before or during the study, please contact me. I will be happy to talk with you in more detail. Please also discuss the research with your child.

Contact details:

[redacted]

Department of Education
15 Norham Gardens
Oxford OX2 6PY

[redacted]

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

Project: *'You can write whatever you want'*: Exploring the relationship between student self-concept and creative writing practices

Researcher: [redacted]

Parent/guardian consent/opt-out form

If for any reason you **do not** want your child to be included in the research, please return this form with your preference circled below and I shall not contact you again. You can also withdraw your child from the research at any stage by contacting me.

Please circle as appropriate

- ☐ I would like more information about the research, please contact me (please provide a phone number or email address here: _____)
- ☐ I do not want my child to take part in this research

Child's name (block capitals)…… ……..

Parent/guardian name (block capitals) ……

Parent/Guardian signature: ……Date: ……

Researcher name: ……..

Researcher signature……Date: ……

Thank you for your help.

Please return this form to [redacted]

4. INFORMATION FOR PARENTS: CONTROL GROUP

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

29 October 2019

Dear Parent or Guardian,

I am writing to invite your child, together with the rest of his class, to take part in my research study investigating creative and scientific self-concept(s) of students. You may be aware that your child's school has agreed to take part in a research study.

By participating in the research, the school is contributing to a project that will deepen our understanding of how working with scientific content in a creative manner may help develop students' self-concept as scientific and creative individuals.

I hope that your child will want to take part in the research, but before you decide, it is important that you understand what it will involve. Please take some time to read through the information on the following page.

Yours faithfully,

[redacted]
Oxford University Department of Education

What will your child be asked to do?
Your child will be invited to complete a questionnaire about how they relate to subjects such as creativity, science or English. Students will be invited to complete this questionnaire once in December 2019 or January 2020, and once again towards the end of the school year. Your child's name will not be published in any part of this research.

Who is running the research?
I am a research student at the Department of Education, University of Oxford and I am also a fully qualified and experienced secondary teacher. A more experienced academic researcher, [redacted] supervises my research.

Ethics
Any research with young people needs to be conducted with care and sensitivity. My research will be consistent with the strict guidelines required by Oxford University. Your child's school has agreed to participate in the research. Taking part in this research is completely voluntary. You and your child are free to say you do not want to participate.

Your child will be free to withdraw from the research at any point, without giving any reason. This would not affect your child's education in any way.

I will make the data I collect in the study anonymous and all data will be stored securely. I will also maintain confidentiality consistent with current law in the UK and Ireland. Your child's school will not have access to the data, and no one other than me, and my supervisor, will see the data. If I wanted to use the data for any other purpose, I would have to contact you and obtain your permission. I will send a brief report on the research to your child's school at the end of the project, and you are welcome to see this. I will not identify the school, teacher or any students in any reports of the research.

This study has received ethics clearance through the University of Oxford's ethical approval process for research involving human participants.

What do you do now?
If for any reason you do not want your child to be included in the research, please return the form stating this and I shall not contact you again. You can also withdraw your child from the research at any stage. The form should be returned to [redacted].

If you would like to ask any questions about the project before or during the study, please contact me. I will be happy to talk with you in more detail. Please also discuss the research with your child.

Contact details:

[redacted]

Department of Education
15 Norham Gardens
Oxford OX2 6PY

[redacted]

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

Project: *'You can write whatever you want'*: Exploring the relationship between student self-concept and creative writing practices

Researcher: [redacted]

Parent/guardian consent/opt-out form

If for any reason you **do not** want your child to be included in the research, please return this form with your preference circled below and I shall not contact you again. You can also withdraw your child from the research at any stage by contacting me.

Please circle as appropriate

- ☐ I would like more information about the research, please contact me (please provide a phone number or email address here: _____)
- ☐ I do not want my child to take part in this research

Child's name (block capitals)…… ……..

Parent/guardian name (block capitals) ……

Parent/Guardian signature: ……Date: ……

Researcher name: ……..

Researcher signature……Date: ……

Thank you for your help.

Please return this form to [redacted]

5. LETTER FOR PRINCIPAL

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

[redacted]

29 October 2019

Dear [redacted],

I am writing to enquire about conducting a research project with your school. I am a MSc student at Oxford University, supervised by [redacted] In my research project, *'You can write whatever you want': Exploring the relationship between student self-concept and creative writing practices,* I will explore how the creative and scientific self-concept(s) of students are affected by participation in a creative writing project which takes place outside of their normal school environment.

