The nature of creativity in Arts and science teaching: views from the primary classroom

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Abstract

This article considers teachers' perspectives of creativity in both their Arts and science lessons. It elaborates on the ways in which they reflectively report that they are creative in their teaching ***and*** *how they foster learner creativity. Drawing on questionnaire data from over a hundred teachers recognised for specialist excellence, this article contemplates the extent and nature of these teachers' varied views. The questionnaire responses were collated and analysed to present descriptive statistics and a thematic analysis. Comparison across teachers' perspectives of creativity in Arts and science suggests a sophisticated picture, describing features that characterise creativity across subjects as well as subject-specific contrasts. From these findings, propositions are offered about ways that teachers could promote creativity across subject disciplines and ideas for supporting it specifically in science. An outcome from this study is a proposed framework of creative teaching practices, which could be drawn on to develop pedagogies to support learner creativity within and across science and the Arts.*

Keywords: Science, Arts, learner creativity, creative pedagogies

Introduction

The Durham Commission (2019, p.74) highlighted *'growing national and international interest in the importance and value of creativity and creative thinking in our society'.* Despite this, creativity receives scant mention in National Curriculum Science policy documents (McGregor & Frodsham, 2019). In addition, the UK has decided not to participate (TES, 2019) in international PISA tests to formally recognise creative skills (OECD, 2019), thus leaving the task of identifying and developing learner creativity to educators themselves.

Creativity can be understood and thought about in various ways. PISA defines creative thinking as *'the competence to engage productively in the generation, evaluation and improvement of ideas, that can result in original and effective solutions, advances in knowledge and impactful expressions of imagination'* (OECD, 2019, p.8). Often it is described as something related to the Arts (Mullet *et al,* 2016), connected to performance of some kind: for example, *playing* a musical instrument, *painting* a picture, *acting* a part in a play, or *writing* a unique song, poem or story. However, without the creative thinking and innovative problem-solving of scientists, we might not have COVID-19 vaccines, plastic digesting bacteria, hybrid cars or even hydroponics that may feed the world in the future. Initiating creative thinking in schools to inspire future scientists has long been advocated by the Organisation of Economic Cooperation and Development (OECD, 2019). In England, Ofsted (2010, p.5) has described how creative approaches can be incorporated into school science teaching as well as 'traditionally "creative"' Arts. Clarity is needed to enable teachers to appreciate and adopt common principles for creative teaching (Sawyer, 2012) or recognise where subject-specific approaches might be more effective.

The OECD (2019, p.9) also acknowledges the unresolved question of: *'Is creative thinking in science different from creative thinking in the Arts?'* Glaveanu (2018) argues that there may be ontological divides in creativity, with artistic approaches associated with creative transformation of materials, thoughts and feelings

into a particular medium (visual, musical, for example). Whereas, creativity in solving problems, discovery and inventiveness is, Glaveanu contends, more closely associated with science. He does advise, however, that if educators are to successfully nurture a range of forms of creativity, there needs to be wider recognition of contrasting characterisations across disciplines. Mullet *et al* (2016) reiterate that teaching for creativity in disciplines beyond the Arts (in science, for example) requires more specific pedagogical guidance. The research discussed here takes steps towards addressing this.

Focus of the research

The intention of the questionnaire research in this article was to explore teachers' thoughts about and experiences of creativity in the classroom. This formed the initial phase of a mixed-methods doctoral research study connected to a larger PSTT (Primary Science Teaching Trust)-funded project exploring creativity in science (McGregor & Frodsham, 2021).

Research questions

- How do primary teachers with specialist excellence in Arts and science characterise creativity in their lessons?
- What features of practice do these teachers associate with nurturing creativity?
- In considering creativity in Arts and science lessons, are commonalities evident?

Research approach

Primary school teachers were purposively invited to participate because of their involvement with Artsmark, PSQM (Primary Science Quality Mark) or the PSTT award schemes relating to Arts or science teaching. Ethical approval was gained before a questionnaire exploring their views about creativity in Arts and science lessons was distributed through the gatekeepers of these organisations. The total number of respondents was 104, with relatively balanced numbers representing Arts and science specialists (N=51 and N=53 respectively). All responses were collated and de-identified for anonymity.

