

Year Two Report: Build and Test

Penryn Creativity Collaborative Action Research Report

Research Question:

How can we harness creative skills
when thinking like a scientist?

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Creativity Collaboratives Network Partner:

The Leach Pottery



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This Action Research project is part of the Penryn Creativity Collaboratives.

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CONTEXT

Creativity Collaboratives is a national pilot programme of eight clusters of schools across England who are working together to test innovative practices in teaching for creativity, sharing learning to facilitate system-wide change. The programme, launched in October 2021, is funded by Arts Council England with generous support from the Freelands Foundation. Creativity Collaboratives: Penryn Partnership is the Southwest pilot for the programme and over the course of three years is focused on exploring one central question:

Does teaching creativity across the curriculum lead to young people who are better prepared for their future in a changing workforce?

The Penryn Creativity Collaborative is led by Penryn College with eight local primary schools and research partner, the School of Education at the University of Exeter. This report presents findings from one of thirteen action research projects which took place during Year 2 of the Penryn Creativity Collaboratives programme. Each action research project was led by a teacher with students from their own school, included a link with a partner from a local industry and the lead teacher was supported by researchers from the University of Exeter through a programme of training and mentoring.

Full findings from Year 2 can be found in the research report. To cite this report please use:

Crickmay, U. Childs, S. Chappell, K. (2023) *Preparing for a Creative Future: Year Two Report Build and Test* <https://penryn-college.cornwall.sch.uk/creativity-collaboratives>

This action research project took place in Penryn College, an 11-16 school on the south Cornish coast, England. A lively, thriving and oversubscribed school, Penryn College prides itself on offering the very best for their students.

This project involved a Year 8 (aged 12-13) class of high prior attainment (HPA) pupils of Penryn College Secondary School in Penryn, Cornwall. It was led by Eleanor van Veen, a science teacher with previous experience in scientific research. The project explored how we can harness creative skills to encourage students to think like a scientist when designing and planning a scientific investigation. Students came up with ideas for the investigations themselves. The action research focused on the creative skills of dialogue and collaboration and thinking like a scientist.

The role of the industry partner was to provide an example of the scientific process being used in a creative industry. The Leach Pottery uses glaze trials as part of the creative process of making pots. During this creative process many variables are kept the same (such as kiln temperature, clay body, shape and size of the clay tiles and the main glaze body recipe) and one variable is changed (the metal salts used to colour the glaze). This is like the independent and dependent variables in a science investigation. Staff from the pottery ran a workshop with the students where they learnt about The Leach Pottery and about the materials used in glazes and glaze trials. Students mixed glazes and carried out glaze trials which The Leach Pottery brought back once fired for students to examine. As a group, the students voted on one glaze colour which was then used to glaze a set of mugs from The Leach Pottery.

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DEFINITIONS OF KEY TERMS

- **Key Stage (KS):** the different stages or phases from the National Curriculum for England
- **High Prior Attainment (HPA):** High Prior Attaining students are defined as those students who achieve 105 or above in their combined English and Maths scaled scores in Primary Schools

Creative Skills

The research drew on the Penryn Partnership Creative Skills Framework developed during Year 1 of the Penryn Creativity Collaboratives programme (Crickmay, Childs & Chappell, 2023). The framework defined creative skills in a five-part model, and this action research focused on two sections of this model as follows:

- **Dialogue and collaboration:** Drawing in notions of dialogue, questioning, communicating and collaborating in both verbal and embodied ways
- **Honing and developing an idea:** This combines the skills needed to develop creative ideas, incorporating aspects of self-reflection together with development of techniques and understanding of the rules, and the persistence needed to progress creative ideas and actions

AIM OF THE RESEARCH

This study tackled the following problems:

- Employers and tertiary educators report that students can lack independence of thought when asked to use the skills necessary to plan, do and evaluate scientific investigations after leaving compulsory education (from personal discussion with those in the sector)
- In my experience, given the knowledge-rich nature of the current national curriculum, students often do not have the time and opportunity to design and plan their own investigation without constraints
- Research on practical work in science provision in England and Scotland has previously found that most experiments in schools involved "following prepared instruments" and that there were few opportunities for open-ended or long-term experiments. (Cramman, 2019).