The research will take place with a single class group of the school's choosing. The project would involve the students attending a series of two-hour workshops approximately once a week between January and May. During these workshops, the students will work with a team of [redacted] volunteers to develop short stories.

The primary commitment from the school would be to allow me to conduct research alongside and during those two-hour workshops. This research would include asking consenting pupils at different points in the project to complete questionnaires, and a small number of pupils will be invited to take part in semi-structured interviews (audio recorded) to discuss their experiences in the project and ideas around their self-concept in greater depth. Additional data gathered will also include samples of student work produced, photographs (to show group layout, or activities - no images with identifiable minors will be used), and field notes or observations (which may record the actions or speech of project participants) will be made during or following workshops. Additionally, I would ask for permission to give two questionnaires, one at the beginning and one at the end of the project, to a comparable group of students who are not taking part in the workshops with [redacted] (for example, a second transition year class).

Oxford University has strict ethical procedures on conducting research with teachers and young people, consistent with current British Educational Research Association guidelines. Before beginning the research, I would inform parents and guardians about the research and offer the students, parents and guardians the opportunity to refuse to participate. Throughout the research, students, parents and guardians, will be able to withdraw their consent to participate at any time.

All participants, including students, the teacher and the school, would be made anonymous in all research reports. The data collected would be kept strictly confidential, available only to my supervisor and myself, and not used other than specified without the further consent of all involved being obtained. All raw data gathered (recordings or completed questionnaires) would be destroyed at the end of the research period, and kept in locked conditions until that point.

I am a fully registered post-primary teacher (Teaching Council registration number: [redacted]), and all [redacted] volunteers or staff who would be involved with the project are trained for their role and Garda vetted.

The workshops will take place on the [redacted] Campus of [redacted] University. [redacted] has a formal partnership with [redacted] University and we work closely with them on a number of projects. As part of this relationship, we run workshops on [redacted]'s campus in addition to those taking place at [redacted].

By participating in the research, your school would be contributing to a project that will deepen our understanding of how working with scientific content in a creative manner may help develop students' self-concept as scientific and creative individuals, as well as being a fun and rewarding creative experience for those involved.

If you feel you would like to take part in the study, or need more information about what is involved, please contact me. Whether or not you feel it would be appropriate for your school to participate, I would be grateful if you would complete the pro-forma below, and return it to me in the stamped addressed envelope enclosed with this letter.

Thank you for your time and attention. I look forward to hearing from you.

Yours sincerely,

[redacted]

***'You can write whatever you want'*: Exploring the relationship between student self-concept and creative writing practices**

[redacted]
Oxford University Department of Education

[redacted]

Ms [redacted] Principal

- ☐ We do not wish to participate in this project.
- ☐ We would like to find out more about this project.
- ☐ We would like to take part in this project.

Signature of principal: _____

Please return this form in the stamped addressed envelope enclosed with this letter.

Thank you for your help.

6. INFORMATION FOR ADULT PARTICIPANTS

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

[redacted]

***'You can write whatever you want'*:**
Exploring the relationship between student self-concept and creative writing practices

ADULT PARTICIPANT INFORMATION SHEET

1. ***Why is this research being conducted?***

   This research aims to explore how the creative and scientific self-concept(s) of students are affected by participation in a creative writing project which takes place outside of their normal school environment, and to identify the characteristics of the creative writing programmes which may contribute to these effects.

2. ***Why have I been invited to take part?***

   You have been invited because you are involved with a creative writing project with [redacted]. Although this research is primarily focussed on the experiences of the young people involved, we would like to include your perspective on the project as a volunteer, colleague or teacher associated with the project.

3. ***Do I have to take part?***

   No. You can ask questions about the research before deciding whether or not to take part. If you do agree to take part, you may withdraw yourself from the study at any time, without giving a reason, by advising me of this decision. The deadline by which you can withdraw any information you have contributed to the research is June 2020. I will make the data I collect in the study anonymous. Audio recordings, photographs, my notes, and all other data will be stored securely by myself and only myself and my academic supervisor have access to the data. If I wanted to use the data for any other purpose, I would have to contact you and obtain your permission. At the end of the study, the recordings will be erased and personal data destroyed.

4. ***What will happen to me if I take part in the research?***

   If you are happy to take part in the research, you will be interviewed either as an individual or in a group setting before or after the project workshops. The interview/session should take approximately 20 minutes. These sessions will be audio recorded and transcribed later, so I have an accurate record of your thoughts and ideas. You can also ask to pause or stop the interview at any time, or to withdraw from the interview completely. If you are still happy to take part, I will ask you to sign a consent form.

