What are the barriers to creativity in primary science lessons? A qualitative examination of Irish primary school teachers' views

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Abstract

Creativity within the teaching of primary science offers the potential to transform children's understanding of and engagement with the subject area. This perspective is not universally shared and, as such, feelings exist that there is not enough emphasis being placed on the importance of creativity in the teaching of this subject. As a result, opportunities to engage the younger generation with the wonders of science are being missed. This is where the crux of this paper is to be found. Through seeking to increase knowledge of the components of creative science lessons, and to assess the impact of benchmark testing on creativity in pedagogical practice, this article is sympathetic to a view that there is a place for creative strategies within the science discipline.

To do this, this current study seeks to examine the perceived barriers to teaching creatively in primary science as told by teachers who are currently engaged in the process; and, using a small scale study, twenty primary school teachers from rural Irish schools partook in semi-structured interviews to elucidate their experiences. Data from these interviews were subjected to phenomenographic analysis, and two broad themes were developed. These themes indicated that there were systemic barriers to creative teaching, which consisted of the tension between creativity and teaching for assessment, and the perceived constraints placed upon teachers by the curriculum to which they are asked to teach.

Keywords: Creativity, primary science, primary teachers, assessment, curriculum

Introduction

The act of teaching creatively in classroom settings is considered to be teacher-centred as opposed to child-centred, and is quite common (Cremin, 2015; Ulger, 2017) – an opinion held by many teachers around the world, but not all (Newton, 2010). For creativity to thrive in the classroom there must be a degree of creativity from the teacher, but there is also a sense that sees creativity being for the Arts rather than science delivery (Newton, 2010). With this, it is of note that Cremin and Barnes (2010) list common characteristics that most creative teachers appear to possess. These include enthusiasm, passion and commitment to teaching; a degree of risk-taking; a deep curiosity or questioning stance; willingness to be intuitive and retrospective; a clear set of personal values; and an awareness of self as a creative being. Cremin and Barnes (2010) argue that all of these are critical to any good teacher, but knowledge of oneself as being creative is what resonates with teachers who are considered to be creative.

There are countless documents and research that highlight the attributes of a creative teacher. Ofsted's (2010) work, *Learning: Creative approaches that raise standards*, examines the success of creativity within schools, whilst Wiesberg's (2010) paper focuses on cognition within the study of creativity within science teaching. The document found that, in the most effective schools, creativity was given a high level of importance within the school curriculum. Ofsted (2013), for example, found that teachers with a clear understanding of creativity increased learner subject curiosity; the teachers in question may not be able to put this understanding into words, but are still capable of modelling creativity to their students, which is another cornerstone of effective creative teaching.

This reality is indicative of Shulman's (1986) theory on subject matter knowledge, which required teachers to be expert also in pedagogy and, arguably, those who have mastered that need are those who form the backbone of the select few identified by Ofsted (2013). Burgess (2007) also found that teachers were more likely to teach creatively if they had support from senior management, giving them time to: teach, with less focus on paperwork and more focus on learning; enjoy, with less pressure on teaching; imagine, with less prescription in order to plan creative lessons; and motivate, through less pushing to connect to individual needs. These measures aided in promoting creative teaching in the classrooms significantly.

However, it is important to note that teaching creatively may hamper children's creative outlets. This is particularly relevant where there is a more summative system of teaching, which sees the use of benchmarks to test knowledge acquired (Ofsted, 2013). This perspective is of particular importance, given that there is increased recognition that it is through science where many of the skills that underpin creativity, such as questioning, challenging, making connections, keeping options open and problem-solving (DCSF, 2008), can be taught. From a constructivist perspective, generating explanations and testing them are creative processes (Newton, 2010) and meaningful learning is inherently creative (Newton & Newton, 2009). Teaching science involves the use of provocative questions in a safe and enabling environment for exploring, risk-taking, experimenting and speculating, a process that helps students to improve their creativity (Ofsted, 2013). Additionally, the notion of creativity was expressed explicitly in an earlier version of the National Curriculum for Science in England, *'that science is about thinking creatively to try to explain how living and non-living things work, and to establish links between causes and effects'* (DfES, 1999, p.21). This premise, for Caulton (2007), is intended to increase learner interest in the subject.

