ACER

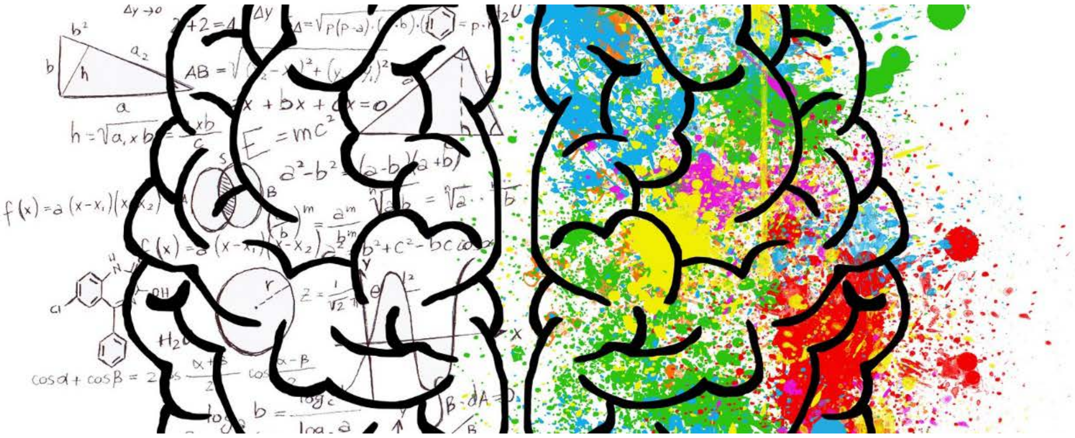
Improving Learning

FINAL REPORT – DEVELOPMENT OF A TRANSCRIPT TO RECORD LEARNER CREATIVITY AND CURIOSITY

SUBMITTED TO THE INTERNATIONAL BACCALAUREATE ORGANISATION BY THE AUSTRALIAN COUNCIL FOR EDUCATIONAL RESEARCH

25 February 2022

In the spirit of reconciliation ACER acknowledges the traditional custodians of country throughout Australia and their connections to land, sea and community. We pay our respect to their elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today. ACER acknowledges the Aboriginal and Torres Strait Islander people who continue to contribute to our work to improve learning, education and research.

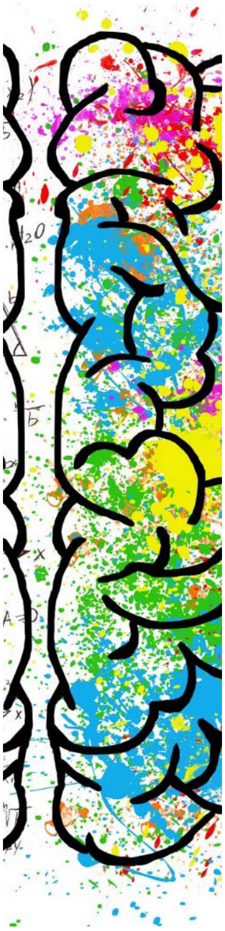


ACER staff who contributed to this project were

Prue Anderson
Toby Carslake
Anit Cherian
Bethany Davies
Laura Good
Jonathan Heard
Sladana Krstic
Brendan McGinley
Dara Ramalingam
Sarah Richardson
Claire Scoular
Shani Sniedze-Gregory
Jennifer Star

TABLE OF CONTENTS

SUMMARY



Introduction

This report provides a summary of the diverse work undertaken by ACER during this project. The ultimate goal was to develop transcripts that enabled learner achievement in creativity and curiosity to be recorded.

As with any traditional academic domain, before learner achievement can be identified, it is first necessary to define what the domain is. Decades of work have gone into defining domains such as mathematics, science and reading in ways that are relevant to learners at the primary and secondary levels. This enables learner progress to be tracked over time and forms the basis for the development of assessment tools.

In domains such as creativity and curiosity, however, this has not been done. While many educational stakeholders are interested in measuring learner achievement in transversal domains, this remains challenging due to the absence of commonly agreed definitions of what these comprise. Where measurement has been attempted, such as in the innovative domains in the PISA assessment programme, this has been for one specific age group.