5. ***Are there any potential risks in taking part?***

   The are minimal risks involved in taking part. As the work of pupils involved in the project will be published, and adults involved in the project are usually thanked in the acknowledgements, there is a chance that you could be identified as part of the group with whom the research was conducted.

However, whether individuals gave consent to the research element of the project, and therefore might be represented in the research (as opposed to the project), will not be public knowledge. Therefore, most participants could not be absolutely identified as having contributed to the research.

Due to the small population involved in the project, someone who knew that the particular school or charity were involved with the project might be able to identify anonymised individuals where there is only one of a type – the class teacher, the education director, the principal etc. As the focus of the research is not highly personal for the adults involved, and the adults involved are not a vulnerable population, it is unlikely that such identification would pose a risk to them or their wellbeing. Nonetheless, the potential for identification – and any possible personal or professional impact - will be considered if these adults are interviewed and any of their contributions considered for inclusion in the written research.

To reduce any potential risks with raw data being accessed or lost, recordings will be stored in password-secured folders or drives.

6. ***Are there any benefits in taking part?***

There will be no direct or personal benefit to you from taking part in this research.

7. ***What happens to the data provided?***

The information you provide during the study is the **research data**. Any research data from which you can be identified (such as your name) is known as **personal data**.

Personal / sensitive data will be stored a lockable file box (for physical records, eg consent forms) or kept in an encrypted folder (for digital records, eg audio recordings and transcripts). Personal/sensitive data will be destroyed three months after the the MSc examination/appeals period at the University of Oxford is completed.

Other research data (including consent forms) will be stored for at least 3 years after publication or public release of the work of the research.

The researcher and supervisor will have access to the research data. Responsible members of the University of Oxford may be given access to data for monitoring and/or audit of the research.

I would like your permission to use direct quotes [attributed anonymously or against a pseudonym] in any research outputs.

8. ***Will the research be published?***

The research may be published in academic publications

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

The research will be written up as a student's thesis.On successful submission of the thesis, it may be deposited both in print and online in the University archives to facilitate its use in future research. If so, the thesis will be openly accessible.

9. *Who has reviewed this study?*

This study has been reviewed by, and received ethics clearance through, the University of Oxford Education Department's Departmental research ethics committee

10. *Who do I contact if I have a concern about the study or I wish to complain?*

In the first instance, please contact the student researcher, [redacted]

If your complaint or concern is adequately addressed by the research, the overseeing ethics committee is: Education Departmental Research Ethics Committee (DREC)] Chair: Dr Liam Gearon.
Email: research.office@education.ox.ac.uk
Address: University of Oxford, Department of Education, 15 Norham Gardens, Oxford OX2 6PY

11. *Data Protection*

The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the study.

The University will process your personal data for the purpose of the research outlined above. Research is a task that is performed in the public interest.

Further information about your rights with respect to your personal data is available from https://compliance.web.ox.ac.uk/individual-rights.

12. *Further Information and Contact Details*

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

[redacted]

University of Oxford
Department of Education
15 Norham Gardens, Oxford OX2 6PY
Director: Jo-Anne Baird
Tel: +44 (0)1865 274024

[redacted]

ADULT PARTICIPANT CONSENT FORM

***'You can write whatever you want'*:**
Exploring the relationship between student self-concept and creative writing practices

		Please initial each box
1	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or penalty.	☐
3	I understand that research data collected during the study may be looked at by authorised people outside the research team. I give permission for these individuals to access my data.	☐
4	I understand that this project has been reviewed by, and received ethics clearance through, the University of Oxford.	☐
5	I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.	☐
6	I understand how this research will be written up and published.	☐
7	I understand how to raise a concern or make a complaint.	☐
8	I consent to being audio recorded	☐
9	I consent to having my photo taken	☐
10	I understand how audio recordings / photos will be used in research outputs	☐
11	I give permission to be quoted directly in research outputs against a pseudonym **OR** fully anonymously	☐

12 I agree to take part in the study ☐

Name of Participant	dd / mm / yyyy Date	Signature
Name of person taking consent	dd / mm / yyyy Date	Signature