There is no claim that the views and experiences collected represent all values, experiences or practices of primary teachers, particularly because participants were chosen for their specialist excellence. However, for precisely that reason, the expertise of these individuals meant that they were well placed to emphasise common features of creative pedagogies across disciplines and highlight effective approaches for nurturing pupil creativity in these subjects.

The questionnaires

The questionnaire design involved defining aims, devising and piloting questions, before distributing, collating, coding and analysing results (Gray, 2018, Ch.10). Hetherington *et al* (2019) explain how, in their creativity research, Likert questions enabled the description and comparison of perspectives between groups, while open-ended questions facilitated the emergence of unanticipated themes.

Similarly, in this questionnaire Likert scale questions queried how often different features of creative pedagogies were employed in Arts or science lessons, with options offered of '1-never', '2-rarely', '3-sometimes', '4-often' and '5-always'. Suggestions from Craft (2005), Davies and McGregor (2016), Sawyer (2012), QCA (2005) and Jones and Wyse (2013) were merged to form 15 distinct features representing creative teaching (Figure 1).

There were also five open text questions seeking unfettered responses about the nature and enactment of creativity, focusing on teachers' memories of creative lessons in Arts and science. Care was taken to avoid leading questions, ambiguity, stereotyping and assumptions (Gray, 2018, Ch.14). Most of the open questions were divided into two parts for separate focus on the (a) teacher and (b) learners.

Three academic colleagues checked the questions for face validity and subject bias before the questionnaire was piloted with two practising teachers and two groups of seven student teachers, inviting their comments. Any ambiguous and problematic wording was resolved before administering the final questionnaire.

Data analysis

The quantitative data was statistically analysed using SPSS. Cronbach's alpha was used to assess the internal consistency of the Likert scale items (Gardener, 2017) to ascertain the scale reliability. Despite some variations in factor loadings, all the individual features of creative pedagogy showed acceptable correlations (> r =0.3), with an overall Cronbach's alpha of $\alpha = 0.864$. Modes were then calculated to provide an overview of the frequency of use of each creative practice in lessons.

Following this, non-parametric Pearson Chi-square testing was undertaken, because the collated Likert scale responses were essentially categorical (Gardener, 2017). These tests were chosen because they could determine the extent to which teacher ratings fitted the null hypothesis that features of creative pedagogies would demonstrate the same distributions for frequency of use in science and Arts: in other words, whether distributions of ratings appeared independent of subject discipline (Arts or science). A result above an accepted significance level of .05 implied that subject discipline and the use of that particular creative practice might be related. Counts for ratings for science and Arts lessons were compared where significant results were found to tentatively consider the possible nature of any relationship.

Teachers' open textual responses were thematically analysed through 'initial coding' involving reading and assimilating, before developing themes and categories based on notable patterns (Saldana, 2015). Systematic rounds of coding and refining of categories were undertaken in 'focused coding', comparing '*data*