Consequently, while the development of transcripts has been the goal of this project, the path towards that, and much of the effort expended, has been in wrestling with optimum ways to explain creativity and curiosity – and their sub-components - in language that resonates with learners and teachers, and that is appropriate across numerous cultural settings.

Along the way, we have resolved some conceptual challenges and come up with new ways of viewing transversal attributes in the classroom. This incorporates their definition, approaches to identifying achievement and the critical importance of schools providing environments that are conducive to learners' creativity and curiosity.

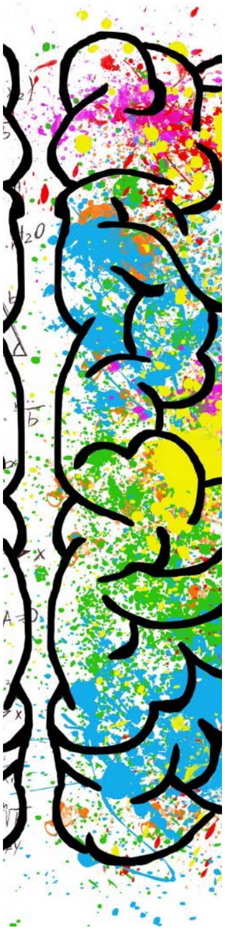
From definitions to classroom materials

Given the importance of defining creativity and curiosity in ways that are suitable for interpretation in school classrooms around the world, we started the project with a focus on the definition of terms and scope.

In a global symposium that took place virtually in September 2020, we brought together some of the leading international scholars on creativity and curiosity with educational experts and practitioners from schools around the world implementing International Baccalaureate (IB) programmes. The goal of the symposium was to identify ways to bring together the scholarly understandings of creativity and curiosity and the practical requirements of teachers and learners.

After advancing through the development of a series of substantive pieces of work, we feel that the project has come full circle. 18 months after the initial symposium, we have created a series of materials and resources which – we hope and believe – synthesise understandings of creativity and curiosity in ways that are suitable for use in classrooms around the world and enable learners' creativity and curiosity to be evidenced.

A significant contribution of our work is the notion that rather than a linear progression in which skills and knowledge evolve over time, transversal competencies such as creativity and curiosity rise and fall in response to external stimuli and internal preferences. This sets the scene for work on other transversal domains and encourages reflection and growth among learners and teachers.



To reflect the rise and fall of creativity and curiosity we have used the metaphor of a thermometer. Not only is this easily understandable by both primary and secondary learners, but it is also non-judgemental. Cold, cool, warm and hot are different, but none are 'better' or 'worse' than another. We deemed this to be particularly important in considerations of creativity and curiosity because of the importance of context.

An important aspect of our work has been the focus on the environment that schools and teachers provide for learners, and the extent to which this enables them to express their creativity or curiosity. This project has been implemented in parallel with a project led by the Oxford University Centre for Educational Assessment (OUCEA) on Facilitating Curiosity and Creativity in the Classroom.

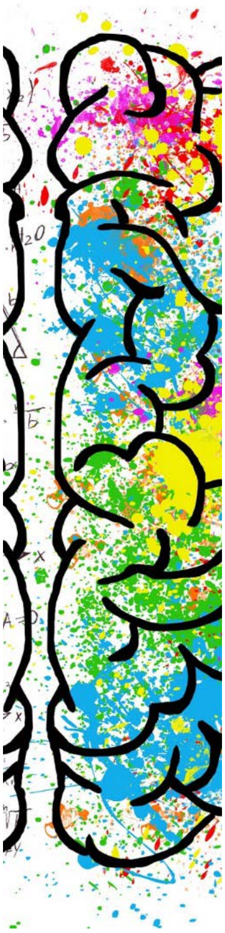
While not wanting to overlap with the OUCEA work, we have found it essential to place emphasis on the context in which learners learn as part of our focus on evidencing learner achievement. This is because judging learners for demonstrating a lack of creativity or curiosity in an environment in which neither of these are nurtured, would be unfair and counterproductive.

Hence, we refer to an 'enabling environment' and have used the metaphor of fertility. In 'unfertile' growing environments, seeds are present in the soil but there is not the right environment for them to grow. This reflects the latent creativity and curiosity of learners whose learning environment, and whose teachers, do not provide them a supportive environment in which to be creative and curious. The other three categories of an enabling environment we have used illustrate increasing levels of growing conditions in which the latent seed can grow into a stronger and stronger plant.