Appendix 4: Complete questionnaire data

Control group, pre-intervention questionnaire

		January																	
	Respondent number (see guidance above if you've forgotten yours)	7149	O664	7724	1387	1370	1104	2155	2512	7127	4198	5622	O420	6969	2515	9479	8225	O219	**Averages**
	Practice question: I would never put pineapple on pizza.*	6	1	1	4	2	2	5	1	1	5	3	1	1	1	1	2	2	2.4375
	* Reverse scored																		
S1	I get good marks in science.	5	5	2	6	3	5	5	4	2	4	6	6	6	2	5	4	5	4.6875
S2	I learn things quickly in science lessons.	5	6	1	6	3	5	6	4	4	4	5	6	5	2	6	1	4	4.5625
S3	I find science difficult.*	5	6	1	6	3	5	6	4	1	6	5	5	5	1	6	2	5	4.5
S4	I do well in science.	5	5	2	6	4	5	5	4	2	5	6	6	6	1	6	5	6	4.9375
S5	I am a scientific person.	5	4	1	5	3	5	4	3	1	4	4	6	4	1	5	3	3	3.8125
S6	I have never been excited about science.*	6	6	4	6	4	6	6	4	2	4	4	6	6	1	6	3	5	4.9375
S7	Work in science classes is easy for me.	4	5	1	6	3	5	5	3	1	4	4	4	4	2	6	3	4	4
S8	Compared to most people my age, I'm good at science.	4	4	1	5	3	5	5	3	1	3	4	5	5	1	5	3	4	3.8125
S9	I'm hopeless when it comes to science.*	5	6	2	6	4	6	6	5	1	3	6	6	6	1	6	4	6	4.9375
S10	I find science interesting and challenging.	5	6	1	6	4	6	6	3	1	3	5	6	6	5	6	5	4	4.875
S11	I hate science.*	5	6	2	6	5	6	6	4	3	1	5	6	6	1	6	3	5	4.75
	AVG SCIENCE	4.909	5.364	1.636	5.818	3.545	5.364	5.455	3.727	1.727	3.727	4.909	5.636	5.364	1.636	5.727	3.273	4.636	4.528409
C1	I do well in creative tasks.	4	6	4	5	4	4	2	5	3	5	5	6	6	4	6	5	5	4.513946
C2	I have never been excited about creative writing.*	3	4	5	6	2	6	3	5	2	4	3	4	6	3	6	5	4	4.509532
C3	I am not very original in my ideas.*	4	3	4	6	4	4	3	5	4	5	4	4	6	2	6	3	5	4.510399
C4	Compared to most people my age, I'm good at creative writing.	4	6	4	5	4	5	2	5	3	3	4	1	4	2	5	4	4	4.471572
C5	I am an imaginative person.	5	3	5	6	6	5	5	6	6	6	4	5	6	3	6	5	6	4.531487
C6	I'm hopeless when it comes to creativity.*	3	5	6	6	5	5	4	6	6	5	5	4	2	3	6	5	6	4.494577
C7	I find creative problems interesting and challenging.	4	4	3	6	2	4	6	5	1	4	4	4	5	5	5	3	4	4.539538
C8	I hate creative writing.*	4	4	6	6	3	6	5	6	3	4	4	6	6	6	6	5	5	4.605633
C9	I get good marks for creative writing.	4	5	4	5	4	5	2	5	3	5	4	2	5	3	5	5	5	4.575463
C10	Creative writing is easy for me.	3	5	4	6	3	5	3	5	3	4	4	3	5	2	6	5	4	4.548232
C11	I find creative writing difficult.*	4	5	4	6	4	5	4	5	3	5	4	4	6	2	6	2	5	4.52989
	AVG CREATIVE	3.818	4.545	4.455	5.727	3.727	4.909	3.545	5.273	3.364	4.545	4.091	3.909	5.182	3.182	5.727	4.273	4.818	4.530024

		January	
	Respondent number (see guidance above if you've forgotten yours)		
	Practice question: I would never put pineapple on pizza.*		
	* Reverse scored	Science	Scientist
S1	I get good marks in science.	4.6875	
S2	I learn things quickly in science lessons.	4.5625	
S3	I find science difficult.*	4.5	
S4	I do well in science.	4.9375	
S5	I am a scientific person.		3.8125
S6	I have never been excited about science.*	4.9375	
S7	Work in science classes is easy for me.	4	
S8	Compared to most people my age, I'm good at science.	3.8125	
S9	I'm hopeless when it comes to science.*	4.9375	
S10	I find science interesting and challenging.	4.875	
S11	I hate science.*	4.75	
	AVG SCIENCE	4.6	3.8125
C1	I do well in creative tasks.		4.513946
C2	I have never been excited about creative writing.*	4.509532	
C3	I am not very original in my ideas.*		4.510399
C4	Compared to most people my age, I'm good at creative writing.	4.471572	
C5	I am an imaginative person.		4.531487
C6	I'm hopeless when it comes to creativity.*		4.494577
C7	I find creative problems interesting and challenging.		4.539538
C8	I hate creative writing.*	4.605633	
C9	I get good marks for creative writing.	4.575463	
C10	Creative writing is easy for me.	4.548232	
C11	I find creative writing difficult.*	4.52989	
	AVG CREATIVE	4.540054	4.517989
		Creative Writing	Creative