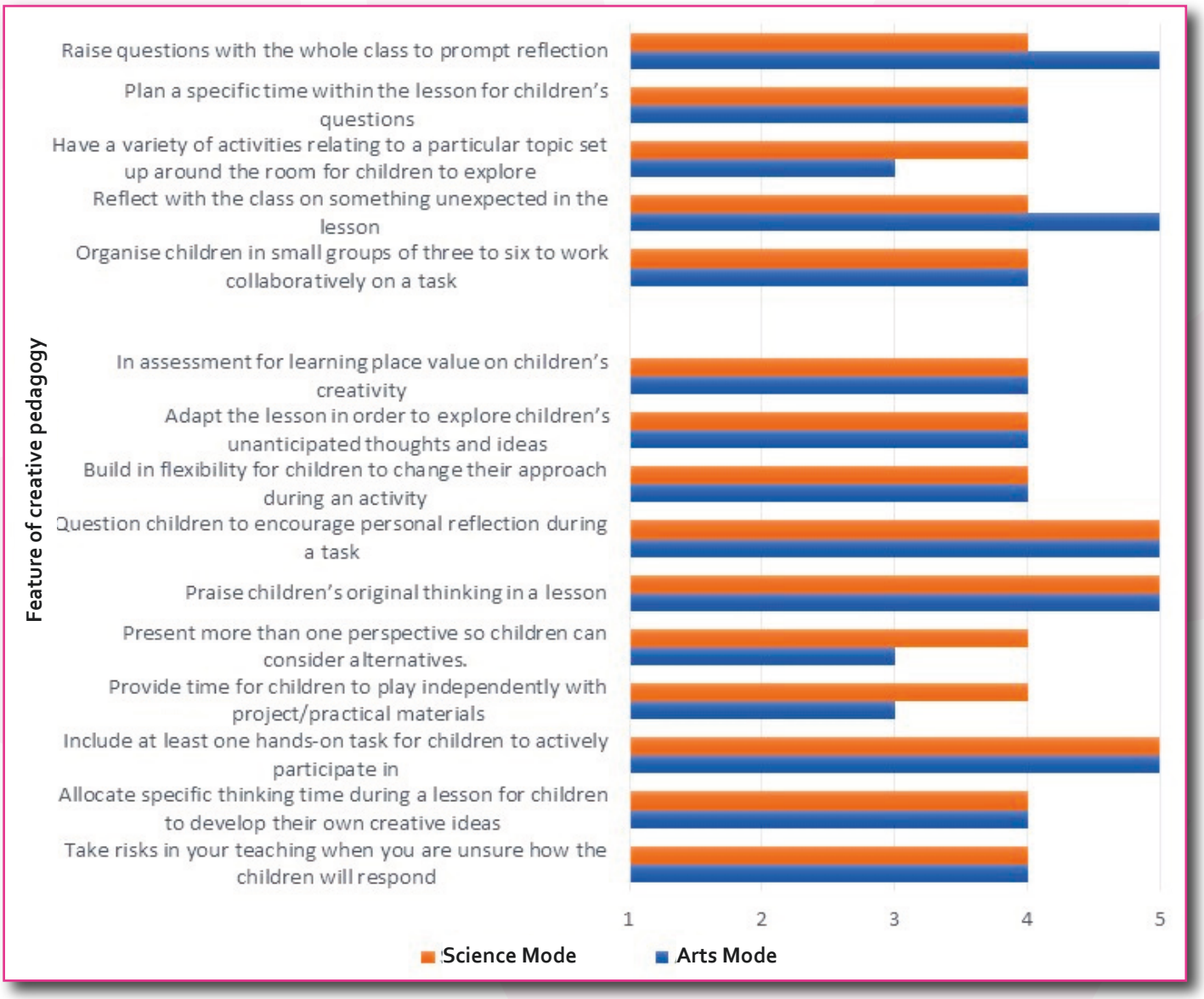


Figure 1. Teachers' use of features of creative pedagogy in lessons (N=104).

with data, staying close to and remaining open to exploring what they [the researcher] interpret is happening in the data; constructing and keeping their codes short, simple, precise and active' (Thornberg & Charmaz, 2014, p.156).

Findings

Findings from the Likert scale items

Figure 1 indicates the extent to which teachers reported adopting each of the different features of creative teaching. For all items, the mode was at least '3-sometimes' for Arts and science lessons.

The last ten features of creative teaching displayed in Figure 1 produced non-significant values in Chi-square testing, implying that their pattern of use was reported to be independent of subject discipline (broadly similar in Arts and science).

However, the first five items produced statistically significant values, thus implying a distinction in the distribution of ratings between Arts and science lessons. Counts were examined to describe the possible nature of this. Figures 2a and b (shown with the associated Chi-square statistics) present higher counts centred on modes of 4 (often) in science. These differences could indicate a trend towards their more frequent use in science in comparison with the Arts.

In contrast, in Figures 2c, d and e, ratings appear more spread out across the Likert scale for Arts compared to science (where teachers more consistently selected 'often' or 'aways'). These differences in distributions could suggest higher variation between teachers in the frequency that they use these creative pedagogy features in Arts lessons.