The importance of context is further reflected in our design of the transcripts to record learner creativity and curiosity. The transcripts we have created focus on supporting learner agency, metacognition and reflection. Instead of judging and grading learners' creativity and curiosity, our approach ensures that the diversity of expressions of creativity and curiosity by learners aged 3 to 19 can be evidenced. This both enables feedback loops into ways to enhance creativity and curiosity – and ultimately approaches to learning - and generates tangible records of accomplishment for learners to share.

Moreover, we ask learners to reflect on the extent to which their school and teachers can help to support their creativity and curiosity, hence explicitly pointing to the importance of context.

We sincerely thank the International Baccalaureate Organisation (IBO) and the Jacobs Foundation (JF) for the opportunity to undertake this fascinating work. We look forward to further opportunities to collaborate on this important – and rapidly emerging – area of educational research and practice.



Key outcomes and outputs

This report provides a guide to a suite of resources that are provided as Appendices. All of these have been through various revisions with input from the IBO, JF and teachers, with insights and recommendations gleaned from a series of consultations and surveys.

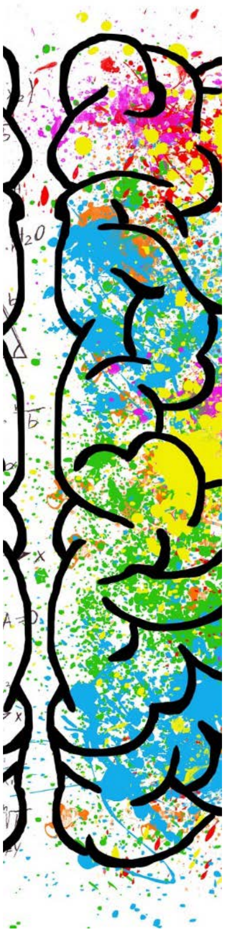
It is important to note that none of these resources have yet been trialled or validated, since this was not in the scope of the current project. Trialling and validation with learners and teachers around the world are further steps required before they are suitable for widespread use in the classroom.

The **Literature Reviews** (Appendix 1: Creativity Literature Review; Appendix 2: Curiosity Literature Review) were the starting point of this work. They synthesise scholarly research on the concepts of curiosity and creativity and identify their implications for use in schools and classrooms.

The **Frameworks** (Appendix 3: Creativity Framework; Appendix 4: Curiosity Framework) take the insights from the **Literature Reviews** and turn them into definitions and constructs that are suitable for use in educational settings. Each construct is divided into dimensions and sub-dimensions to help situate creativity and curiosity in the type of activities that learners undertake in schools.

Each **Framework** includes numerous examples of how a sub-dimension might play out in a classroom for learners of different ages. It also defines different levels of achievement in each element. This helps to put complex scholarly language into statements that have meaning and application in a school.

The **Framework** definitions of levels are further converted into resources that learners can refer to in class. We have termed these **Thermometers** (Appendix 5: Creativity Thermometers; Appendix 6: Curiosity Thermometers) – a neat metaphor to explain the ways in which curiosity and creativity rise and fall from 'cold' to 'hot'.



Increases and decreases in curiosity are influenced by learner interests, teacher pedagogy and access to the time, resources and support required for learners to practice creativity and curiosity.

Due to the importance of the context, we have further expanded our focus from what learners can do, to the extent to which schools and teachers provide an enabling environment for learners to be creative or curious. We have presented these through the metaphor of a plant developing from seed, through seedling, to a healthy plant.

The **Enabling Environment** (Appendix 7: Enabling Environment for Creativity; Appendix 8: Enabling Environment for Curiosity) summaries are designed to help teachers, programme coordinators and school leaders reflect on the extent to which they enable creativity and curiosity in their schools and classrooms.

Teachers are further provided with **Reflective Quizzes** (Appendix 11: Educator Creativity Quiz; Appendix 12: Educator Curiosity Quiz) for creativity and curiosity. These are designed to encourage reflection of individual teachers, or discussion among a group of teachers. They indicate ways in which simple changes in pedagogy can facilitate the growth of creativity or curiosity among learners.

