



Research paper

## Nurturing curiosity and creativity in primary school classrooms

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### ABSTRACT

Creativity and curiosity are recognised as vital skills to prepare students to engage with the significant challenges and opportunities of the future. To address the research question “*What practices do teachers enact with the aim of encouraging creativity and curiosity in primary classrooms?*”, 21 teachers were interviewed about their teaching practices; this data was triangulated with self-captured classroom videos from 19 classrooms in nine countries. Results of the analysis demonstrated a variety of promising classroom practices. These findings and implications for practice are discussed in terms of diverse feedback pathways, nurturing inquisitive minds, supporting self-regulatory learning and self-expression.

### Author contributions

Juliet Scott-Barrett (Research Officer): Investigation; Methodology; Data curation; Formal analysis; Project administration; Resources; Visualisation; Writing – original draft; Writing – review & editing. Samantha-Kaye Johnston (Research Officer): Investigation; Methodology; Data curation; Formal analysis; Project administration; Resources; Visualisation; Writing – original draft; Writing – review & editing. Tracey Denton-Calabrese (Project Manager and Research Officer): Investigation; Methodology; Data curation; Formal analysis; Project administration; Resources; Visualisation; Writing – original draft; Writing – review & editing. Joshua A. McGrane (Co-Investigator): Conceptualisation; Funding acquisition; Investigation; Methodology; Data curation; Formal analysis; Supervision; Writing – review & editing. Therese N. Hopfenbeck (Principal Investigator): Conceptualisation; Funding acquisition; Investigation; Methodology; Data curation; Formal analysis; Project administration; Resources; Supervision; Writing – original draft; Writing – review & editing.

### 1. Introduction

Creativity and curiosity are recognised as vital skills to support

future generations to innovate, explore, navigate uncertainty, and engage with the emerging questions and challenges of the 21st century (Beghetto, 2021; Jirout & Matthews, 2022; Organisation for Economic Co-operation and Development [OECD], 2021). The development of creativity involves innovation and experimentation and has been highlighted as essential to preparing learners to thrive in uncertain futures (Beghetto, 2021; Karwowski et al., 2022). Curiosity has been recognised as a stimulus for exploration and question-asking (Jirout & Klahr, 2020; Vogl et al., 2019) and motivator of learning (Gross et al., 2020; Jirout & Matthews, 2022; Murayama, 2022). Recent policy initiatives emphasise the importance of nurturing opportunities for creativity and curiosity to support young people to thrive in rapidly changing societies (OECD, 2021; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2022). Research has begun to explore how teachers can promote creativity (e.g., Beghetto, 2019a), as well as curiosity (e.g., Jirout et al., 2018; Peterson, 2020). There have also been initial explorations into the link between creativity and curiosity (Gross et al., 2020; Hagtvedt et al., 2019; Schutte & Malouff, 2020), which highlight a strong call to develop an evidence base to better understand curiosity and creativity, and how these skills can be fostered in diverse real-life contexts.

This current study responds to the call above and draws insights from

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a multi-site, international study across nineteen primary/elementary classrooms in nine countries, exploring the practices of teachers working in diverse global contexts. The aim of this research was to explore creativity and curiosity in classroom contexts, and to document the teaching interactions in which opportunities for creativity and curiosity arose. The central research question was:

- *What practices do teachers enact with the aim of encouraging creativity and curiosity in primary classrooms?*

We sought to explore this question through analysis of video recorded classroom lessons and online student and teacher interviews. This article contributes empirical data that illustrates how teachers facilitated diverse opportunities for curiosity and creativity into their classrooms. The article concludes with implications for teaching practice, and nurturing curiosity and creativity in young learners.

### 1.1. Defining creativity

Although diverse definitions of creativity exist (Simonton, 2018), two elements are consistently emphasised as key to describing creativity: originality (also described as novelty) and usefulness (Plucker et al., 2004; Runco & Jaeger, 2012; Torrance, 1974). Rhodes (1961) proposes a 4 P model: person (the individual [s] involved), process (the physical or mental activity involved), product (the outcome/concept), and press (the environment/surroundings); this four-part conceptual framework has also been influential in understanding the situated and dynamic nature of creativity (Scoular & Ramalingam, 2021). These earlier conceptualisations have sparked more critical reflections on the different kinds of environments and processes that could support opportunities for creativity that all can engage in (Beghetto & Zhao, 2022; Karwowski et al., 2022).

Creativity scholars have written about different types of creativity (see Table 1): “Small-C” creativity refers to everyday creative ideas and connections which most people experience frequently (Gregory et al., 2013; Kaufman & Beghetto, 2009; Scoular & Ramalingam, 2021).

**Table 1**  
A summary of key creativity definitions from the literature.

Key Concepts in Creativity Research	Definition from the literature
Mini-c creativity	“Novel and personally meaningful interpretation of experiences, actions, and events”. (Beghetto & Kaufman, 2007, p. 73, p.73)
Little/Small-c creativity	“Those creative actions in which the non-expert may participate each day”. (Kaufman & Beghetto, 2009, p. 2, p.2)
Pro-c creativity	“the developmental and effortful progression beyond little-c that represents professional-level expertise in any creative area”. (Kaufman & Beghetto, 2009, p. 1, p.1)
Big-c Creativity	“The revolutionary creativity that transforms culture and society”. (Glăveanu, 2018, p. 25, see also Kaufman & Beghetto, 2009)
Ed-c Creativity	This was first articulated as “Creativity for learning or achievement in formal educational environments.” (Lassig, 2020; see also Lassig, 2019); And more recently: “Ed-c refers to perceiving and pursuing novelty for learning or achievement in formal educational environments.” (Jackson & Lassig, 2020, p. 56, p.56)
Creative learning	“Creative learning, which can occur in formal and informal learning environments, refers to the dual processes of developing new and meaningful thoughts and actions ... and making creative contributions to the learning and lives of others”. (Beghetto, 2021, p. 3, p.3)
Creative dispositions	These vary across the literature but the following have been highly influential over the last decade: “1. Inquisitive ... 2. Persistent ... 3. Imaginative ... 4. Collaborative ... 5. Disciplined.” (Lucas et al., 2013, pp. 16-17)

“Big-C” Creativity is a significant creative product or idea that impacts society or a broader community (Karwowski et al., 2022), such as Louis Braille’s creation of a tactile writing system (Torrance, 1965), or Stephanie Kwolek’s invention of Kevlar for hurricane-safe buildings (White et al., 2012). Kaufman and Beghetto (2009) expand on this distinction between Small-C and Big-C (see Table 1, rows 1 to 4), adding “professional” level creativity and the individually meaningful “mini-c”, (see also Beghetto, 2019a).

These theoretical concepts have helped researchers articulate practical implications for understanding creativity in classrooms. For example, Lassig (2020) reflects on these different manifestations of creativity and argues: “models such as these highlight that creativity has shifted from being regarded as a capacity held by a special creative few, to one that is possessed by all” (p.2); she closes her argument by calling on schools and researchers to explore with students the different ways that they experience and develop creativity. Similarly, Lucas (2022) revisits the creative dispositions framework (see Lucas et al., 2013); and considers the diverse ways that international policies and curricula seek to offer learners a range of opportunities to experience creativity. Ed-c is a helpful addition and adds depth to earlier theories that conceptualise learning and creativity as distinct yet compatible processes (Beghetto, 2019b). These dimensions have received continued critique and refinement (see for example Runco, 2014); however, for the purposes of research in education, little-c, mini-c and Ed-c, are particularly helpful concepts to understand how children and teachers experience and construct opportunities for creativity in their everyday learning and teaching (Beghetto & Zhao, 2022; Scoular & Ramalingam, 2021). This focus on everyday personally meaningful creativity influenced our choice of working definition:

Creativity is coming up with new solutions and ideas (Vincent-Lancrin et al., 2019), or the creation of a novel or useful product (Plucker et al., 2004; Rhodes, 1961).

This definition aligns with the suggestion in the OECD conceptual rubric (see Vincent-Lancrin et al., 2019, p. 27) that creativity can remain abstract as an idea, solution, design-process, or concept (see also Karwowski et al., 2022); or may manifest as a product (Plucker et al., 2004; Rhodes, 1961). Thus, having established a working definition of creativity, we now discuss the different ways that curiosity is defined in the literature, and introduce the key concepts that have shaped research into curiosity.

### 1.2. Defining curiosity

Loewenstein (1994) proposes an account of curiosity as “a form of cognitively induced deprivation that arises from the perception of a gap in knowledge or understanding” (p.75). Litman and Jimerson’s (2004) further developed Loewenstein conception to delineate two types of curiosity: “curiosity as a feeling of interest” and “curiosity as a feeling of deprivation” (p.148), and explore how different kind of curiosity may affect “behavioural expressions of curiosity” (p.156). Recent theorists maintain the call to distinguish curiosity from interest by acknowledging that curiosity relates to an information gap, whereas interest encourages a broader scope of focus (Hidi & Renninger, 2019; Pekrun, 2019; Shin & Kim, 2019). Pekrun (2019) argues that curiosity is hugely influenced by environmental stimuli, and so even people with a disposition or determination to repeatedly experience curiosity (trait-curiosity), may only experience the “state” of curiosity in certain contexts; he also explains an individual’s curiosity may vary and change over time (see also Jirout & Matthews, 2022).