Control Group, post-intervention questionnaire

		May								
	Respondent number (see guidance above if you've forgotten yours)	9479	8225	**AVG**		Excluded				AVG
	Practice question: I would never put pineapple on pizza.*	5	5	5		5	4	1	1	2.75
	* Reverse scored									
S1	I get good marks in science.	6	4	5		2	5	6	2	3.75
S2	I learn things quickly in science lessons.	6	3	4.5		3	4	5	1	3.25
S3	I find science difficult.*	6	3	4.5		1	3	5	2	2.75
S4	I do well in science.	6	3	4.5		3	5	6	2	4
S5	I am a scientific person.	4	3	3.5		1	2	4	2	2.25
S6	I have never been excited about science.*	6	2	4			4	5	3	4
S7	Work in science classes is easy for me.	5	2	3.5		1	3	5	2	2.75
S8	Compared to most people my age, I'm good at science.	5	4	4.5		2	5	5	1	3.25
S9	I'm hopeless when it comes to science.*	6	6	6		1	5	6	4	4
S10	I find science interesting and challenging.	5	3	4		6	4	5	2	4.25
S11	I hate science.*	6	5	5.5		1	5	6	4	4
	AVG SCIENCE	5.545	3.455	4.5		1.9	4.1	5.3	2.3	3.386
C1	I do well in creative tasks.	6	5	5.5		6	5	4	4	4.75
C2	I have never been excited about creative writing.*	6	3	4.5		2	6	4	6	4.5
C3	I am not very original in my ideas.*	2	4	3		3	3	4	blank	2.5
C4	Compared to most people my age, I'm good at creative writing.	5	4	4.5		5	5	4	6	5
C5	I am an imaginative person.	6	5	5.5		4	3	4	4	3.75
C6	I'm hopeless when it comes to creativity.*	6	5	5.5		5	5	5	2	4.25
C7	I find creative problems interesting and challenging.	6	4	5		5	4	4	4	4.25
C8	I hate creative writing.*	6	6	6		5	5	6	2	4.5
C9	I get good marks for creative writing.	5	5	5		4	4	4	1	3.25
C10	Creative writing is easy for me.	5	5	5		4	2	4	1	2.75
C11	I find creative writing difficult.*	6	5	5.5		5	3	5	1	3.5
	AVG CREATIVE	5.364	4.636	5		4.4	4.1	4.4	2.8	3.909