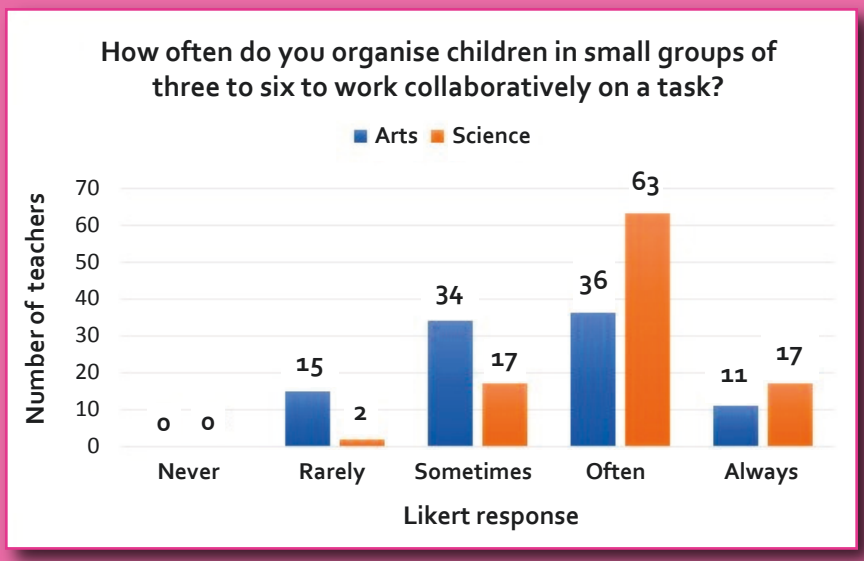
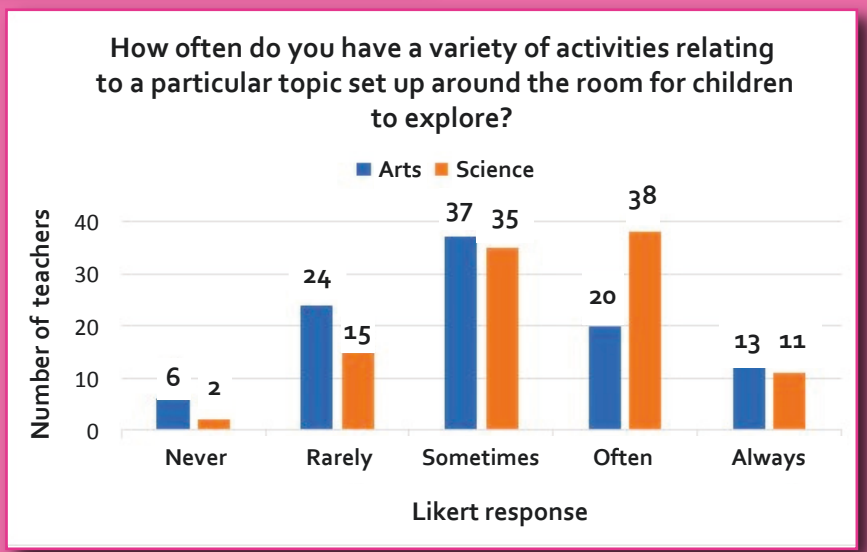


Figure 2a. Teachers' responses relating to collaborative group work. $\chi 2$ (3, N = 195) = 24.22, $p < .001$

Figure 2b. Teachers' responses relating to a variety of activities. $\chi 2$ (4, N = 201) = 9.88, $p < .05$



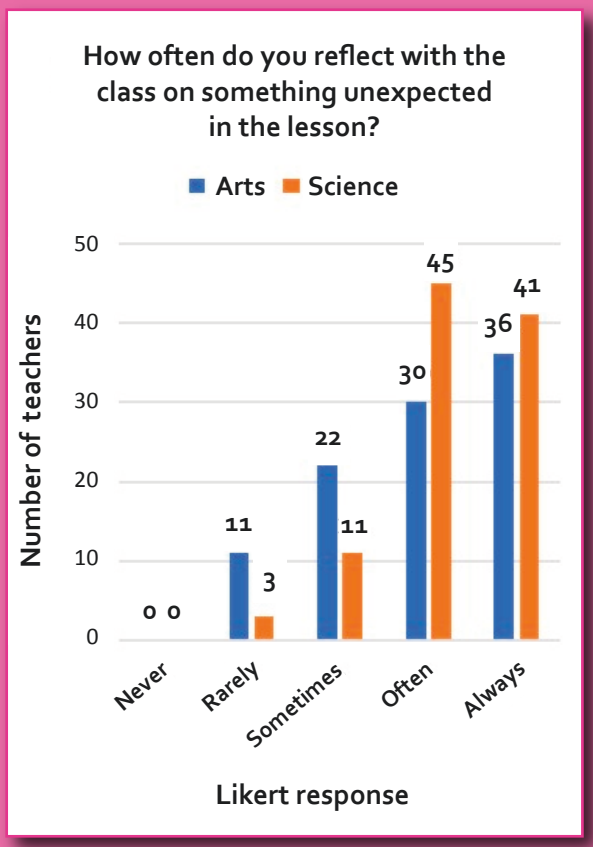


Figure 2c. Questionnaire responses relating to reflecting on the unexpected
$\chi 2$ (3, N = 199) = 11.56, p < .01