Students begin their training in working scientifically at primary school Key Stages (KS1 and 2), this develops as they move through the KS3 and KS4 compulsory secondary curricula and through KS5 where there is choice to choose a scientific subject (DfE, 2015). However, with the knowledge rich nature of the current national curriculum at KS3 and 4, students often do not have the time and opportunity to design and plan their own investigation without constraints. They often do not seem to be thinking like scientists. This research focused on how the creative skills of "honing and developing an idea" and "dialogue and collaboration" are used when students are planning free choice scientific investigations.

This culminated in the research question: How can we harness creative skills when thinking like a scientist?

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METHODS AND PARTICIPANTS

Students used the investigative skills developed in their previous school career which were referenced, but not explicitly re-taught. They designed, planned and carried out an investigation of their choice. Before planning the investigation, students visited the science prep room for inspiration, this is the room where the scientific apparatus is stored. After the students had planned their investigation, they presented it to a teacher and a technician to check their ideas for safety, but not viability, before implementation.

The group for study was a class of 31 Year 8 (aged 12-13) students with high prior attainment.

The project lasted 10 weeks, and consisted of:

- A session where student's thoughts on the use of creative skills in science were gathered using a forms quiz (16.01.2023)
- A session where students visited the prep room and planned their investigation in small groups, their opinions on which creative skills were used were gathered using the Creative Skills Wheels (see below) printed on white paper. There is also data from an observation by Sarah Childs during this lesson (19.01.2023)
- A session where a teacher and technician checked the students plans for safety and equipment availability (26.01.2023)
- A session when students did their investigation. Their opinions on which creative skills were used were gathered using the Creative Skills Wheels printed on orange paper (30.01.2023)
- A session when students reflected on their investigations in student journals. Four of the small groups of students were interviewed by the teacher in focus groups (21.03.2023)
- A workshop from The Leach Pottery on glaze trials (28.03.2023)

The methods used were student interviews in focus groups; observations; student journals; a teacher journal; artefacts; photos and creative skills wheels completed by the students to reflect on the skills that they had used while planning and doing their investigations. The Penryn Partnership Creative Skills Wheel is a data collection tool designed for the Penryn Creativity Collaboratives project. Around the edge it includes the five-part definition of creative skills developed during year 1 of the project, with each skill broken down into three detailed sections. Inside the wheel, teachers or students can mark whether they noticed each of the skills being used a little, some, or lots.

Data analysis was carried out via immersion in all data after transcription of audio-based data. Photographs were coded using the See, Think, Wonder technique from Harvard Project Zero. All data was then systematically coded using low level through to higher level coding which led to a thematic analysis. This is written up below in this report.

Ethical research practice was ensured by following the ethical guidelines of the University of Exeter ethics committee which are grounded in the British Educational Research Association (2018) guidelines; protocols involved seeking informed consent for all research activity from all participants alongside careful data protection practices.

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MAIN FINDINGS

Creative Skill - Dialogue and Collaboration

Question posting / responding, problem finding/ solving

There is weak evidence from two sources for dialogue and collaboration through posing and responding to questions. There were two examples from the focus groups and evidence from the creative skills wheels which shows that several students did not consider themselves to be using this skill during the planning stage when they were designing their independent investigations. However, most students thought they were using these skills during the investigation.

An example of students problem-solving through dialogue can be seen in this extract from focus group 1:

Kate: Well, we all had a slightly different idea of how we were going to do it. And then we kind of figured out a way in between.

Samantha: Yeah. We had, like, two or three ideas at first. And we sort of looked at...we sort of had a talk about it and looked at which one we would all prefer to do and which one we all think that we were able to do. And we sort of had, like a bit of the...not really a vote but we just sort of talked about it for a while, and then decided that that was the most easy thing. And then we also talked a lot about how we were going to make it work and how we were going to measure. 'Cause we weren't sure whether to measure the height of it or to measure the amount of reaction.

Kate: And we had to decide how many Mentos we were going to put on, different types of Coke. Yeah, and stuff like that.

Teacher: And were there any disagreements or did you manage to...?

Kate: There was a few, especially about how many Mentos we should put in. But I think we figured it out and we kind of went in between everyone.