Researchers also emphasise the importance of recognizing the active behaviours associated with curiosity (see Table 2): Shin and Kim (2019) argue that curiosity encourages individuals to “engage in persistent information-seeking behaviour” (p.854): this focus on “information-seeking behaviour” is echoed throughout educational research into curiosity (e.g., Jirout et al., 2018; Peterson, 2020), and was selected as a key element of our working definition:

**Table 2**  
A summary of key concepts relating to curiosity.

Key Concepts in Curiosity Research	Definition from the literature
<b>Curiosity as an information gap.</b>	“a form of cognitively induced deprivation that arises from the perception of a gap in knowledge or understanding.” (Loewenstein, 1994, p. 75, p.75)
<b>Curiosity as an active process</b>	Curiosity involves the “active seeking for specific knowledge” (Shin & Kim, 2019, p. 859); “The process of searching for information to resolve curiosity requires the investment of cognitive effort.” (Shin & Kim, 2019, p. 867, p.867)
<b>Curiosity as a learning opportunity</b>	“The realization that one does not know something can be perceived as an opportunity for learning, and the desire to seek this information is related to an important intellectual virtue: curiosity.” (Jirout & Matthews, 2022, p. 253, p.253)

Curiosity is the strong desire to fill a “gap in knowledge” (Loewenstein, 1994, p. 75) and the associated information-seeking behaviours (Pekrun, 2019; Shin & Kim, 2019).

This definition aims to be practical and accessible as it includes information-seeking behaviours (Murayama, 2022; Shin & Kim, 2019) that might be observable in a classroom context, and it uses language that could be accessible to discuss with teachers and students. The definition helps conceptualise curiosity as different from interest, by emphasising the distinguishing element of “a gap in knowledge” (Loewenstein, 1994, p. 75), which is noted as a key element of the “informational gap theory” (Loewenstein, 1994; see also Grossnickle, 2016; Murayama, 2022). These definitions of curiosity and creativity aimed to be accessible to our participants, and relevant to our video-based methodology, in terms of describing behaviours that might be observable in classroom contexts (Hopfenbeck et al., 2022).

### 1.3. Teaching practices to promote creativity and curiosity

Recognition of the essential role of creativity and curiosity in education is increasing (e.g., Beghetto & Zhao, 2022; Jirout, 2020; OECD, 2021). However, there remains a significant gap in the literature as to how creativity and curiosity can be fostered in everyday classroom interactions. There is also an acute lack of practical, and accessible information for teachers as to how they can support each student to develop these skills in their everyday practice (Hopfenbeck et al., 2022). Insights from previous research offer an initial indication of teaching practices that may be useful, therefore we summarise the key insights from previous works of review in Table 3. In this table, we highlight recommendations for both teaching practice and future research, as the recommendations have significant implications for the design and value of this present study (see discussion in Section 2).

The teaching practices described in Table 3 emphasise the teacher role as a supportive facilitator rather than a didactic instructor (see especially Cremin & Chappell, 2021; Jirout et al., 2018; Peterson, 2020). Bereczki and Kárpáti (2018) draw attention to the teacher’s role in fostering student’s creative capacities, and to developing opportunities and environments for flourishing. This focus on capacities, opportunities and environments offers a helpful lens to organise the literature.

#### 1.3.1. Nurturing capacities for both creativity and curiosity

When exploring the links between creativity and curiosity across the literature, uncertainty and novelty are highlighted as key (Evans & Jirout, 2023). Nurturing student capacity to explore uncertainty and risk has been highlighted as a catalyst to fostering curiosity (e.g., Hidi & Renninger, 2020; Jirout et al., 2018), and the centrality of uncertainty and risk is also echoed as key to supporting creativity (Beghetto, 2021; Beghetto & Jaeger, 2022; Lucas et al., 2013). Adom et al. (2021) suggest a focus on the learning environment is key and identify that this field has seen shifts towards research into teachers’ own creativity and beliefs

**Table 3**  
Key recommendations from seminal review work in this field.

Authors and focus of review	Recommendations for Practice	Recommendations for future research
<b>Beghetto and Kaufman (2014)</b> <i>Classroom Contexts for Creativity</i>	Beghetto and Kaufman (2014) offer five recommendations: a “explicitly teaching for creative thinking, b Providing opportunities for choice and discovery, c encouraging students’ intrinsic motivation, d establishing a creativity-supportive learning environment, e Providing opportunities for students to use their imagination while learning.” (p.58)	1 Research must recognise the important role of the educational environments (both physical and social) (see for example p.57). 2 Research is needed into concrete strategies that are grounded in theoretical conceptions of creativity that can be adapted and developed in context (see pp.63-65).
<b>Lucas et al. (2013)</b> Progression in student creativity in schools: First steps toward new forms of formative assessment	Lucas et al. (2013) conceptualise five dispositions and associated behaviours: “1. Inquisitive: Wondering and questioning; Exploring and investigating; Challenging assumptions. 2. Persistent: – Sticking with difficulty; Daring to be different; Tolerating uncertainty. 3. Imaginative: Playing with possibilities; Making connections; Using intuition. 4. Collaborative. Sharing the product; Giving and receiving feedback; Cooperating appropriately. 5. Discipline: Developing techniques; Reflecting critically; Crafting and improving.” (pp.16-17)	Lucas et al. (2013) emphasise that there is certainly eagerness for resources and research to help teachers support learners to develop their own creative expression more effectively.
<b>Cremin and Chappell (2021)</b> <i>Creative Pedagogies</i>	Cremin and Chappell (2021) conceptualise seven themes: a “Generating and exploring ideas; b encouraging autonomy and agency; c Playfulness; d Problem-solving; e Risk-taking; f Co-constructing and collaborating; g Teacher creativity” (p.311).	1 Collaboration between researchers and practitioners: “in order to enable a more layered examination of the impact of creative pedagogies on student creativity” (p.326). 2 There is a need for further collaboration between practitioners: “for educators to work collaboratively in order to co-construct their understanding of the dynamic and responsive nature of creative pedagogical practice and how to assess its outcomes” (p.326).
<b>Patston et al. (2021)</b> <i>Creativity in curricula and practical tips for teachers</i>	The authors use the recommendations from Beghetto and Kaufman (2014) to analyse the curricula from 12 countries. They conclude that “There was strikingly little explicit advice that focused on how teachers might include creativity-supporting practices in their area of expertise, and an overall lack of understanding at the policy level of a need for this advice” (p.223).	This review not only has broad implications for research but also curricula and policy in terms of: 1 Emphasis on meaningful and coherent definitions of creativity throughout the curricula, policy documents and across disciplines. 2 Recognition of the need for high-quality professional development for teachers: “If new curricula are

(continued on next page)

Table 3 (continued)