According to both Cheng (2011) and Unger (2017), creativity can also be generated through scientific knowledge in various forms of expression. For example, knowledge, concepts and principles can be presented in the form of role-playing, drama, music, pictures, poems, and stories. Consistent with the importance of creativity in science, creativity has been recognised as a crucial component of school science (Perking, 1992). Although creativity is not confined to any particular subject area, Torrance (1992) supported the view that science has a much wider range of activities with which to foster creativity than other school subjects. This is because the process of creativity (preparation, incubation, illumination and verification) is similar to the steps in scientific method: observation, hypothesis, experimentation and verification (Garg & Garg, 2010; Fitzgerald, Danaia & McKinnon, 2019). Here it is suggested that these approaches lead to a more enquiry-based practice and the consideration of how important it is to teach creativity within primary science. This is the process that Cutting and Kelly (2014) relate to the issue of a need for teachers to inspire learners to engage with the subject and acquire knowledge as a result. It is in this spirit that the aim of this current study is to investigate the experiences of primary school teachers with regard to their perceptions of what the current barriers are to creative teaching in primary science. The following section will outline how this aim will be achieved.

Research aims:

- To increase knowledge of the components of creative science lessons; and
- To assess the impact of benchmark testing on creativity in pedagogical practice.

Methodology

This study adopted the qualitative paradigm to develop rich and in-depth data with regard to the views and lived experiences concerning the teaching of primary science. This approach is considered to help develop a more thematic line of findings, which sees elements being grouped together as a process for gathering additional insights into the phenomenon in hand (Braun & Clarke, 2006; Cohen, Mannion & Morrison, 2013).

Study ethics

The research adhered to the British Educational Research Association (BERA)'s code (2011) addressing informed consent, confidentiality and secure data storage. The ICO (2019: 12) notes that the anonymisation of personal data, as is the case

here, lies outside of GDPR and Data Protection systems. Nevertheless, this study has undertaken to build upon regulations and apply BERA code requirements, which, ostensibly, are stronger than those offered by current legal restrictions and regulations. As such, BERA (2011) is the governing system for this work and, following approval from the school's Board of Management, written informed consent was acquired from teachers who partook in this research.

Sample selection

Sampling is viewed by Anderson (2004) as a deliberate process that sees a number of people being used as representative of a greater population and, with this, a more purposive sampling system was used to recruit participants to the study. Yet, although the generalisation of samples is not a priority within purely qualitative research, the prevailing ratio of male to female teachers in primary schools was considered; this led to the recruitment of n = 20 teachers, of whom n = 4 were male and n = 16 were female. Recruitment took place from rural primary schools in Ireland. To help concretise findings, a triangulation system, in line with Stenhouse's (1975) pioneering introduction to curricular research and development, is utilised. This sees the incorporation of necessary components for creativity in education: imagination, desire and motivation.

Data collection

Face-to-face semi-structured interviews were conducted to determine the perceptions of teachers regarding aspects of creative teaching in primary science. Participants were interviewed by the study researcher under Marton's phenomenographic approach to identifying the perceptions of participants' lived experiences (Marton, 1988a). Interviews were recorded using a digital recorder and were subsequently transcribed verbatim into play-script transcripts. Each interview lasted approximately 45 minutes.

Data analysis

Following transcription of the audio files, full data analysis, following Marton's (1988b) method of phenomenographic analysis, was conducted. This involved a series of steps in which the data were categorised and sub-categorised into codes and themes. Cohen, Mannion and Morrison (2013) argue that this approach also sees a need to undertake analysis of the themes, because it is this that ultimately informs knowledge. This process began with the researcher familiarising themselves with the data – a process that began during the transcription of the audio files, and subsequent read-throughs of the play-script output – during which initial ideas about lower level codes were developed. The next phase sought to hone and refine these lower level codes and, additionally, saw similar codes be organised into thematic clusters. From these clusters, themes began to develop, at which point reference was made back to the original raw data to ensure fidelity between the themes and the actual accounts of participants. At this stage, any themes that did not match the data to a satisfactory level were discarded, whilst remaining themes were further refined and developed.