Control group: Pre- and post-intervention data compared

		Pre-group			Post-group			Pre group		Post group	
	Respondent number (see guidance above if you've forgotten yours)	9479	8225	AVG	9479	8225	AVG	**Pre-intervention**		**Post-intervention**	
	Practice question: I would never put pineapple on pizza.*	1	2	0.5	5	5	1.666667	Science	Scientist	Science	Scientist
	* Reverse scored										
S1	I get good marks in science.	5	4	4.5	6	4	5	4.5		5	
S2	I learn things quickly in science lessons.	6	1	3.5	6	3	4.5	3.5		4.5	
S3	I find science difficult.*	6	2	4	6	3	4.5	4		4.5	
S4	I do well in science.	6	5	5.5	6	3	4.5	5.5		4.5	
S5	I am a scientific person.	5	3	4	4	3	3.5		4		3.5
S6	I have never been excited about science.*	6	3	4.5	6	2	4	4.5		4	
S7	Work in science classes is easy for me.	6	3	4.5	5	2	3.5	4.5		3.5	
S8	Compared to most people my age, I'm good at science.	5	3	4	5	4	4.5	4		4.5	
S9	I'm hopeless when it comes to science.*	6	4	5	6	6	6	5		6	
S10	I find science interesting and challenging.	6	5	5.5	5	3	4	5.5		4	
S11	I hate science.*	6	3	4.5	6	5	5.5	4.5		5.5	
	AVG SCIENCE	5.727273	3.272727	4.5	5.545455	3.454545	4.5	4.55	4	4.6	3.5
C1	I do well in creative tasks.	6	5	5.5	6	5	5.5		5.5		5.5
C2	I have never been excited about creative writing.*	6	5	5.5	6	3	4.5	5.5		4.5	
C3	I am not very original in my ideas.*	6	3	4.5	2	4	3		4.5		3
C4	Compared to most people my age, I'm good at creative writing.	5	4	4.5	5	4	4.5	4.5		4.5	
C5	I am an imaginative person.	6	5	5.5	6	5	5.5		5.5		5.5
C6	I'm hopeless when it comes to creativity.*	6	5	5.5	6	5	5.5		5.5		5.5
C7	I find creative problems interesting and challenging.	5	3	4	6	4	5		4		5
C8	I hate creative writing.*	6	5	5.5	6	6	6	5.5		6	
C9	I get good marks for creative writing.	5	5	5	5	5	5	5		5	
C10	Creative writing is easy for me.	6	5	5.5	5	5	5	5.5		5	
C11	I find creative writing difficult.*	6	2	4	6	5	5.5	4		5.5	
	AVG CREATIVE	5.727273	4.272727	5	5.363636	4.636364	5	5	5	5.083333	4.9
								Creative Writing	Creative	Creative Writing	Creative

Intervention group, pre-intervention questionnaire

		January																		
	Respondent number	3384	5847	5534	0148	6930	3744	9755	0728	3932	2697	1866	5651	3845	9426	4565	1430	2507	4828	1528	AVG
	Practice question: I would never put pineapple on pizza.*	6	5	1	6	6		1	6	1	6	1	1	6	1	1	1	1	1	1	3.25
	* Reverse scored																				0
S1	I get good marks in science.	5	5	6	5	4	5	6	6	4	6	4	4	1	5	5	5	1	6	4	4.35
S2	I learn things quickly in science lessons.	5	5	5	4	4	5	5	6	4	6	1	3	1	2	6	5	4	5	5	4.05
S3	I find science difficult.*	5	5	5	5	5	6	6	6	5	6	3	3	1	3	6	5	5	6	5	4.55
S4	I do well in science.	5	5	6	5	4	5	5	6	3	6	4	4	1	4	6	2	3	5	4	4.15
S5	I am a scientific person.	4	5	4	2	3	5	2	6	2	5	2	3	1	1	5	3	1	4	4	3.1
S6	I have never been excited about science.*	6	5	5	4	5	6	4	6	5	6	4	2	1	6	6	5	1	5	6	4.4
S7	Work in science classes is easy for me.	4	4	5	4	5	5	5	6	4	6	1		1	1	6	3	1	5	5	3.737
S8	Compared to most people my age, I'm good at science.	5	4	6	4	4	4	6	6	5	5	3		1	4	5	3	2	5	4	4
S9	I'm hopeless when it comes to science.*	6	6	6	5	5	5	6	6	6	6	6		1	5	6	4	2	6	6	4.895
S10	I find science interesting and challenging.	6	5	5	1	5	6	5	5	2	5	5		1	6	6	4	5	5	6	4.368
S11	I hate science.*	6	6	6	1	6	6	5	6	4	6	4		1	6	6	6	4	6	6	4.789
	AVG SCIENCE	5.182	5	5.364	3.636	4.545	5.273	5	5.909	4	5.727	3.364	3.167	1	3.909	5.727	4.091	2.636	5.273	5	4.217
C1	I do well in creative tasks.	3	5	5	4	6	4	6	3	5	5	4	5	6	6	6	6	4	6	4	4.65
C2	I have never been excited about creative writing.*	3	6	4	5	6	1	5	3	3	5	1	3	1	1	6	6	2	5	5	3.55
C3	I am not very original in my ideas.*	3	5	5	5	6	3	6	4	5		6	3	4	5	6	5	4	2	4	4.263
C4	Compared to most people my age, I'm good at creative writing.	1	6	3	4	5	3	6	3	3	2	4	3	1	6	6	5	1	4	3	3.45
C5	I am an imaginative person.	3	5	4	5	6	3	6	5	5	5	6	4	6	6	6	5	4	5	5	4.7
C6	I'm hopeless when it comes to creativity.*	5	6	4	5	6	4	6	5	5	5	6	4	1	6	6	5	4	6	4	4.65
C7	I find creative problems interesting and challenging.	5	6	3	5	6	5	5	5	2	5	3	6	1	5	6	5	6	3	5	4.35
C8	I hate creative writing.*	6	6	5	6	6	2	6	5	2	5	4		2	6	6	6	6	6	5	4.737
C9	I get good marks for creative writing.	1	6	4	5	5	3	6	5	4	4	5		1	6	6	5	5	4	4	4.158
C10	Creative writing is easy for me.	1	6	4	5	5	3	6	4	2	4	4		1	6	6	5	4	5	3	3.895
C11	I find creative writing difficult.*	2	5	4	6	5	3	5	5	6	3	5		4	6	5	6	3	2	3	4.105
	AVG CREATIVE	3	5.636	4.091	5	5.636	3.091	5.727	4.273	3.818	4.3	4.364	4	2.545	5.364	5.909	5.364	3.909	4.364	4.091	4.228