Authors and focus of review	Recommendations for Practice	Recommendations for future research
<b>Jirout et al. (2018)</b> <i>Curiosity in schools.</i>	<ul style="list-style-type: none"> <li>a “Provide opportunities to think, question, participate, and respond</li> <li>b Model comfort with uncertainty</li> <li>c Prompt students to generate questions ...</li> <li>d Reflect on what students do and do not know, make connections</li> <li>e Encourage student generation of alternative ideas ...</li> <li>f Provide opportunities to explore ideas, materials, and own interests and questions</li> <li>g Model or provide scaffolding for effective information seeking methods</li> <li>h Respond to student questions in positive verbal and nonverbal ways”. (p.248)</li> </ul>	<p>introduced, teachers need to be familiar with what they should do to promote it and how to ascertain the degree of success of their efforts” (p.223).</p> <p>1 Development of Classroom-based research: “it is essential to bring curiosity research into classrooms. Classroom-based research has strong ecological validity because it involves observing and measuring behaviours as they naturally occur in learning environments.” (p.251).</p> <p>2 Recognition of the complexity of classroom-based research and difficulty standardising across contexts: reference to or inclusion of lab-based “proof of concept” research may help address some of this complexity.</p> <p>Research must explore ways for curiosity to be nurtured and integrated into classroom practices and behaviours: “Given the tremendous benefits curiosity has for learning, efforts toward incorporating it in the learning environment should be made” (p.12)</p>
<b>Singh and Manjaly (2021)</b> Curiosity in classrooms.	<p><b>Singh and Manjaly (2021)</b> offer two important suggestions:</p> <ul style="list-style-type: none"> <li>a exposing gaps in student knowledge bases and holes in schema of understanding.</li> <li>b Creating opportunities to foster student self-efficacy by ensuring the information to fill knowledge gaps is accessible so that curiosity is satisfied (see pp.10-11).</li> </ul>	<p>Neuroscientific research into curiosity and interest should inform both educational research and practice: this is especially in terms of how curiosity can be sparked and how interest can be sustained and how the two of these can be used to support and develop learning.</p> <p>Researchers should recognise curiosity is malleable, and examine ways to create space and opportunity for curiosity in practice, curricula and classroom contexts.</p> <p><b>Peterson (2020)</b> recommends: “recognizing curiosity as a modifiable characteristic; targeting ideas for which students have moderate knowledge; supporting epistemic beliefs associated with increased curiosity; directly teaching students question-asking; providing</p>
<b>Hidi and Renninger (2020)</b> <i>Curiosity and Interest.</i>	<p><b>Hidi and Renninger (2020)</b> highlight the importance of uncertainty, complexity and novelty. They elaborate explaining that practices known to stimulate interest (such as group work, self-related information, autonomy and challenge) could also be useful (p.100).</p>	<p>Neuroscientific research into curiosity and interest should inform both educational research and practice: this is especially in terms of how curiosity can be sparked and how interest can be sustained and how the two of these can be used to support and develop learning.</p> <p>Researchers should recognise curiosity is malleable, and examine ways to create space and opportunity for curiosity in practice, curricula and classroom contexts.</p> <p><b>Peterson (2020)</b> recommends: “recognizing curiosity as a modifiable characteristic; targeting ideas for which students have moderate knowledge; supporting epistemic beliefs associated with increased curiosity; directly teaching students question-asking; providing</p>
<b>Peterson (2020)</b> <i>Supporting curiosity in schools and classrooms</i>	<ul style="list-style-type: none"> <li>a “Biopsychosocial Factors: Having some, but not too much knowledge; Believing that knowledge evolves, and requires justification and evaluation; Growth mindset.</li> <li>b Proximal Processes: Opportunities for invention, exploration, and question-asking; Direct instruction on question-asking and inquiry techniques; Culturally relevant curricula and pedagogy.</li> </ul>	<p>Neuroscientific research into curiosity and interest should inform both educational research and practice: this is especially in terms of how curiosity can be sparked and how interest can be sustained and how the two of these can be used to support and develop learning.</p> <p>Researchers should recognise curiosity is malleable, and examine ways to create space and opportunity for curiosity in practice, curricula and classroom contexts.</p> <p><b>Peterson (2020)</b> recommends: “recognizing curiosity as a modifiable characteristic; targeting ideas for which students have moderate knowledge; supporting epistemic beliefs associated with increased curiosity; directly teaching students question-asking; providing</p>

Table 3 (continued)

Authors and focus of review	Recommendations for Practice	Recommendations for future research
	<ul style="list-style-type: none"> <li>c Educational Context: Educational settings that decrease emphasis on high-stakes testing; Classrooms that value positive peer discussions” (p.9).</li> </ul>	<p>culturally relevant curricula; and advocating for flexible academic contexts that have time and space for curiosity” (p.11).</p>

about creativity (see [Amponsah et al., 2019](#); [Lin, 2012](#); [Kettler et al., 2018](#)). This also aligns with recent exploration into how teachers perceive they can teach for creativity (e.g., [Anderson et al., 2022](#); [Huang et al., 2021](#)), highlighting the need for teaching environments that can support both students and teachers to think creatively.

**1.3.1.1. Creating opportunities.** Creating meaningful opportunities for students to give and receive feedback ([Lucas et al., 2013](#)) and for decisions and discovery ([Beghetto & Kaufman, 2014](#)) is emphasised as significant in nurturing creativity. In relation to curiosity, several practices are highlighted as key, including encouraging question asking ([Jirout et al., 2018](#)), exposing knowledge gaps ([Singh & Manjaly, 2021](#)), modelling curiosity ([Jirout et al., 2018](#); [Peterson, 2020](#)), and encouraging comfort with uncertainty ([Hidi & Renninger, 2020](#); [Jirout et al., 2018](#)). [Evans and Jirout \(2023\)](#) explain: “Uncertainty refers to an awareness of a lack of knowledge or understanding that is distinct from ignorance” (see also, [Anderson et al., 2019](#)). Research also suggests novelty and real-world relevance are also crucial elements of curiosity-inducing practice ([Hidi & Renninger, 2020](#); [Peterson, 2020](#)), which overlaps with the criteria often used for evaluating and defining creativity ([OECD, 2021](#)).

A call for rigorous classroom-based research is echoed across both curiosity and creativity research ([Huang, 2021](#); [Jirout et al., 2018](#); [Peterson, 2020](#)). [Cremin and Chappell \(2021\)](#) emphasise the importance of triangulating interview data with observation data, and [Beghetto \(2019b\)](#) calls for researchers to collaborate with teachers to “carefully document examples of creative learning” (p.39). This research seeks to respond to these calls, in proposing a rigorous classroom-based methodology, developed in collaboration with teachers.

1.4. The present study

This article reports on an exploratory multi-site study across 19 classrooms that sought to document the teaching practices that might offer practical and accessible ideas for how to nurture curiosity and creativity among primary school students.

2. Methods

2.1. Participants

Purposive sampling was employed focusing on the criteria of having at least six primary (elementary) schools participate, including a diverse international sample of both private and non-fee paying (public/state) schools. We carefully considered the infection rates of Covid-19 in each country and checked which schools were open; we were able to pivot the methodology to collect all data online in accordance with safety protocols. To protect participant anonymity, we do not provide extensive demographic details about our participants. However, we highlight the multi-cultural, international diversity of our participants; many of the teachers had taught in a different country from their present location, and the students engaging in the project represented a wide diversity of nationalities within each classroom. All classrooms were learning through the IB Primary Years Programme [PYP] curriculum, and all spoke English (we discuss this element in our limitations). We do not



make any statements or comparisons relating to different cultural influences on classroom practices (for an analysis of inter-cultural differences of beliefs about creative students see Karwowski et al., 2020); our focus was on the diverse eco-systems of creativity and curiosity within each of the classroom.

Recruitment efforts were severely impeded by the Covid-19 pandemic, which limited the availability of schools who perceived they would like to participate. The research team worked to include any school that expressed an interest in taking part in the study. In one case, we pivoted the methodology to capture virtual classroom interactions, to enable a school in India to participate, even though students from this school were not able to attend their physical classrooms. Ninety-six schools were contacted, and participation was secured from nine schools (six fee-paying and three public), in nine different countries. Twenty-one teachers self-captured video recordings from 19 classrooms. Twenty-two semi-structured interviews were conducted with teaching staff (Table 4), and 92 semi-structured interviews were conducted with students between the ages of 7 and 12 years old (Hopfenbeck et al., 2022). This age range was chosen so that children could participate meaningfully in the reflective interviews, and understand the language on consent materials. The language on consent materials was verified to be accessible for this age-group through checking with each teacher. The research team sought to interview three or four students from each class; in some cases, many students wanted to be interviewed, and the research team discussed what would be possible and adapted accordingly. Table 4 shows the number of participating teachers, videos captured, and interviews conducted (see also Hopfenbeck et al., 2022).

One of the central constraints of conducting research in the COVID-19 pandemic was schools withdrawing from the study, leaving a majority of European participating schools. Moreover, as seen in Table 4, the number of videos submitted per teacher and school varied depending on the time teachers had for recording.

2.2. Procedure

Ethical approval was granted from the authors' University Ethics Committee, and informed consent was sought from participating teachers, students and their parents/guardians. Each school was sent the following equipment:

- (a) a tripod and phone clamp,
- (b) a wireless microphone (to capture the teacher's voice),
- (c) a speakerphone (to capture the students' voices),
- (d) a mobile phone with high-quality camera features,
- (e) a voice recorder as a backup tool to capture student voices.

For further details of the selection, piloting and evaluation of this equipment, please see Hopfenbeck et al., 2022.

2.2.1. Introductory consultation sessions

To introduce the project and discuss the practicalities of collecting

data in each school, the research team conducted online consultation sessions with the teachers. These sessions provided an opportunity to discuss with the teachers any adaptations that might need to be made to ensure staff and students could participate fully in the research, and to ensure the research processes aligned with school procedures (such as how parental and student consent is usually sought). These consultations also helped researchers learn more about each school context, and ensure preparations were made for any challenges or barriers that might arise. Consultation 1 comprised an introduction to the project team and a discussion about the focus and time-frame of the project. Consultation 2 focused on the ethical considerations of collecting data (such as the management and storing of the data and the processes of consent). Consultation 3 focused on the practical considerations in the self-generation of classroom videos (this involved discussions around how to set up the camera-phone and where the camera could be positioned to avoid glare or shadow obscuring key elements of the classroom).