Results

Following analysis of the interview data, there were two core themes that emerged surrounding the challenges of implementing creative teaching in primary science lessons. The first of these referred to the tension between teaching creativity and working towards educational assessments, as per the evidence in the literature concerning the place of summative assessments in science (Ofsted, 2013). The second referred to the tension of having to work to the National Curriculum, though this could be a structural issue, which was felt to limit opportunities for creative thinking. These will be discussed in further detail in the following sub-sections and, where appropriate, these themes will be highlighted utilising extracts of the verbatim accounts of study participants.

The tension between creativity and assessment

Analysis of the interviews indicated that teachers found it incredibly difficult to implement creative teaching in their science lessons. One teacher stated that: *'We did not undertake any creative teaching in university, and even though I'm not great at modelling creativity, I do try to help students to see their own abilities or encourage creative problem solving. I feel that science is a really difficult subject, as you think that it should be practical, but you would need to see how individual children work out an experiment in order to access it accurately…'*

This was followed by *'...but the nature of it [science] should be a practical subject full of creativity!'*

Another teacher furthered this sentiment by stating: *'I suppose it would be easier if you orientated children to the subject. For example, sometimes I see children really engaged in the activity as in the example of electricity, and they try to work how a bulb lights in different ways...'*

The teacher gave the example that science needs to be presented in an interesting way to children, with opportunities for displaying creativity. For example, a child engaged in creative learning might express possibility thinking characterised by questions such as 'what if?' These questions are crucial to science, as they allow the children to come up with predictions, which in turn aid their learning. One teacher concurred with this as he stated: *'Within the topic of light, the children predicted where the light would reflect off a mirror by drawing it in their science books.'*

To be creative, children are required to be involved in:

- Exploration;
- Enquiry;
- Explanation; and
- Making connections.

The four abstract components, it is to be noted, relate to the fundamental ethos of the primary science programme, which allows children to explore their ideas.

Testing to benchmarks: The tension of teaching to National Curriculum Benchmarks (Testing)

Negative: One teacher described the IPSA-T (Irish Primary Science Achievement Test) that she is obliged to take with her class. There are three levels to this test, which make it possible to assess children's knowledge at the end of second, fourth and sixth class. The test uses multiple choice and short answers to respond to questions. The aim of the IPSA-T is to report pupil progress to parents.
Positive: Even though this particular teacher favoured the test, she also stated that: *'My major concern is that creativity is squashed by undertaking this test as I feel I am teaching to the test. I think that assessment gets in the way because students have to get a certain response.'* This premise is supported by the literature, which sees Cohen *et al* (2013) argue that the adoption of such approaches can be used to help inform the transfer of knowledge between teacher and class.

One teacher expressed disappointment that his experience in teaching science had resulted in pupils becoming unwilling to be creative and preferring a set structure of teaching and learning science. He agreed with the above statement and wondered whether a constructivist approach, as propagated within the curriculum, would encourage creativity: *'I feel if we use the constructivist approach to teaching science, as we learned in university and as proposed by Howe et al, of orientation, elicitation, experiment, reflection and application, this could promote independent thinking and creativity.'*

An assessment system predicated on a behaviouristic view of teaching and learning is one that is currently used in the assessment of learning by paper and pencil (Knight, 2011). The aim is to determine how much of the core curriculum learned from the teacher is still an important part of the curriculum in Ireland. Some teachers may argue that this testing approach is contrary to the needs of creative lessons. Furthermore, summative pedagogical practice only serves as a measurement approach, which is more theoretically consistent with earlier forms of the curriculum and their associated beliefs about learning. With this in mind, one teacher stated that: *'If [only] we could bring the enjoyment back into science and assess the children based on their levels of enjoyment and not their levels of achievement.'*