Finally, the **Transcripts** (Appendix 9: Transcript for Creativity; Appendix 10: Transcript for Curiosity) we have created for each domain is designed to balance learner reflection and teacher validation. It provides learners with agency over which piece of work they choose to highlight and the language (taken from the thermometers) to explain what they think they have been able to demonstrate.

A second part of the Transcripts enables learners to reflect over a series of expressions of creativity and curiosity and to identify insights into their own preferences that they can use to strengthen their approach to learning.

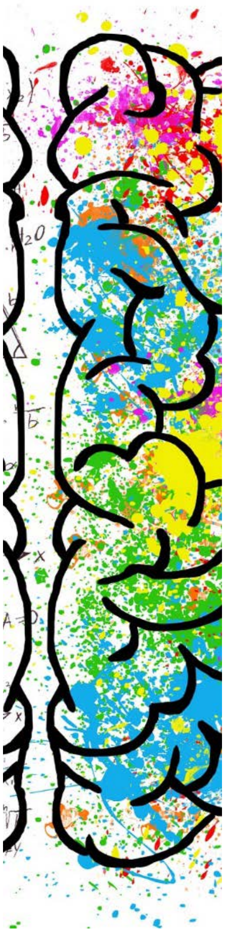
To help teachers navigate these resources we have created a one-page summary document for each domain, and this is shown in the introduction to this report.

It is important to note that the work on this project has focused on learners aged 3 to 19. Where we feel it necessary, we have therefore created different versions (for example of the **Thermometers** or the **Transcripts**) for use by learners of different ages or abilities. As with any resource, it will fall on teachers to introduce the resources to learners in ways that meet the needs of particular cohorts.

All learners will require scaffolding that helps them gain an understanding of the concepts of creativity and curiosity, what they mean for their learning, how they can make the most of opportunities to practice and demonstrate them, and how to use the transcripts.

Consultations
In order to arrive at the final deliverables for this project, we have undertaken several rounds of consultation with numerous stakeholders. We would like to thank them very much for their input, thoughtfulness, ideas and considerations. We further acknowledge that their input was provided during the Covid-19 pandemic in which learners, schools and teachers experienced significant disruptions and stresses.

Reports from the first round of **Consultations** on the frameworks (Appendix 13: Report from First Round of Consultations (Frameworks)) and the second round of **Consultations** on the support materials (Appendix 14: Data from Second Round of Consultations (Support Materials), including the questionnaires that we used, are available at the end of this report.



Limitations
We have done our best to optimise the consultations for this project. Inevitably, however, they have been impacted by the Covid pandemic. We pivoted from a focus on virtual consultations to the inclusion of virtual surveys – providing teachers with flexibility in providing feedback.

Despite our best efforts, and even with the insights obtained from teachers in multiple countries around the world, the level of engagement of schools and teachers was negatively impacted by the pandemic. This means that we were not able to have as many teachers try out our materials as planned. Nevertheless, we did receive some fascinating feedback from those who did, and hence gained valuable insights for future implementation.

Next Steps
The purpose of this project has been to focus on the development of materials for implementation in schools around the world. Validating these resources on a large scale was not included in the scope and this would certainly be an important next step. Providing opportunities for teachers and learners to try out the resources in daily practice, to reflect on them, critique them and make suggestions for improvement will strengthen their relevance and we look forward to this subsequent, exciting phase.

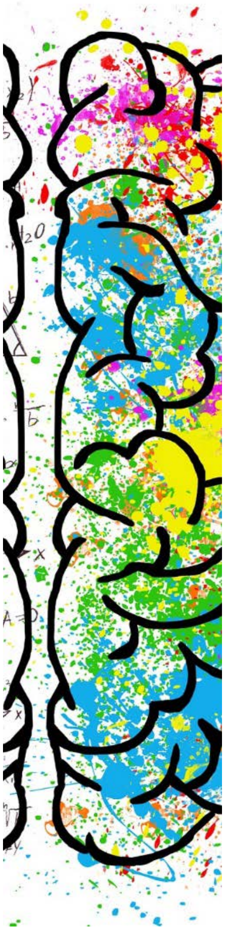
Trait or State?
Finally, one of the big questions we have grappled with throughout this project is whether creativity and curiosity are states or traits. The scholarly literature indicates that some learners have traits that cause them to be naturally more or less creative or curious than others.