2.2.2. Self-captured classroom videos

Capturing high quality videos of classroom contexts is a complicated and ethically sensitive process (Blikstad-Balas, 2017; Flewitt, 2006). For this reason, we carefully consulted previous research relating to the practicalities and ethical dimensions of the collection and analysis of video data (e.g., Jewitt, 2012; Richards et al., 2021). The literature offers detailed insight into how to develop an ethical and practical classroom-based methodology. For example, Blikstad-Balas (2017) emphasises the importance of a clear articulation of what is to be studied through developing a detailed codebook (see also Klette & Blikstad-Balas, 2018) to support focused analysis of specific aspects of the data (see Section 2.3). Secondly, Blikstad-Balas (2017) underscores the importance of seeking contextual insights from participants. For example, asking teachers and students about how typical a practice or behaviour might be that has been observed in the video, and seeking to better understand the context of, and rationale behind, the visible features of the videos.

Teachers were provided with a video recording protocol and instructional videos to help them set up the data collection equipment. Teachers set up the camera-phone on the tripod in their classroom, and wore the wireless microphone on their collar or jacket. Some teachers chose to film several short sections of a lesson, other teachers captured full teaching sessions (40–60 min). The lesson subjects captured included Maths, Science, History, Literacy, Sports, or a combination of subjects.

2.2.3. Interviews

All interviews were conducted online in English on Microsoft Teams (the platform approved by the University's Ethics Committee). The semi-structured interviews with teaching staff were scheduled to last around 30 min, but were extended if the teachers indicated that they wanted to continue. The teacher-interviews focused on how teachers conceptualised and created opportunities for curiosity and creativity. The interviewer also asked teachers why they chose to showcase the

Table 4  
Participants and data collected.

Country	Participating Teachers	Classroom Videos	Teaching Staff Interviews	Student Interviews
1.Sweden	5	10	5	28
2.Ghana	3	4	3	16
3.Germany	2	6	2	12
4.India	2	2	2	6
5.Netherlands	1	11	1	4
6.Norway	1	6	1	4
7.Denmark	2	2	2 Teachers 1 Teaching Specialist	8
8.Italy	3	4	3	8
9.France	2	1	2	6
TOTAL	21	46	22	92

lessons that were recorded, and their rationale behind the practices that were captured. The student-interviews focused on conceptualisations of creativity and curiosity from the learner's perspective. This student-focused data is discussed elsewhere (Hopfenbeck et al., 2022), in order to devote the full focus of this article to the discussion of the video data and teacher interviews.

#### 2.2.4. The research team

Our research team comprises five members of five different nationalities, each bringing diverse skills and experiences. Three members of the team have experience as classroom teachers, one has expertise as a psychometrician, and one is a specialist in educational technology. All five contributed their skills to collaborate across the five phases of the project (project design, preparation, data collection, analysis and dissemination). We thought reflexively about our dynamic researcher positionalities, and reflected carefully on how our individual positionality affected the research interactions, and the interpretation of the data (Lu & Hodge, 2019; Olukotun et al., 2021). For example, we discussed in detail how to facilitate the initial meetings with teachers. We needed to develop conversations that were inclusive and informative, as well as respectful of the distinct expertise that each teacher brought to the conversation. We also wanted to listen carefully to their ideas about how we could make sure the methodology was feasible in their school context. In tune with the explorative nature of the research, we expressed to teachers that they were the experts, both in terms of their contextually relevant knowledge and their professional expertise. This was conveyed in our initial consultations with teachers. We also emphasised that the research was a collaborative process between teachers, students and researchers. We were careful not to impose our views on how one might facilitate curiosity and creativity, and encouraged teachers to record lessons that they believed fostered these skills.

#### 2.3. Analysis of data

A thematic analytical approach was adopted for the analysis of the video data and interviews with teachers and students. The theoretical constructs that conceptualise the different manifestations of curiosity and creativity (introduced in Section 1), and our working definitions of creativity and curiosity, were a helpful lens in analysing the data: Kaufman and Beghetto (2009)'s levels of creative magnitude, the information gap theory (Loewenstein, 1994) and the associated information-seeking behaviours (Pekrun, 2019; Shin & Kim, 2019) played a central role in both the development of the video observation codes and the analysis procedures and discussions.

##### 2.3.1. Development of video observation codes

The challenges and opportunities of analysing classroom video data were carefully considered especially in terms of the ethical and methodological implications of analysing dynamic socially-situated classroom interactions (Beghetto, 2019a; Blikstad-Balas, 2017). With this complexity in mind, codes were developed through a deductive theory-driven process (Boyatzis, 1998; Braun & Clarke, 2006). Theory-driven approaches to code development generally involve three phases (1) code generation to organise and understand different aspects of the data (Boyatzis, 1998; Elliott, 2018); (2) revising codes (Boyatzis, 1998; Klette & Blikstad-Balas, 2018); (3) examining coder reliability and decision-making (Boyatzis, 1998; Elliott, 2018). Following this procedure, codes were initially generated based on theoretical conceptualisations of creativity and curiosity and previous research (Kaufman & Beghetto, 2009; Pekrun, 2019; Shin & Kim, 2019). These were then evaluated, developed and distilled through a critical, iterative and reflexive process (Braun & Clarke, 2006, 2019). The codebook was developed to contain 26 codes: the research team sought to generate code labels and examples of classroom behaviours illustrating these codes that were meaningful and clear (Braun & Clarke, 2019; Klette &

Blikstad-Balas, 2018). The reviewing and revisions of codes based on data, and examination of code and coder reliability (Boyatzis, 1998; Elliott, 2018), took place following the collection of video data. For full detail of code generation and a copy of the code book, please see (Hopfenbeck et al., 2022).

#### 2.4. Video analysis

Following the advice articulated in Derry et al. (2010), the analysis of videos had multiple stages and aspects (see Fig. 1). Three researchers (JSB, SKJ, TC) engaged in individual viewing of video segments as well as "social viewing" (viewing together as a team) to discuss interpretations (see Derry et al., 2010). The videos were watched carefully before the interviews, in order to enable the researchers to discuss the videos with the teachers, and to gain deeper insight into the rationale behind some of the visible elements on the video. The iterative process of the video-viewing and analysis is illustrated in Fig. 1 (further detail of the analysis process and a copy of Fig. 1 can be found (Hopfenbeck et al., 2022).

##### 2.4.1. Interview analysis and theme development

The interview data was analysed thematically to support understanding of the video data following the steps to thematic analysis as described in Braun and Clarke (2006): "1. Familiarizing yourself with your data; 2. Generating initial codes; 3. Searching for themes; 4. Reviewing themes; 5. Defining and naming themes; 6. Producing the report" (p.87). The tension between description and interpretation was a key source of reflection and discussion among the three members of the team conducting the analysis. The five emergent themes were discussed at three follow-up online meetings with the participating teachers, to identify any further reflections on our interpretation and analysis of the data. We introduce four of these five themes, including illustrative quotes from the video-recorded lessons and teacher interviews. Detail of the final theme "Facilitating collaboration" necessitates data drawn from the children's interviews which is discussed in the full report (Hopfenbeck et al., 2022).

### 3. Findings and discussion

In this section, we highlight examples from across the school classrooms that illustrate different elements of each theme. The following themes were observed in the data: Choice over self-expression (Table 5); Diverse feedback pathways (Table 6); Self-regulated learning (Table 7); and Nurturing an inquisitive mind (Table 8). Evidence supporting each of these themes was observed in every classroom, with two exceptions relating to practical factors. These factors were the length and number of videos that were submitted, and which activities the teachers chose to record. When teachers only submitted short videos or one video, strong evidence of the theme "self-regulated learning" was either not observable, or hard to observe in those videos. We perceive this as a methodological constraint, rather than a comment on the teaching practice. This methodological limitation relates to the time pressures on the research and teaching, as well as the difficulty of observing the metacognitive processes in self-regulated learning. This is a complexity of classroom video research that resonates throughout the literature (e.g., Blikstad-Balas, 2017). The limitation could perhaps be addressed by adding an additional method (such as collecting student classroom journal reflections), to allow insight into processes less visible in video observation. It should also be noted that the choice of activity affected how frequently instances of different themes were observed. Overall, where instances of a practice were not clear from the video, we clarified details in the teacher and student interviews. This triangulation is advised by video researchers who encourage a multi-method, multi-perspective approach when using video (Dignath van Ewijk et al., 2013).