Negotiating difference, responding appropriately

In the extract from the focus group above, we can also see how the students are negotiating their differences through this dialogue, and there was overall strong evidence for dialogue and collaboration through negotiating different ideas. In the data from the focus groups there are four examples of this. Evidence from the creative skills wheels shows that most students (all but one) considered themselves to be using these skills to some extent during the planning stage and this increased after the investigation. This negotiation of difference can be seen in the focus group

Working individually, collaboratively and within a community

There is strong evidence for dialogue and collaboration through working individually and collaboratively. This comes from several data sources including focus groups, observations, photographs and the creativity wheels and is particularly strong for working collaboratively. There is one data point for working individually which comes from an observation that students chose to work individually when drawing to communicate their plans. Evidence from the creative skills wheels shows that all students considered themselves to be using these skills during the planning stage and even more so after the investigation.

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An example of this is from Focus Group 2, where one of the students is explaining how decisions were made collectively, and then roles were allocated with the group.

Teacher: How did that work in the group coming up with that idea? What was it...

Louis: Well, we kind of like, when we were going through, like, different ideas to use, we kind of just decided to, like, agree on one specific one and, like, decide who should do what job. So like, who should be testing and who should be writing all of the information down.

Teacher: So you gave each other roles quite early on?

Louis: Yeah.

Creative skill – honing and developing ideas

Reflection

There is very strong evidence for honing and developing ideas through reflection both during the planning stage and during the investigation in the data from several data sources including the focus groups and observations. The data from the student journals and the creativity wheels give evidence that the students themselves recognise that this is happening.

Extract from student journal:

It was good that we were able to do the experiment we wanted to do and had no issues with it. However we didn't finish all the entry logs so we don't have enough information to make a conclusion yet. We could of managed our time better and chose place to closer to the classroom in our original plan.

Understanding rules and consequences

There is again very strong evidence for honing and developing ideas through understanding the ways of working in this subject. This comes through from all the data sources, with the teacher recording a lot of evidence for this in the teacher journal. There is also evidence that the students are also recognising this themselves in their student journals and creative skills wheels.

Extract from teacher journal:

Group x (Mike/Andrew) were doing an investigation that involved collapsing cans. Unfortunately, they had not really understood the science of a collapsing can so did not do their investigation in a way that produced usable results.

Persistence

Interestingly, there is no evidence for persistence identified in the focus group data, although some of the evidence to support considering alternatives under reflection above could arguably also be used to evidence persistence. However, there is evidence identified by the teacher in the photographs from all three investigations, and in the other data sources.

An example of this is in the photograph below which was documented during the 'mentos and coke' investigation. The students have constructed this experiment using a number of different materials, and the black gaffer tape which can be seen in the photo shows that way that they, perhaps with help from the technician, have found a way to steady the bottle for their investigation. This adjustment in the set up shows them both reflecting and persisting to make their investigation work.

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Figure 1: Photo of Kate, Charles and Samantha (group 1) adding mentos to the coke and mentos bottle during their investigation.

EMERGENT FINDINGS

Safety

One emergent finding that came through particularly strongly were the safety considerations that need to be taken into account when allowing students creativity in a science classroom. The evidence for this was very strong in this well behaved, high prior attainment class and came through in the focus group, photographs and both the teacher and student journals.

Emergent findings relating to the creative skills framework

Although these were not the focus of the action research, evidence for the creative skills of being imaginative and playful (particularly playfulness) and empowered action (particularly immersion) came through strongly in the data.

Data for being imaginative and playful was clear in the focus group conversations and observations. For example, one pair of students chose to do an imaginary investigation where they planned and made up the data for their investigation.

The following extract from a focus group provides an example of the way in which the students were immersed in their activity, thus developing their creative skills in empowered action, and how this related to the core line of enquiry which was about thinking like a scientist:

Teacher: And do you think that it gave you an opportunity to think a bit like a scientist?

Kate: Yeah, and be more independent.

Teacher: So talk me through how it gave you the opportunity to think like a scientist, if you can.

Samantha: Well it made us think of the different variables and the different outcomes that could happen, and like, make a hypothesis of, 'Yeah, this Coke might have the biggest reaction, this will have the least amount of reaction.' And it also...we thought of all of the ways that could make it work more, which I think sort of was thinking a bit more like a scientist, I guess.