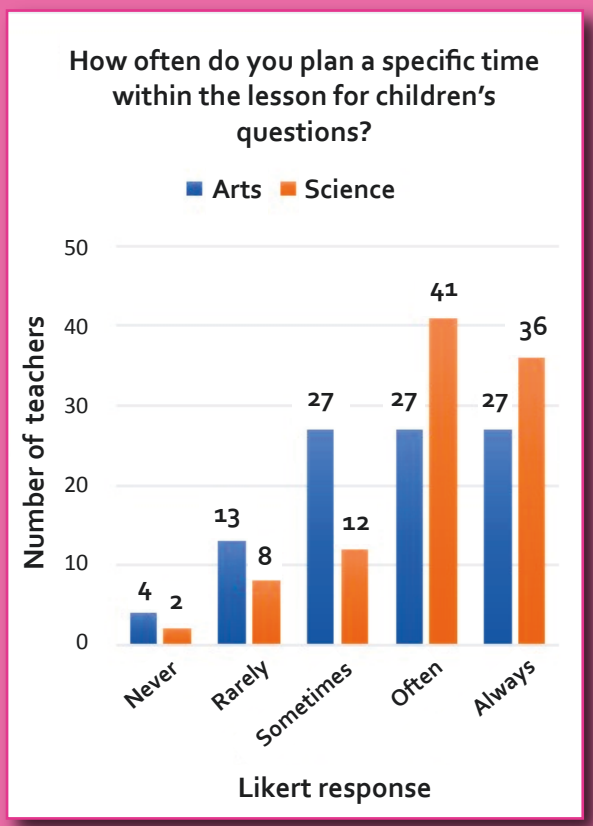


Figure 2d. Questionnaire responses relating to time for questions
$\chi 2$ (4, N = 197) = 11.79, p < .05

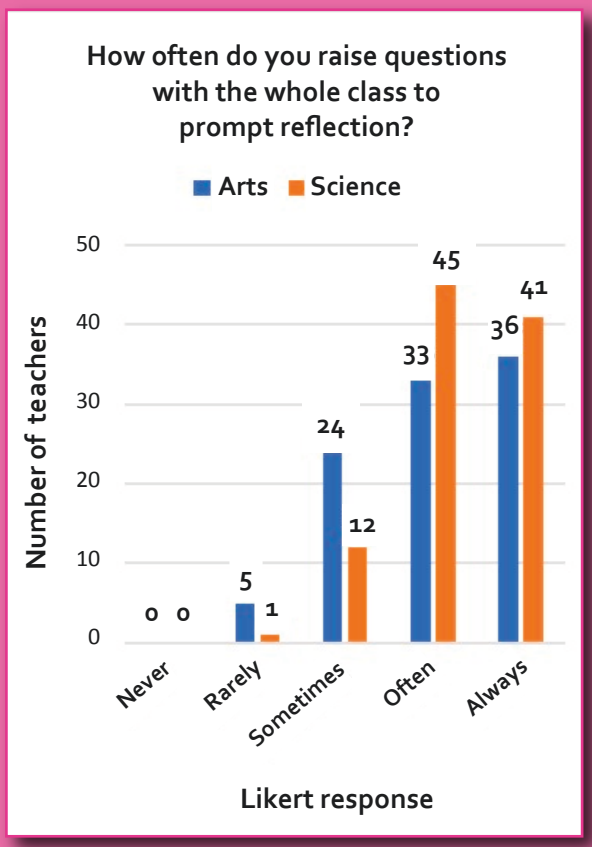


Figure 2e. Questionnaire responses relating to questions for reflection
$\chi 2$ (3, N = 197) = 8.83, p < .05

Findings from the qualitative data

In teachers' responses to the open questions, word clouds were produced using NVivo software from teachers' collected descriptions (see Figure 3) to indicate what they perceived characterised creativity in Arts and science lessons. Default stop words were excluded from frequency counts of words, as well as the defining stemmed words 'Science', 'Arts' and 'lesson' to avoid obscuring results.