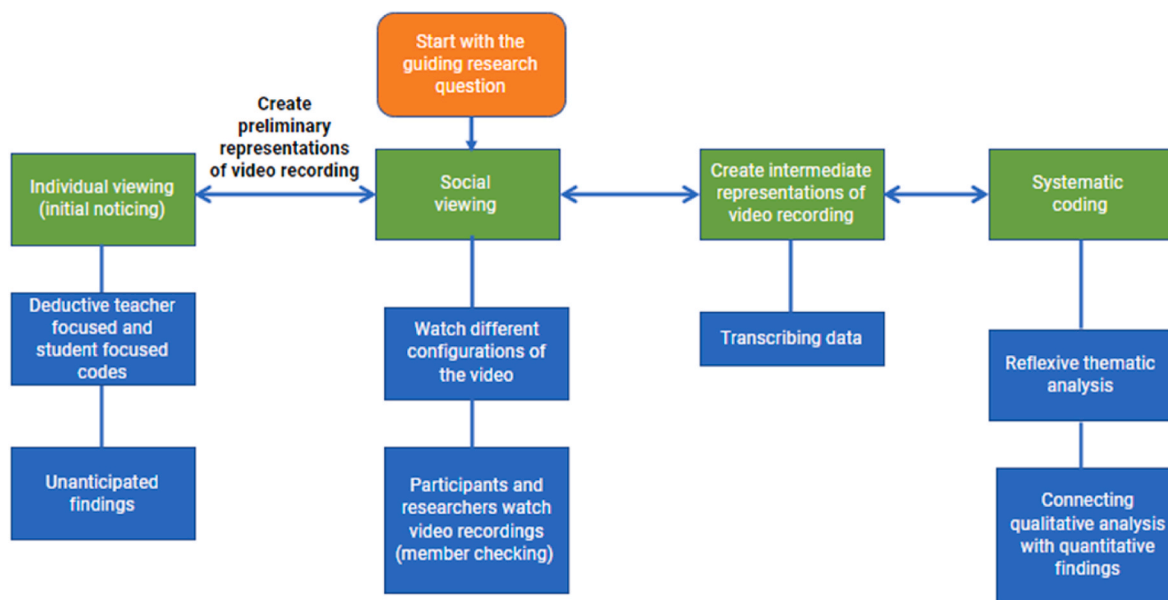


Fig. 1. Flow chart of video analysis steps (Hopfenbeck et al., 2022).

### 3.1. Choice over self-expression

In Table 5 we include illustrative quotes from the theme of “choice over self-expression”, which related to modelling and valuing multiple modes of expression, supporting confidence to express curiosity and imagination, and opportunities for autonomy in choice and taking risks.

### 3.2. Facilitating choice, autonomy and self-expression

#### 3.2.1. Autonomy and making choices

Teacher behaviours are known to be highly influential over the extent to which student autonomy is inhibited or nurtured (Kupers et al., 2017; Reeve & Jang, 2006). We align our conceptualisation of autonomy with that of Kupers et al. (2022): “being able to make relevant choices, a sense of agency in working and learning” (p.2). In the current study, choice and autonomy were especially observable in the way that teachers talked about self-expression. Teachers emphasised the importance of ensuring that students could feel independent and autonomous when choosing and using diverse expressive modes, as well as ensuring they did not feel restrained when using more traditional communicative modes (see for example Teacher 4’s discussion of writing). Choice over self-expression could support students’ sense of competence and creative self-efficacy in the way they develop and share their creative products and ideas. Creativity offers opportunities for learner autonomy, as it locates the student firmly as the proactive creator, as they are the ones to generate and develop new ideas. This aligns with the emphasis on supporting proactive, engaged learners. By nurturing learner autonomy the teacher can play the role of facilitator in the classroom, developing and supporting opportunities for creativity, allowing the students to be active agents in their own diverse creative processes. Our findings align with the work of Lassig (2020), who explains: “Instead of instructing students to ‘Be creative!’, schools can explore with students the different ways in which they can be creative and types of creativity applicable to certain tasks” (p.11). Lassig (2020) proposes a typology of student creativity comprising: “creative personal expression, creative boundary pushing, and creative task achievement” (p.1); we align our work with this typology suggesting teachers seek to offer students choice in the way they express themselves, autonomy in the way they identify and expand boundaries, and multiple opportunities to make decisions about the way they approach and work through tasks.

Teachers also described the role that making choices had for students

to develop their own autonomous skill-sets. Teacher 20 described how he encourages children to choose where they sit in the class each week, and how that may help them learn to make decisions, as well as learn about how to engage in strategies to help them stay focused and ward off distractions. In this way he sought to upskill students with their own decision-making skills, as well as help them learn about how they can best find focus and work productively. The teacher reflected that encouraging choice is “going to be more powerful for them, going forward into the later years, than just me simply sitting them away from their friends ...”. The teachers of this study discussed various different ways that they structured the learning environment and tasks. They explained that this was to encourage the students to learn about different ways to create, inquire and investigate, and so could draw on these diverse experiences to make decisions about how to create and inquire in future scenarios.

#### 3.2.2. Taking creative risks and intellectual courage

Teachers integrated diverse opportunities for children to make creative decisions and take low-stakes creative risks in the classrooms; these could be small, short-term decisions such as how they wanted to present their ideas to the class, or decisions about where and how to work. Teachers discussed the importance of both supporting student confidence, and creating opportunities for students to explore and take intellectual risks:

“I see it as my job to **build the confidence to make those choices** and to make those decisions to let their creativity come through” (Teacher 20, Denmark)

“They have the **opportunity to think outside the box, come up with their own solutions**, go off in their own way and investigate what they want to investigate” (Teacher 18, Netherlands)

A useful concept to help interpret the significance of this creative risk-taking and exploration is “intellectual courage” which Jirout and Matthews (2022) discuss in relation to both curiosity and creativity: they define intellectual courage as “action and persistence toward gaining knowledge, understanding or new ideas or perspectives when faced with risk” (p.258, see also Movshovitz-Hadar & Kleiner, 2009). Jirout and Matthews (2022) discuss how both curiosity and creativity carry with them the risk of judgment and failure, but that teachers need to seek ways to help students acknowledge this risk and persevere with confidence towards their curious or creative goal (see also Henriksen et al., 2021).

**Table 5**  
Illustrative quotes of the “Choice over self-expression” theme.

Summary of Observation	Illustrative Quotes
1a. Modelling and valuing multiple modes of expression	When students demonstrate what they have learnt, we try to let them do it in many different ways, so it could be like a role play or PowerPoint or making an iMovie. (Teacher 10, Sweden) Creativity, it's very individual. I think it can be something that can be displayed in many different facets and it's to do with imagination ... <b>I see it as my job to build the confidence to make those choices and to make those decisions to let their creativity come through</b> ... It can be the books they choose to read, the art they choose to draw, and as I said, many, many different ways they can express it, but it's having the confidence to do that and to engage their imagination. (Teacher 20, Denmark)
1b. Supporting confidence to express curiosity and imagination	So, what does creativity in the classroom mean to me, as a teacher? They have the opportunity to think outside the box, come up with their own solutions, go off in their own way and investigate what they want to investigate, that they are curious about themselves, but also about the people around them. It's not just an individual process, of course. Learning to collaborate, communicate and solve problems with each other. Being curious about each other. (Reflective interview, Teacher 18, The Netherlands) <b>I let the children choose where they sit in the class each week</b> ... if I can get them to, by the end of the year, to understand that it's OK not to sit with my best friend ... I've got the strategy in place to deal with any distractions that come along. <b>It's going to be more powerful for them, going forward into the later years, than just me simply sitting them away from their friends</b> ... And then you make sure that when they do have a good week, you praise them and you say 'Listen, I see what you've done this week. You made a good choice'. (Teacher 20, Denmark) We have a diverse set of students. Their likes are different so it's important to give them a choice board to really bring out the engagement. (Teacher 17, India) <b>I think we need to empower students and we need to allow them that freedom.</b> In writing, for example .... Many days I just let the children write, and I say, 'I'm not going to mark it because this is just for you to be free to put down whatever ideas you would like to do'. I said 'It doesn't need to be written in a certain way. You can put it in whatever form you like' ... <b>writing should just be pleasure, and if it's not creative for them, and they don't enjoy it, then writing becomes a task.</b> (Teacher 4, France)
1c. Opportunities for autonomy in choice and taking risks	

<sup>a</sup> The elements highlighted in bold are discussed below.

### 3.3. Diverse feedback pathways

In Table 6, we illustrate how teachers used feedback to support and extend creative processes, affirm student contributions, foster a safe intellectual environment and encourage self-generated feedback. Feedback can be defined as “information provided by an agent (e.g., teacher, peer, book, parent, self, experience), regarding aspects of one’s performance or understanding” (Hattie & Timperley, 2007, p. 81). In our data, we saw examples of each of these different kinds of feedback interactions (teacher, peer, self), with the exception of parent feedback, as we did not capture any home-learning interactions. We do recognise parental/carer feedback may be a fruitful domain for future research to

**Table 6**  
Illustrative quotes of the “Diverse Feedback Pathways” theme.

Summary of Observation	Illustrative Quotes from Video-recorded Lessons and Teacher Interviews
2a. Feedback supporting and extending creative processes	OK, now that's a great answer, but I would just like to ask ... Is there another way, or another title that we could use also to bring in what we've been doing within our art lessons? (Teacher 18, Netherlands) Every character should have something in that story. You don't just mention their names ... you have to describe them, what did they do? That makes the story interesting ... this is very, very important. (Teacher 11, Ghana)
2b. Feedback affirming student contribution and effort.	I like the fact that you've understood the properties of 3D shapes and you're using them. (Teacher 17, India) I like that you put the statistics to the side. (Student of Teacher 6, Sweden, commenting on a poster) I like your drawing, it looks really cool ... I have a question, where did you get the idea to do all of this? (Student of Teacher 6, Sweden). So, I liked the idea of the ball, it was very cool, and my question is, how much time did it take you to make this? And, if you had more time, would you add people coming in asking if they can play? (Student of Teacher 6, Sweden, the same student as the quote above).
2c. Feedback encouraging a safe space for contributions	Everyone's ideas are valid ... and I want everyone to be able to contribute their ideas. (Teacher 20, Denmark) There are no wrong and right answers. It's just your thoughts (Teacher 18, Netherlands).
2d. Facilitating self-generated feedback.	<b>Fig. 2</b> <b>Fig. 3</b> So together with the students, we co-construct the essential agreements. So what do they want the class to look like: so regarding management, self-management skills, regarding collaboration, regarding group work ... And then every morning we choose about five of them to go through ... they are able to remember some of the essential agreements and teach it to their friends means that it becomes relevant to them because now they are using that as a self-assessment tool. (Teacher 13, Ghana)

investigate.