Kate: We could have thought a bit more about how we could have done it better after the reaction, though. Like after we'd done it.

Teacher: After you'd done it? Yeah. That's always the way. That's how science works. So that's exactly thinking like a scientist.

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Thinking Like a Scientist

There is strong evidence for thinking like a scientist in the focus group data and the teacher journal. The students did not notice that they were thinking like a scientist during the activities until prompted to reflect. Some commented that it did not feel like science, more like STEAM or art even though what they were doing is exactly what scientists do.

Areas in which students did not use creative skills

An analysis of the creativity wheels gave the opportunity to see which creative skills the students did not feel they were using during the activities. Most students responded lots or some to all the creative skills on the wheel. After the planning session students answered “little” in varied areas of the creativity wheel ten times whereas after the investigation session students answered “little” only four times, and always under the heading of generating new ideas that mattered.

There were a surprisingly high number of links to the chemistry science curriculum noted during the Leach Pottery Workshop. Surprisingly, no creative skills were used during the workshop as students were instructed directly how to make up the glazes. The students were using the scientific enquiry process of finding the best colour; however, it was not possible for them to have agency in this due to their lack of understanding of the colours that would be produced using the different glazes prior to firing the test tiles. The value was in seeing how the scientific enquiry process can be used in other industries and in showing how chemistry is involved in the glazes.

The following extract from a focus group reflecting on this experience shows that the students felt that they were ‘thinking like scientists’ even though on this occasion this was not a creative process:

Teacher: And did it feel like you were being scientists when you were doing that?

William: Yeah. Well, yeah. It felt fun but also, like, controlled and scientific. Yeah.

Teacher: Did you feel like you were thinking like scientists?

William: Yeah.

Harry: Yes.

Teacher: How did it feel like you were thinking like scientists?

William: We were thinking of the different, like, possibilities and, like, our predictions of what would happen and, like, also, like, how different things would affect the reaction and...yeah.

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DISCUSSION AND IMPLICATIONS OF THE PROJECT AND FINDINGS

Following this research, our science department is replacing one of the traditional assessment points with an investigation. We are considering how this can be assessed whilst allowing students to develop their creative skills. This may be difficult. In the pre 2017 science General Certificate of Secondary Education assessments (GCSE's) there was concern around the fairness of the internal controlled assessments known as Investigative Skills Assignments (ISAs). These were high stakes, and some students were given a lot of help. It will be important that our assessment focus is not on results, or it will be difficult to move away from the common student fixation on getting things right. One idea could be to focus on the design of the investigation. We could also consider using the creative skills framework, looking at their graphing skills or even using a literacy framework to assess the write-up of the investigation.

The project has impacted my teaching practice with this group of students. The five creative skills (Crickmay, Childs and Chappel 2023) are equally essential skills for successful scientific research. I now have the language to encourage students to use their creative skills in the classroom which in turn has encouraged the students to think like scientists. If students come to ask me "is this OK?" or "what do I do now?" I send them back to "hone and develop their ideas" through "dialogue and collaboration". We can discuss failure in a positive light in terms of empowered action and risk taking.

It was a challenge ensuring student safety. With students doing different activities, a safety briefing that covered all eventualities was not possible. Several investigations had to be stopped for safety reasons. It would have been difficult to ensure safety if students had displayed more challenging behavior. To enable the creative application of science it is essential that students have the knowledge, skills and experience to base it on. This was a class of high prior attaining (HPA) students. Running a similar series of lessons with middle or low prior attaining (MPA/LPA) students would need an adapted approach.

Interacting with The Leach Pottery showed how the scientific process can be used in the creative process of developing glazes. We identified many links with the science curriculum both in terms of the product development and the materials used. We used this understanding to a) improve the relevance of the workshop to the science curriculum and b) enable it to be delivered in during a double lesson, facilitating engagement by negating the need for room changes and teacher cover.

I have shared the research with our head of department and with the school in whole school training. I would be interested in sharing the work at the Association for Science Education from 4-6 January 2024 and/or contributing to peer reviewed publications that are based on the work.

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Creative Skills

PENRYN PARTNERSHIP

“Does teaching creativity across the curriculum lead to young people who are better prepared for their future in a changing workforce?”