The word clouds for science and Arts appear broadly comparable, with 'children' centrally placed, illustrating its frequent mention. In addition, numerous words emphasise hands-on, practical activities, such as 'using', 'made', 'performed' and 'investigated'. Subject-specific words are also apparent, such as 'portraits', 'paint' and 'draw' (for Arts), and 'experiments', 'electricity' and 'system' (for science), although some of these occur within both word clouds, for example 'drama', 'water', 'music' and 'instruments'.

Figure 3. Word clouds illustrating teachers' descriptions of creativity in (from left to right) science lessons, Arts lessons and children's talk.

This could represent the creativity recognised in cross-curricular STEAM lessons. For children's talk, words relating to positive emotions and active engagement feature prominently, with teachers frequently discussing the excitement, enjoyment and enthusiasm of learners when being creative, thus highlighting their positive educational experiences.

Further thematic analysis of teacher descriptions of creative lessons identified themes of: *'investigation'*, *'performing'*, *'making a product'*, *'discussion'*, *'group work'*, *'cross-curricular'*, *'practical'* and *'agency'*. In learner creativity, pertinent themes included: *'discussion with peers'*, *'engagement'*, *'ideas'* and *'questioning'*. Notably, teachers often did not differentiate between creativity in teaching and learning, providing mixed descriptions despite being prompted to address each of these aspects individually.

Developing practical guidance for teachers

The centrality of the word 'children' (depicted in Figure 3) emphasised that teachers recognised the important contribution of learners to the creativity emerging in lessons, despite often neglecting to see this separately from creative pedagogies. Figure 4 was developed to conceptualise the key characteristics of learner creativity informed by exploration of teachers' open questionnaire responses alongside consultation of the literature (Robson, 2014; QCA, 2005; Lucas & Spencer, 2017; Redmond, 2005; Littleton & Mercer, 2013; Craft, 2000; Ofsted, 2010). Table 1 (p.43) elucidates how these characteristics might be observed by teachers in the classroom.

The synthesis of teachers' views and experiences of creativity in the questionnaire verified existing themes in the literature, such as allowing choice, opportunities to think across disciplines, collaboration, discussion, openness and giving time for students to develop their creative ideas (Sawyer, 2012). However, the open responses also added the teachers' perspective and further detail to how themes such as affording pupils agency might be exemplified in primary school science and Arts lessons. The creative practice and learner creativity model (Table 1) emerging from the questionnaire analysis offers a theoretical framework that could support practitioners wishing

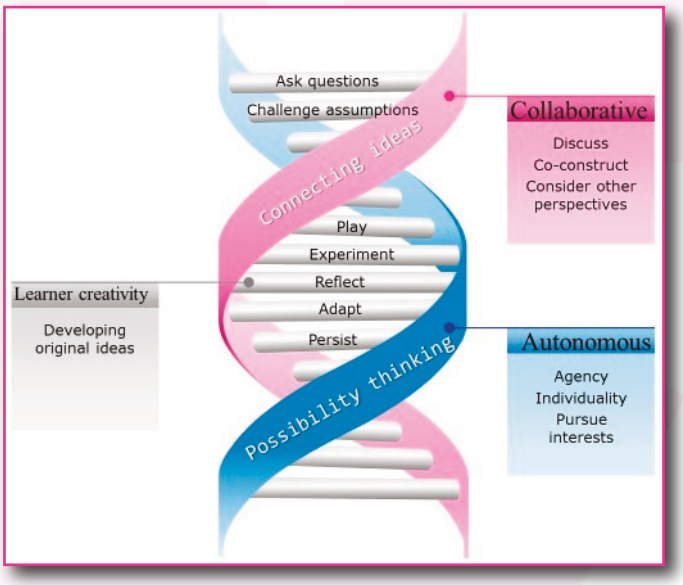


Figure 4. A conceptual representation of 'learner creativity'.

Table 1. Features of creative pedagogy augmenting development of learner creativity in Arts and science lessons.