### 3.4. Diverse feedback pathways

Holinger and Kaufman (2018) explore the relationship between creativity and feedback, emphasising that high-quality feedback is useful for helping students generate and revise ideas; two processes which are central to creativity. Feedback which supports confidence and intellectual safety is key to nurturing the creative process; this is often described as constructive “competence-affirming” evaluation (see Amabile, 1979; Hennessy, 2001; 2010). Examples of competence-affirming evaluation were articulated by teachers in this study (e.g., *I like the fact that you've understood the properties of 3D shapes and you're using them, Teacher 17, India*). Teachers also combined affirming evaluation with more constructive feedforward, which could be used to develop and improve an idea or process: Teacher 18 often phrased this constructive “feedforward” as a question “OK, now that's a great answer, but I would just like to ask ... Is there another way ...” (Teacher 18, Netherlands). Teachers used supportive feedback to focus students' attention on both the creative process as well as creative products: Beghetto (2019b) argues: “feedback (giving and receiving) typically serves as a key transition point from mini-c to little-c creativity” (p.31), and explains that teachers need to encourage students to share their mini-c creativity in order to receive feedback, as this can help them gage



**Table 7**  
Illustrative quotes of the “Self-Regulated Learning” theme.

Summary of Observation	Illustrative Quotes
3a. Planning	You have to give yourself time to think about it. So, don't just start, have a think ... try to draft something down. Give it a name. What problem will it solve? (Teacher 11, Ghana) When you get stuck on what to write, start with a picture. (Teacher 19, Norway) First plan what character you want to create, you can also research if you want. (Teacher 16, India).
3b. Time Management	I want to do a time check just so you are aware. We have probably 7 more minutes of working time left. (Teacher 14, Germany) Keep [the] time limit in mind ok and I want you to be really creative, so you have half an hour. Can you finish 3 activities in half an hour, or do you want to combine them and create something new? (Teacher 17, India)
3c. Supporting focus	Don't worry about other people, only focus on yourself for now (Teacher 21, Denmark). After lunch we do a mindfulness session, just to get them into that sort of learning space. So, they understand that ok, all my problems outside are outside, and I come in and this is my learning space. (Teacher 15, Germany)
3d. Making mistakes	I wonder, if you think of creativity as a concept, I wonder whether there are mistakes at all? ... maybe that is creativity, trying things in a different way ... I think there needs to be a balance of offering or providing work, which children can make mistakes, but don't make too many mistakes ... when they succeed that second time, they become even more engaged and curious. (Reflective interview, Teacher 15, Germany) If we got a culture where it's OK to make mistakes, then it puts the students at ease. (Reflective interview, Teacher 19, Norway) Trust in the teacher and also trust, knowing that they're not going to be laughed at or ridiculed. So then they should be confident in that 'whatever I say, there's no right and wrong and I will be accepted'. (Reflective interview, Teacher 9, Sweden) I also make mistakes and we all learn from that and we can help each other. Rather than getting upset or anything, so that we're all learning together and I really like that they even suggest things. (Reflective interview, Teacher 10, Sweden)
3e. Students talking about learning processes	There is one thing in self-management that I used, time-management. I was basing my project on the amount of time I had, I was predicting that I would be able to do it in like 20 min (Student of Teacher 6, Sweden) So, I think, how I learnt how to draw an eye, was by looking in steps how to do it, taking my time. Just trying new things ... Taking my time, it doesn't matter if you make a mistake, because you learn from mistakes. (Student of Teacher 18, Netherlands)

the novelty and meaningfulness of the idea/process/creation. This process could help them to build on or fine-tune the idea, and it also teaches them to explore and recognise what makes something creative by asking if and how it is novel, original, meaningful, useful or relevant (Beghetto, 2019b; Karwowski et al., 2022).

### 3.4.1. Peer-feedback and creative learning

Competence-affirming feedback was also observed from peers (see examples in Table 6 2 b). An interesting element is seen in the two quotes from the second student: “I like your drawing, it looks really cool ...”, “I liked the idea of the ball ...” (Student of Teacher 6, Sweden). It is striking that in both quotes we have from this second student, he combined affirming praise with a genuine curiosity in the creative process (“where did you get the idea to do all of this?”; “How much time did it take

**Table 8**  
Illustrative quotes of the “Nurturing an inquisitive mind” theme.

Summary of Observation	Illustrative Quotes
4a. Modelling and encouraging question-asking	If we pulled apart all of the substances containing all of the atoms in the universe and put them into separate piles, how many would we have? ... Good question, how do we know that? That is a good question and that is something that we should write for the wonder wall. (Teacher 7, Sweden) *Student name* mentioned something ... that really made me try to wonder and think about trade. (Teacher 13, Ghana) Now my question is, how did you choose the steps? What was the thought behind choosing your steps and the practice that you did? (Teacher 17, India) Why do you think it [science project] is not exploding anymore? (Teacher 2, Italy)
4b. Supporting inward reflective questions	Let's ask ourselves, 50 years from now, hundred years from now, what do you think people will be inventing? (Teacher 11, Ghana) You have to reflect at the end, so use your thinking hats whenever you are questioned. Why are you doing this? Why did you pick this? (Teacher 16, India)
4c. Attending to different expressions of curiosity	That you understand individually the students' own drives towards their curiosity and that you provide them with an environment where they feel like it's OK to be in tune with their own questioning, and their own understanding, and their own wanting to know more about what they're learning about ... I think, understanding or helping the children to understand that they are the drivers behind their own understanding of the world, and how they make sense of it. (Teacher 18, Netherlands)
4d. Encouraging students to wonder about the outside world	Did anybody have any wondering questions that they want to share?.. Anything that they were really curious about? (Teacher 7, Sweden) When we were walking to swimming, and we saw this construction going on, and there were some pipes, and we were learning about systems at that time. So I just stopped and said 'oh I'm wondering what part of what system this is?'. I think just by showcasing what I'm thinking about, I feel it really inspires the students to do the same. (Teacher 10, Sweden)

Fig. 4

you to make this?”). The student appears to show interest in the creative processes and ideas of others, which can play a key role in developing one's own creativity (Baruah & Paulus, 2019). Beghetto (2021) argues: “there is also the possibility that primary creative outcomes can contribute to the creative sense-making and experiences of others. In other words, the creative outcomes of the primary phase creative learning can become creative learning stimuli for a secondary audience” (p.4). This was perhaps illustrated in the student quote, “I liked the idea of the ball ..., if you had more time, would you add people coming in asking if they can play?” (Student of Teacher 6, Sweden). This student was commenting on an animated ball being kicked between two figures, and we see in his question his thinking about the ways this could be developed into a more complex creation. This example resonates with the definition of creative learning: “the dual processes of developing new and meaningful thoughts and actions ... and making creative contributions to the learning and lives of others” (Beghetto, 2021, p. 3). Teachers can play a key role in fostering opportunities for students to develop and share their creative ideas. Teachers could then extend the value of this process by opening the discussion up to the class, encouraging a supportive interaction of questions and feedback, in order to draw out how this primary creation could act as a stimulus of creativity and curiosity to others.

### 3.4.2. Feedback affirming student contribution and competence

Competence-affirming feedback helps contribute to creating an intellectually “safe” classroom environment. The importance of an intellectually or psychologically safe environment is highlighted throughout creativity research, with [Cremin and Chappell \(2021\)](#) describing the importance of a “secure climate of approval and exploration” (p.311). Similarly, [Peng et al. \(2013\)](#) insist that “in safe, supportive environments and situations, students are more willing to accept challenges and engage in unprecedented behaviour and new activities to produce unique and original ideas” (p.554). Intellectual safety has important implications for creative idea generation, and teachers were heard to set up safe spaces where diverse ideas were valued:

“Everyone’s ideas are valid” (Teacher 20, Denmark)

“There are no wrong and right answers. It’s just your thoughts” (Teacher 18, Netherlands).