Discussion

Assessment within education is crucial to learning, as it *'activates outstanding learning, develops students' abilities and promotes further thinking'* (Cremin & Arthur; 2014). The encouragement of using thinking skills to develop creativity are key values, but if we are to deliver purposeful teaching, we must have the capacity to evaluate it, as anticipating innovativeness will be inadequate. Assessing creativity is as complex as defining creativity, which can be attributed to the numerous theoretical approaches. A key dispute about

assessing creativity is the subjectivity of it (Inoue, 2016); what one teacher may deem as creative may not be viewed in the same light by another. This results in work being open to the cultural disposition and, at times, work being devalued. As creativity is more of a pedagogical issue rather than a subject one, teachers can view such assessment as challenging, as there are no set guidelines to relate to children's work. It is evident that, as creativity is being rooted in all curriculum subjects, there is a greater need for an assessment tool that is inclusive and applicable to the new curriculum. The tension that exists between creativity and assessment is therefore a matter that requires further examination, and the final section of this paper will pay further attention to this matter.

The constraints of teaching to a curriculum

There were some contentions regarding creativity in primary science. Fifteen of the teachers interviewed argued that the National Curriculum places scant emphasis on the importance of creativity, therefore making it difficult to incorporate creative approaches into a teaching programme that had been structured independent of front line staff. With this, one teacher passionately stated that: *'When we went on our in-service days, it would appear that creativity is only relevant to the subjects of ICT, art, design and technology, and music. I wondered why it was not extended to other aspects of the curriculum such as science.'*

Another teacher felt that learning needs to be fun and thus creativity should have a higher value placed upon it: *'A teacher's role is not only to teach children what they need to know, but also to make learning fun and exciting so that the children can remember and enjoy what they have learned.'*

Ofsted (2010) argue that creativity is fundamental to successful learning and therefore teaching for creativity should not be dismissed or deemed 'unimportant' under the pressures of the National Curriculum (Davies *et al,* 2013). Teachers find that the pressures and expectations for high attainment and rapid progress often cause them to neglect creativity. This pressure to produce high levels of achievement is especially prominent amongst fifth and sixth (aged 9-11) class teachers: *'Many sixth class teachers feel that there is no time to teach anything other than mathematics and English due to the constraints and high expectations of parents and children as they enter the second level. These expectations not only leave teachers feeling stressed and nervous, but the children are also left feeling anxious and unhappy rather than excited or inspired.'*

Some teachers felt that the curriculum did not provide them with enough scope to be creative and felt that they were supposed to teach too much to the curriculum. One teacher said: *'I like the idea that the curriculum is there as a tool, but I sometimes feel that in my school we are supposed to follow it like the Bible!'*

With this, it would appear that the attributes of a creative teacher should include an ability to encourage children to produce creative outcomes, both within everyday life and within schooling. In order to do so, they must provide pupils with the chance to explore and examine a range of subject areas in suitable teaching climates. It can, however, be difficult for teachers to incorporate creativity into the expansive and continually changing curriculum. The major findings highlight the fact that, although teachers are not able to change the content of the curriculum, the way in which they deliver lessons is altogether down to the individual teacher. Teachers should be encouraged to use the National Curriculum as guidance in order to promote original and creative outcomes.

However, it is clear from the analysis undertaken in this study that the curriculum, far from providing an environment in which children can learn creatively, actually has the opposite effect and stifles the manner in which teachers feel that they can teach. This is an aspect supported by Ofsted (2010), who found that the most high performing schools were those with which there was little or no *'conflict between the National Curriculum, National Standards in core subjects and creative approaches to learning'* (Ofsted, 2010, p.5). This highlights the need to ensure consistency between government requirements and teacher creativity in order to promote achievement both academically and creatively.

Discussion and conclusion

This final section focuses on the barriers to creativity within primary science lessons, in respect of the need to increase knowledge of the components of

creative science lessons and to assess the impact of benchmark testing on creativity in pedagogical practice. As such, the research considers the limitations of the current study, places the findings described above into context, and concludes with recommendations both for future practice and future research:

- To increase knowledge of the components of creative science lessons; and
- To assess the impact of benchmark testing on creativity in pedagogical practice.