		January	
	Respondent number		
	Practice question: I would never put pineapple on pizza.*		
	* Reverse scored	Science	Scientist
S1	I get good marks in science.	4.35	
S2	I learn things quickly in science lessons.	4.05	
S3	I find science difficult.*	4.55	
S4	I do well in science.	4.15	
S5	I am a scientific person.		3.1
S6	I have never been excited about science.*	4.4	
S7	Work in science classes is easy for me.	3.737	
S8	Compared to most people my age, I'm good at science.	4	
S9	I'm hopeless when it comes to science.*	4.895	
S10	I find science interesting and challenging.	4.368	
S11	I hate science.*	4.789	
	AVG SCIENCE	4.329	3.1
C1	I do well in creative tasks.		4.65
C2	I have never been excited about creative writing.*	3.55	
C3	I am not very original in my ideas.*		4.263
C4	Compared to most people my age, I'm good at creative writing.	3.45	
C5	I am an imaginative person.		4.7
C6	I'm hopeless when it comes to creativity.*		4.65
C7	I find creative problems interesting and challenging.		4.35
C8	I hate creative writing.*	4.737	
C9	I get good marks for creative writing.	4.158	
C10	Creative writing is easy for me.	3.895	
C11	I find creative writing difficult.*	4.105	
	AVG CREATIVE	3.982	4.523
		Creative Writing	Creative

Intervention Group, post-intervention questionnaire

			May							Pre group	
	Respondent number		0148	1430	6930	4565	3384	2697	AVG	**Pre-intervention**	
	Practice question: I would never put pineapple on pizza.*		5	1	6	1	6	6	2.5	Science	Scientist
	* Reverse scored								0		
S1	I get good marks in science.		4	5	4	6	6	6	5.166667	5	
S2	I learn things quickly in science lessons.		4	3	5	6	6	6	5	5	
S3	I find science difficult.*		5	3	5	6	6	6	5.166667	5.333333	
S4	I do well in science.		3	5	4	6	6	6	5	4.666667	
S5	I am a scientific person.		2	4	1	5	4	6	3.666667		3.666667
S6	I have never been excited about science.*		2	5	4	6	6	6	4.833333	5.333333	
S7	Work in science classes is easy for me.		4	3	5	5	6	6	4.833333	4.666667	
S8	Compared to most people my age, I'm good at science.		4	4	4	5	5	6	4.666667	4.333333	
S9	I'm hopeless when it comes to science.*		5	5	6	6	6	6	5.666667	5.333333	
S10	I find science interesting and challenging.		2	6	5	6	5	6	5	4.5	
S11	I hate science.*		2	6	5	6	6	6	5.166667	5.166667	
	AVG SCIENCE		3.36	4.45	4.36	5.73	5.64	6	4.924242	4.933333	3.666667
C1	I do well in creative tasks.		5	6	6	5	1	5	4.666667		5
C2	I have never been excited about creative writing.*		4	6	6	6	5	3	5	5.166667	
C3	I am not very original in my ideas.*		4	6	6	6	4	3	4.833333		5
C4	Compared to most people my age, I'm good at creative writing.		4	5	5	6	3	4	4.5	3.833333	
C5	I am an imaginative person.		4	6	6	6	1	5	4.666667		5
C6	I'm hopeless when it comes to creativity.*		5	6	6	6	6	5	5.666667		5.333333
C7	I find creative problems interesting and challenging.		5	5	5	6	6	4	5.166667		5.333333
C8	I hate creative writing.*		5	6	6	6	6	4	5.5	5.833333	
C9	I get good marks for creative writing.		4	5	5	5	1	4	4	4.333333	
C10	Creative writing is easy for me.		4	5	5	6	2	4	4.333333	4.333333	
C11	I find creative writing difficult.*		4	6	4	6	3	3	4.333333	4.5	
	AVG CREATIVE		4.36	5.64	5.45	5.82	3.45	4	4.787879	4.666667	5.133333
										Creative Writing	Creative