Feedback that creates a safe intellectual environment has been suggested as important for nurturing curiosity ([Jirout et al., 2018](#); [Peterson, 2020](#)). The opposite of a secure environment is highly detrimental to curiosity, [Kashdan and Fincham \(2004\)](#) conclude, “Threats, punishment, negative feedback, and surveillance have clear negative effects on task curiosity and performance” (p.484). [Kashdan and Fincham \(2004\)](#) emphasise that to foster curiosity, feedback needs to be both appropriate and sincere (see also [Deci et al., 1999](#); [Ryan & Deci, 2020](#)); their argument emphasises that supporting students’ sense of competence is key to supporting curiosity. This focus on supportive and constructive feedback aligns with the emphasis in creativity research on supporting students’ sense of competence and self-efficacy to support creativity ([Hennessey, 2010](#); [Holinger & Kaufman, 2018](#)).

### 3.4.3. Self-feedback and encouraging self-talk

[Kashdan and Fincham \(2004\)](#) emphasise the importance of finding ways to give supportive feedback and elicit “positive self-talk” (p.490). This raises the point that teacher and peer feedback can be hugely influential over how students not only talk to themselves about their skills and capabilities, but also how they reflect on their own learning. Student self-talk and reflection are often hard to capture in research. However, glimpses are seen in the student reflections from the Netherlands, where we can see students learning to give themselves justified praise: “I think my second one was the best because it had most detail”. The text also includes reflections on the creative processes (“because I smudged it a little”) (Transcription of [Fig. 3](#)). We also see constructive self-feedback about how they could present information in the future: “I think it could have been neater by using a ruler and communicate better” (Transcription of [Fig. 2](#)). The teachers encouragement of generating and engaging with autonomous feedback relates closely to “proactive recipience”, which involves engaging with the process of feedback, making judgments and decisions about their own work, and progressing their learning through doing so ([Winstone et al., 2017](#)). The examples from this discussion of reflective self-feedback, as well as supportive feedforward from teachers, align with robust evidence to suggest that effective feedback plays a key role in learners’ self-regulatory practices (e.g., [Perry et al., 2020](#)), and these self-regulatory processes in turn play key roles in the cognitive and behavioural processes of creativity and curiosity.

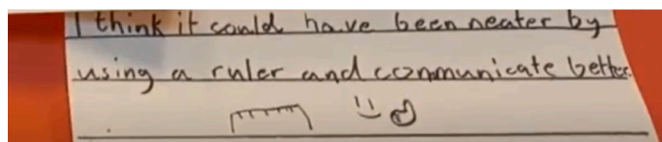


Fig. 2. Example of student-generated feedforward (Netherlands).

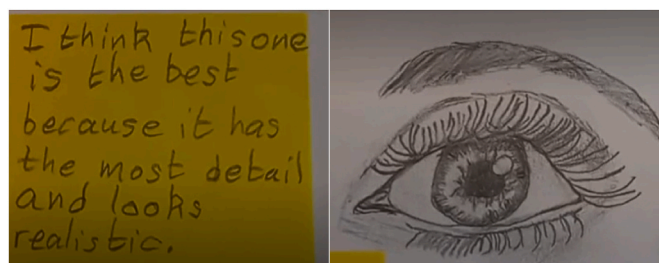


Fig. 3. Example of student-generated feedforward (Netherlands).

### 3.5. Self-regulated learning

This theme, “self-regulated learning”, is related to how teachers helped students plan and manage their time and stay focused. It also related to how teachers talked about the role of making mistakes and how students talked about and reflected on creative learning processes. Self-regulated learning denotes the cognitive, motivational and behavioural processes that help learners pro-actively initiate, steer, monitor and progress learning ([Brandmo et al., 2020](#); [Inzlicht et al., 2021](#); [Schunk & Green, 2018](#)). Examples of these processes include planning, goal-setting, problem-solving, emotional regulation, self-reflection and time-keeping ([Chen & Bonner, 2020](#); [Perry et al., 2020](#); [Zimmerman, 2008](#)). In this current study, the data present several examples of teachers supporting students to self-regulate and engage in processes of meta-learning (often described as “thinking about learning” [Watkins, 2015](#)).

### 3.6. Self-regulation to promote curiosity and creativity

#### 3.6.1. Self-regulation and creative expression

There is early research exploring how adolescents regulate their actions whilst working on creative activities ([Zielińska et al., 2022](#)), and theorising how self-regulation might relate to creative expression ([Ivcevic & Nusbaum, 2017](#)). [Zielińska et al. \(2022\)](#) examined how 739 adolescents regulated their activity while working on creative projects and concluded “adolescents who developed more creative projects self-regulated their creative activity more effectively than their peers” (p.11). They explored the different elements of this regulation explaining that when engaging in creative activities individuals may “benefit from setting priorities, planning their steps, and monitoring how these steps progress” (p.10). This seems to align closely with the way that teachers in our study created opportunities for students to identify goals, and then plan, and monitor progress towards their goal. Some students in the current study reflected on how they planned their timing, and made adjustments throughout the creative process:

There is one thing in self-management that I used, time-management. I was basing my project on the amount of time I had, I was predicting that I would be able to do it in like 20 minutes. (Student of Teacher 6, Sweden)

It is also striking the way that teachers and students talked about mistake-making and acknowledging things do not always go to plan:

Taking my time, it doesn’t matter if you make a mistake, because you learn from mistakes. (Student of Teacher 18, Netherlands)

Our findings align with the assertion in [Jirout and Matthews \(2022\)](#) of the need for teachers to foster an environment which “encourages positive approaches to uncertainty and optimal learning orientations where failure is seen as opportunities to learn” (p.264). It was particularly interesting that Teacher 15 from Germany reflected on the importance of facilitating opportunities for students to make mistakes. He added that there should be a balance, as encouraging too much mistake-making could lead to learners becoming disheartened, which

could affect their sense of self-efficacy, which is key to creativity and creative expression (Lassig, 2020). Likewise, Rao et al. (2021) suggest exploring the creative process through the lens of design-thinking, in which the individual “replaces the word ‘mistake’ with the word ‘prototype’ or ‘attempt’ and makes failure a part and parcel of the process of improvement and learning” (p.6). The examples in our data relating to making mistakes, resonate with discussions in Section 3.4 about creating psychologically safe classrooms and fostering intellectual courage (Jirout & Matthews, 2022). To foster these safe spaces, teachers can model the process of taking creative risks, as well as modelling how to regulate emotional responses to making mistakes (see Teacher 10, Sweden).

This focus on creating an emotionally non-threatening environment was echoed across multiple teacher interviews:

*“if we got a culture where it’s OK to make mistakes, then it puts the students at ease” (Teacher 19, Norway);*

Ensuring the environment supports positive academic emotions and modelling to students how to regulate their emotions has important implications for learning and creativity: “positive academic emotions facilitate the use of flexible, creative learning strategies such as elaboration, organization, critical evaluation, and metacognitive monitoring. Negative emotions, on the other hand, may trigger the use of more rigid strategies” (Pekrun et al., 2002, p. 97). This emphasises the importance of teachers creating safe psychological environments, in which students can learn and develop their own self-regulatory practices (Perry et al., 2020). Similarly, Hoffmann et al. (2022) explore “how those who are skilled in understanding and managing their emotions can convert, channel, and regulate even unpleasant, unwanted feelings – like uncertainty – to support their creative productivity” (p.60).

### 3.6.2. Self-regulation and creativity and curiosity in classroom settings

The relation between self-regulation and curiosity seems to relate to how efficiently students can identify knowledge gaps (often involving complex thinking, reflection and evaluation), and then persevere through distractions and obstacles (often involving inhibitory control and problem-solving) to successfully fill those knowledge gaps (Hidi & Renninger, 2020; Jirout et al., 2018; Loewenstein, 1994). Singh and Manjaly (2021) suggest that teachers should expose gaps in student knowledge-bases and schema to spark curiosity, followed by creating opportunities to foster student self-efficacy (by ensuring the information to fill knowledge gaps is accessible), so that curiosity is satisfied (p.10). Their description of the self-regulating skills necessary for students to identify knowledge gaps, search for information to fill it, and persevere until the information is acquired, aligns with descriptions in other research literature (e.g., Gupta & Sharma, 2019; Hidi & Renninger, 2020; Jirout et al., 2018; Peterson, 2020).

There are some more disruptive elements of creativity and curiosity that are not always conducive to supporting the learning, creativity or curiosity of the individual or indeed to the group as a whole. Bereczki and Kárpáti (2018) highlight “socially undesirable traits such as non-conformity, impulsivity and disruptive behavior” (p.27) and Karwowski et al. (2020) mention “traits associated with unruliness, breaking school rules, impulsivity, or independence” (p.9). Meaningful ways to express impulses and ideas are important, the explicit teaching and encouraging of self-regulatory behaviours may help students develop ways of expressing creativity and curiosity which are productive for themselves, and help them channel their ideas and energy into more pro-social behaviours. Furthermore these self-regulatory processes may enable them to complete and share a creative product or idea - which in turn may be a source of curiosity (see Student 6 from Sweden) or creativity to peers (Beghetto, 2019b).