Limitations

Prior to discussing the above findings in further detail, it is prudent at this stage to discuss the limitations of the current research that yielded these findings. The analysis itself is a laborious process, particularly when working alone. This is an issue that sees the researcher relying on his or her own instincts and interpretations of the available literature. However, there is a need to adhere to a pre-developed set of analytic steps to ensure that the themes that were identified were firmly grounded within the data that were collected and are indicative of the experiences that were reported by participants. However, it must also be noted that, although qualitative research does not seek to make sweeping generalisations, the themes reported may not reflect all the experiences of this particular participant group or even their wider group of peers in education. It must also be noted that this work was carried out by a single researcher, raising the possibility of unconscious researcher bias being a factor in the theme development (Noble & Smith, 2015). Nevertheless, the rigorous nature of the analytic process was designed to minimise the chances of this.

Structural issues for this study related to reliability as, essentially a small-scale study, the paper cannot claim universality of meaning in regards to the findings because, ostensibly, the research offers only a snapshot of teacher and practitioner thinking. But in order to help bypass this issue, triangulation with regard to imagination, desire, and motivation was considered to be crucial because, in essence, it is difficult to create rogue summaries when different components yield the same results (Stenhouse, 1975).

Discussion of findings

The findings of this study conclude that testing in primary education is hampering the teaching of creativity. This finding is coherent with Luzer (2013), who believes that standardised testing is destroying students' creativity and their desire to learn. With the IPSA-T and other standardised testing being introduced to younger and younger children, many teachers are worried about how this might affect the children's creativity. Arthur and Cremin (2014) recognise the constraints that standardised testing impose on creativity; they consider the argument that, through removing national statutory testing of children, we could achieve more creativity. However, many educators argue that the constraints of SATs and other standardised tests can be overcome through teachers' confidence and the willingness to enforce creativity in their classroom (Fisher & Williams, 2004). The teachers in question generally found it difficult to suggest ways of assessing creativity in teaching science in the classroom. For many teachers, they were thinking in terms of pen and paper assessment, as opposed to more creative assessment methods.

Arthur and Cremin (2014) believe that the scant attention paid to creativity, compared to that in the previous National Curriculum, is the reason why teachers discourage creativity in their classroom. However, the National Curriculum (1999) should be seen as a basic structure to support teachers and help them with planning. According to DfE (1999), it was not established to restrict teachers' creativity, but simply to provide the framework that they can use to develop exciting lessons. Fisher and Williams (2004) argue that teachers should do more than just restrict their teaching to the National Curriculum standards; however, as this current study has shown, the perceived constraints of the National Curriculum are felt by teachers to be limiting to their teaching; the implications of these findings shall be discussed below.

Conclusions and future implications

This study set out to examine, in an in-depth manner, the experiences of primary school teachers in relation to the current barriers to teaching creativity within primary science. This was achieved via the conducting and subsequent analysis of semi-structured interviews of twenty teachers who have recent experience of this issue.

The analysis pointed to two core barriers to teaching creativity in primary science. These were created by the tension between creativity and teaching for assessment and also maintained by the perceived constraints of the National Curriculum, which teachers felt placed little emphasis on the role of creativity within learning.

It must be noted at this point that the two key barriers to teaching creativity are systemic issues relating to the 'machinery' of teaching, and the frameworks under which teachers are required to work. It is possible that this 'outward' identification of issues fails to pay heed to the individual characteristics of teachers, or even of school environments, which may limit the use of creativity in class. Indeed, there was very little internalisation of issues, or identification of personal characteristics, such as levels of confidence in teaching creativity, by participants.

This could reflect that it is in fact the external machinations of the educational system that hinder creativity, but future research should focus upon possible personal factors within teachers that may have an impact on this matter. Future research could also further expand upon the findings of the current study and examine the issues outlined above in a large-scale survey of teachers, to gauge the extent of the perceived problems with assessments and curricula within primary science. In a practical sense, schools must support teachers to place importance and emphasis on creative learning within science, free from the tensions and constraints that teachers within this study have identified – this is in line with Ofsted's (2010) recommendations, but, clearly, based upon the evidence of the current study, more needs to be done to support teachers and schools in relation to this most important of areas.

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