Intervention group: Pre- and post-intervention data compared

		Pre-group							Post-group							Pre group		Post group	
	Respondent number	3384	0148	6930	2697	4565	1430	AVG	3384	0148	6930	2697	4565	1430	AVG	**Pre-intervention**		**Post-intervention**	
	Practice question: I would never put pineapple on pizza.*	6	6	6	6	1	1	4.33	6	5	6	6	1	1	4.167	Science	Scientist	Science	Scientist
	* Reverse scored																		
S1	I get good marks in science.	5	5	4	6	5	5	5	6	4	4	6	6	5	5.167	5		5.166667	
S2	I learn things quickly in science lessons.	5	4	4	6	6	5	5	6	4	5	6	6	3	5	5		5	
S3	I find science difficult.*	5	5	5	6	6	5	5.33	6	5	5	6	6	3	5.167	5.333333		5.166667	
S4	I do well in science.	5	5	4	6	6	2	4.67	6	3	4	6	6	5	5	4.666667		5	
S5	I am a scientific person.	4	2	3	5	5	3	3.67	4	2	1	6	5	4	3.667		3.666667		3.666667
S6	I have never been excited about science.*	6	4	5	6	6	5	5.33	6	2	4	6	6	5	4.833	5.333333		4.833333	
S7	Work in science classes is easy for me.	4	4	5	6	6	3	4.67	6	4	5	6	5	3	4.833	4.666667		4.833333	
S8	Compared to most people my age, I'm good at science.	5	4	4	5	5	3	4.33	5	4	4	6	5	4	4.667	4.333333		4.666667	
S9	I'm hopeless when it comes to science.*	6	5	5	6	6	4	5.33	6	5	6	6	6	5	5.667	5.333333		5.666667	
S10	I find science interesting and challenging.	6	1	5	5	6	4	4.5	5	2	5	6	6	6	5	4.5		5	
S11	I hate science.*	6	1	6	6	6	6	5.17	6	2	5	6	6	6	5.167	5.166667		5.166667	
	AVG SCIENCE	5.18	3.64	4.55	5.73	5.73	4.09	4.82	5.636	3.364	4.364	6	5.727	4.455	4.924	4.933333	3.666667	5.05	3.666667
C1	I do well in creative tasks.	3	4	6	5	6	6	5	1	5	6	5	5	6	4.667		5		4.666667
C2	I have never been excited about creative writing.*	3	5	6	5	6	6	5.17	5	4	6	3	6	6	5	5.166667		5	
C3	I am not very original in my ideas.*	3	5	6		6	5	5	4	4	6	3	6	6	4.833		5		4.833333
C4	Compared to most people my age, I'm good at creative writing.	1	4	5	2	6	5	3.83	3	4	5	4	6	5	4.5	3.833333		4.5	
C5	I am an imaginative person.	3	5	6	5	6	5	5	1	4	6	5	6	6	4.667		5		4.666667
C6	I'm hopeless when it comes to creativity.*	5	5	6	5	6	5	5.33	6	5	6	5	6	6	5.667		5.333333		5.666667
C7	I find creative problems interesting and challenging.	5	5	6	5	6	5	5.33	6	5	5	4	6	5	5.167		5.333333		5.166667
C8	I hate creative writing.*	6	6	6	5	6	6	5.83	6	5	6	4	6	6	5.5	5.833333		5.5	
C9	I get good marks for creative writing.	1	5	5	4	6	5	4.33	1	4	5	4	5	5	4	4.333333		4	
C10	Creative writing is easy for me.	1	5	5	4	6	5	4.33	2	4	5	4	6	5	4.333	4.333333		4.333333	
C11	I find creative writing difficult.*	2	6	5	3	5	6	4.5	3	4	4	3	6	6	4.333	4.5		4.333333	
	AVG CREATIVE	3	5	5.64	4.3	5.91	5.36	4.87	3.455	4.364	5.455	4	5.818	5.636	4.788	4.666667	5.133333	4.611111	5
																Creative Writing	Creative	Creative Writing	Creative

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