### 3.7. Nurturing an inquisitive mind

Illustrative quotes from the theme of “Nurturing an inquisitive mind” are displayed in Table 8. These relate to modelling and encouraging

question-asking, supporting inward reflective questions, attending to different expressions of curiosity, and encouraging students to wonder and ask questions about the outside world.

#### 3.7.1. Nurturing an inquisitive mind through supporting self-regulation

Teachers in the recorded videos demonstrated multiple examples of exposing gaps in student knowledge (such as by posing open questions or riddles), and many teachers helped students identify their own gaps in their learning. For example, Teacher 10 encouraged student to write on post-it notes what they wonder about the video (see Fig. 4), or Teacher 7 created a “wonder wall” to collect different questions and wonderings.

Self-regulatory skills are also necessary to support students in tolerating the uncertainty of not knowing the answer (Jirout et al., 2018; Peterson, 2020) and engaging in information-seeking behaviours such as forming and asking questions and identifying reliable sources of knowledge (Jirout & Klahr, 2020; see also Ronfard et al., 2018). The data in this present study suggest that teachers sought to model inward and outward questions, as well as effective sequences of questions. This modelling illustrated ways to inquire and learn new information, and new ways of expressing and satisfying curiosity. Teachers also discussed the importance of sharing their own curiosity and encouraging students to “wonder” about, and make connections to, the outside world beyond the classroom. By sharing their own curiosity and knowledge-gaps, teachers were able to model both higher order and reflective thinking. This practice of modelling and sharing internal cognitive processes aligns with previous research into both curiosity (Jirout et al., 2018; Peterson, 2020) and creativity (Beghetto & Kaufman, 2014).

To link this back to our working definition of curiosity, self-regulation can play a helpful role in individuals’ recognition of information gaps (Loewenstein, 1994), and their persistence in the information-seeking behaviours (as conceptualised in Shin & Kim, 2019). The completion of exploratory, creative and information-seeking tasks can depend on effective self-regulation. Perry et al. (2020) argue “Successfully self-regulating learners use metacognition to assess their strengths and challenges in relation to the demands of tasks and then choose and apply strategies they know will support successful task completion” (p.417). A key element of this success is enabling students to persevere and problem-solve in the face of obstacles, and helping them become proactive decision-makers in their learning.

#### 3.7.2. Modelling and valuing uncertainty

There are multiple examples in our data of how teachers explicitly drew attention to their own wondering, “unknowing” and uncertainty:

I’m wondering what part of what system this is (Teacher 10, Sweden)

Recent work has emphasised the importance of nurturing students’ capacity to recognise, tolerate and respond positively to uncertainty:

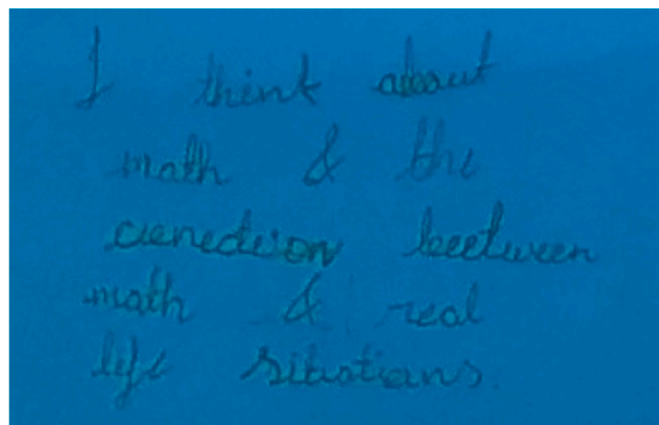


Fig. 4. Student post-it note showing what they “wondered” (Sweden).



“encounters with uncertainty play various and important roles in provoking and sustaining creativity and learning throughout the lifespan” (Beghetto, 2021, p. 1). Emergent research examines the relationship between creativity and uncertainty (Evans, et al., 2022; Henriksen et al., 2022) and curiosity and uncertainty (Jirout & Matthews, 2022). Evans and Jirout (2023) assert, “As uncertainty drives both curiosity and creativity, investigating how uncertainty is promoted in classrooms may further elucidate connections between the two constructs and help develop our understanding of how to cultivate curiosity and creativity in children.” (p.5). We have illustrated authentic classroom-based examples of teachers and students sharing their uncertainty, questions and “wondering”, in order to explore ways that this expressed, modelled or encouraged creativity and curiosity in different classroom settings.

#### 4. Limitations

Our data reflect the constraints of conducting research in a pandemic; despite careful planning and preparation, lockdowns and shifting circumstances resulted in some schools withdrawing, leaving a majority of European schools participating in the study. It is important to note that in the field of curiosity and creativity research, the majority of research conducted and reviewed focuses on western contexts (primarily North America and Central Europe). Hernández-Torrano and Ibrayeva (2020) conducted a bibliometric mapping of the creativity research literature, visualising which universities and researchers are conducting key research in the field, and where these are located; it is acutely apparent that specific areas in the globe have generated the vast majority of the research, and that in other areas, the concept remains relatively under explored. We recognise this western-focused limitation in our own study, relating particularly to the COVID-19 pandemic. Our participating schools are mainly from Europe (with the exception of the schools in Ghana and India) and we adapted the methodology to collect data from online classes in India, to ensure they could take part despite the shifting circumstances. We wanted to ensure our engagement with the literature reflected the diversity of the teaching contexts we were researching. We made sure to engage with research reflecting a diversity of cultural, geographical and economic contexts. We also sought out research that focuses on the non-European countries in our study (India and Ghana), to carefully review the previous research which had been conducted. Thus, throughout the discussions, we have synthesised research which aligns with our sample of schools, including research focusing on Indian teaching contexts (e.g., Gupta & Sharma, 2019; Rao et al., 2021; Singh & Manjaly, 2021) and Ghana (Adom et al., 2021; Amponsah et al., 2019; Opoku-Asare et al., 2015). We also considered research that compares international curricula and practices (e.g., Patston et al., 2021). We underscore the importance of culturally and contextually relevant and responsive pedagogy. We do not suggest our findings should be transferred exactly as they are to any context, but instead offer the suggestions as ideas to be adapted and developed in context, to spark the creativity of teachers, and their curiosity to try out new and different practices.

#### 5. Conclusion

##### 5.1. Concluding discussions and implications for teaching practice

*“What practices do teachers enact with the aim of encouraging creativity and curiosity?”.*

This study sought to document diverse manifestations of curiosity and creativity, and to share the teaching interactions that sought to nurture these phenomena. The data suggest that teachers sought to foster curiosity and creativity by using constructive feedback to support student confidence, value diverse contributions and develop a safe psychological environment. We have also explored the way that the supporting and modelling of self-regulating behaviours may help young

people develop new ways to express and develop their curiosity and creativity. Oates (2019) has argued “Self-regulated learning is vital for everybody. In teacher education the faculty need to explicitly teach, model, and practice the relevant skills and strategies so all learners in primary schools are set onto their successful path of lifelong learning by self-regulated and autonomy supportive teachers” (p.7). This could have implications for how successfully students inquire, explore, bring their creative ideas to life, and problem-solve when they face challenges. In terms of self-expression, it is important to help students feel safe taking exploratory and creative risks and making (and valuing) mistakes throughout the process. By integrating this “structured uncertainty” (Beghetto, 2019b), teachers may consider how they could integrate multiple opportunities for choice into learning activities, as these can allow students to learn new ways of expressing their ideas and progressing their learning (Beghetto & Kaufman, 2014). Opportunities for positive and proactive reflection on one’s own work, and the work of others, has been emphasised as a useful way to helping students engage actively in their own creative and curious learning processes.

It is important to note that the practices documented in the current study do not necessarily require additional material resources. Indeed, Singh (2021) and Opoku-Asare et al. (2015) emphasise the importance of teaching practices that do not require expensive resources or novel and unsustainable infrastructure. This was a central consideration in this present study as we needed to explore and document sustainable practices that could be accessible for teachers and schools, regardless of economic context. Moreover, other scholars have noted that configurable practices such as those identified in our study could benefit from an adaption in the way that pedagogy is enacted (Heard & Anderson, 2021; Scoular & Ramalingam, 2021). Together, practices that require no-resources, or low-cost resources that can be locally sourced, adapted and re-used, should be a key consideration (Opoku-Asare et al., 2015). The use of these practices should be guided by teachers’ pedagogical expertise and contextually-informed “craft-knowledge” (Florian & Black-Hawkins, 2011); flexibly drawing on their professional and contextual knowledge, to proactively develop their curiosity- and creativity-supporting practices, whilst they interact with learners and the learning environment. Low or no-cost developments in teaching practices (and the contextual interpretation of these practices) should be a key focus of future research, with the aspiration to create equitable opportunities for all children to become curious and creative life-long learners.

#### Declaration of competing interest

This work was funded by a grant from the Jacobs Foundation and conducted in partnership with the International Baccalaureate and the Australian Council for Educational Research – we do not to our knowledge have any other competing interests to declare.

#### Data availability

The data that has been used is confidential.

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