Notable features of creative practice		Interactional space supporting creative development	Illustrations of learner creativity	
Teacher's practice	**Nature of practice**		**Characteristic of creativity**	**Nature of characterisation**
Affords pupil agency	Provide opportunities for play, discovery or exploration through genuinely open tasks that allow individual choice.		Autonomy	Explains or shows evidence of personal decisions and choices. Adapts work/ideas to their interests.
Makes possibilities visible	Highlight alternative perspectives, ways of doing or seeing things, ambiguities, or inexplicable phenomena.		Connects ideas	Generalises or finds patterns by linking multiple pieces of information. Highlights a connection or commonalities to previous learning, knowledge, or experience. Uses analogies or metaphors.
Values possibility thinking	Reflect thoughtfully or positively on pupils' ideas or questions without premature judgement.		Asks questions	Poses questions to seek new knowledge or deeper understanding, e.g. asking 'why?', 'how?' or 'what?' Speculates about possibilities, e.g. voicing 'I wonder…' or 'imagine if…' Challenges assumptions/generalities or raises exceptions/inaccuracies.
Encourages possibility thinking	Raise open questions or statements that invite various possible ideas and ask children to share their thoughts.		Imaginative	Articulates an original solution or idea. Proposes an alternative to the accepted way of doing or seeing things.
Includes incubation time	Include time and space for children to develop/ experiment with their ideas and flexibility with time to allow children to work at their own pace.		Risk taking	Tries out or experiments with an original or alternative idea/approach. Acts upon intuition or what 'feels' right. Plays with resources and materials or improvises without any obvious plan.
			Persistence	Reflects upon their approach, idea or emerging outcomes during tasks. Adapts or makes improvements to overcome problems. Critically evaluates the quality of their final performance or product.
Open dialogic space	Incorporate tasks that encourage peer collaboration, co-operation, and discussion.		Collaboration	Gives constructive feedback to peers to inspire improvement. Invites feedback. Considers alternative perspectives or ways of doing things. Extends others' ideas in discussion through developing them further or considering implications.

to develop their practice and promote greater creativity in their classrooms. In addition, the findings emphasised the inter-related nature of creative teaching and learner creativity. This vision of the emergence of creativity 'in relationship' between teacher and learner (Craft, 2005) is represented in the 'interactional space supporting creative development' shown in the Table. In this space, a reflexive two-way relationship shapes and transforms children's possibility thinking, the development of ideas and innovation in outcomes, as well as the teacher's ongoing creative practice in a lesson or topic. Furthermore, the framework encompasses the various phases of the creative process, recognising that children might be supported and encouraged (perhaps in distinct ways) during different stages.

Conclusion

The Durham Commission (2019, p.74) describes how integrating teaching for creativity will support young people 'in all aspects of their lives'. In this questionnaire research, primary school teachers (selected for their specialist excellence) reported using a wide range of creative practices regularly in their science and Arts teaching, evidencing how these strategies are relevant and effective beyond the Arts. These teacher participants have confirmed and detailed that there exist numerous possibilities for nurturing creativity in primary science and have added clarity and richness in understanding what this can look like. To address the lack of clarification in the Primary Science National Curriculum (McGregor & Frodsham, 2019), a creativity framework (see Table 1) has been produced based on the questionnaire findings and assimilated ideas from the literature (e.g. QCA, 2005). This table details features of creative pedagogies, which may augment the development of recognisable aspects of learner creativity in Arts and science lessons.

Crucially, results appeared to suggest that some features of creative practice were adopted more frequently or consistently in science lessons compared to the Arts. Statistical tests indicated differences in the distribution of ratings for the reported use of creative practices, including: incorporating collaborative group work, including a variety of activities for learners to explore, planning time for children's questions, raising questions to prompt reflection, and reflecting on the unexpected in lessons. More work is needed to determine what these apparent differences represent and what the implications of this might be for teachers. Questionnaire findings have highlighted how the relationship between teaching practices and creativity appears nuanced, challenging the assumption that creative pedagogies are synonymous between subject disciplines (Cremin & Chappell, 2019).

Future research

It is imperative that researchers continue to develop and translate findings and identified 'themes' into practical guidance for teachers and learners in the science classroom. The theoretical framework presented in this paper provides a useful starting point for teachers wishing to nurture learner creativity; however, it is only the first step. It must be trialled extensively to establish how it can be adopted and built upon as a practical tool for teachers' planning or assessment. This research has also highlighted the imperative to challenge the nature of assumptions that consider a direct, as well as similar, relationship between creative pedagogy and learner creativity across classrooms, levels of education and subject disciplines. More research is required to explore further how pedagogy and learning inter-relate to promote creativity across subject areas. This would clarify for teachers how they could better nurture creativity in their classroom, whether in a specific subject context such as science, or across a range of STEAM disciplines.

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