Nevertheless, all learners can be provided the opportunity to strengthen their innate tendencies through teachers and schools providing nurturing environments for this to occur. While creativity and curiosity may themselves be regarded as attributes, they include essential elements, such as idea generation or questioning, that can be taught – or at least enhanced – with the guidance of teachers. This highlights the importance of schools providing enabling environments to nurture transversal competencies.

INTRODUCTION

This project started with a question – was it possible to create a transcript that could record learners' transversal attributes alongside their academic transcript? The answer is a resounding 'Yes'. We have implemented this project in parallel with – and in close reference to – the work undertaken by the Oxford University Centre for Educational Assessment on classroom practices that facilitate creativity and curiosity.

As the project has progressed, we have grappled with a range of conceptual and practical challenges that have informed the approach we have used. These reflect many of the debates in contemporary education, such as assessment vs. evidencing, formative vs. summative assessment, learner-centred vs. teacher-led learning activities and domain-specific vs. generic skills and knowledge.



We feel that the deliverables that we have created for this project reconcile these tensions as much as possible yet recognise that further development will be required as understandings of learning evolve over time.

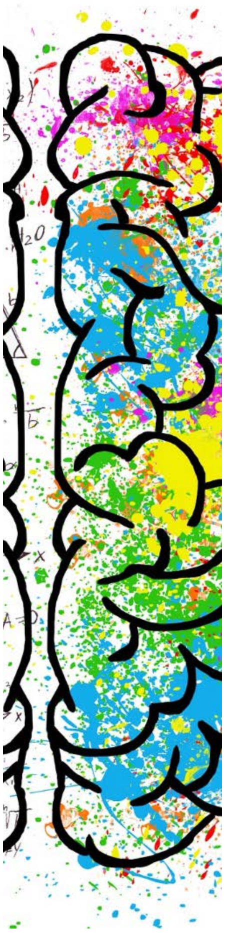
While creativity and curiosity have been the focus of this project, their use has been more as exemplar domains rather than due to anything inherent that elevates them above other possible domains. The intention of our work here is that it is applicable to a whole range of transversal or 21st century domains. Our goal has been to develop materials suitable for usage by schools around the world, but to stop short of piloting the materials created.

Both creativity and curiosity are topics of deep scholarly interest and this project both leveraged, and went beyond, the ways in which they are understood in the academic literature. We commenced with a detailed **Literature Review** (Appendix 1: Creativity Literature Review; Appendix 2: Curiosity Literature Review) of each domain.

We needed to think about what form each domain might take in the context of school education, and this led us to define the tangible expressions that could be recognised – and importantly strengthened – in a school classroom. These are summarised in the two **Frameworks** (Appendix 3: Creativity Framework; Appendix 4: Curiosity Framework).

Moreover, we needed to consider what different 'levels' of achievement might look like in each domain. A standard approach might require a teacher to judge different outputs in terms of their calibre, but we wanted to avoid this. Instead, we focused on learners being able to chart changes in their own creativity and curiosity and developed materials that support these actions.

We refer to these materials as **Thermometers** (Appendix 5: Creativity Thermometers; Appendix 6: Curiosity Thermometers). While the approach to domains such as reading and mathematics are based on the understanding of a linear progression, we did not believe that this was the way in which domains such as creativity and curiosity behaved. Instead, our own insights – confirmed by extensive consultations with stakeholders – was that these ebb and flow in response to both internal and external stimuli. Hence, we felt that the thermometer metaphor is one that suits this concept well.



As the project has been implemented, we have come to focus more on the environment in which learners are studying than we initially expected to. This contradicts approaches to measurement in domains such as reading and mathematics in which the focus is on the competencies that learners can demonstrate. It extends considerations about transversal domains through an explicit recognition of the importance of schools and teachers providing enabling environments for learners to achieve desired outcomes.

Our approach has been twofold – first, to define the factors that create an enabling environment for learners to express their creativity or curiosity. These are elements that can be controlled by school leadership teams and classroom teachers, and that provide the space, resources and structuring that best support learners to be creative or curious.

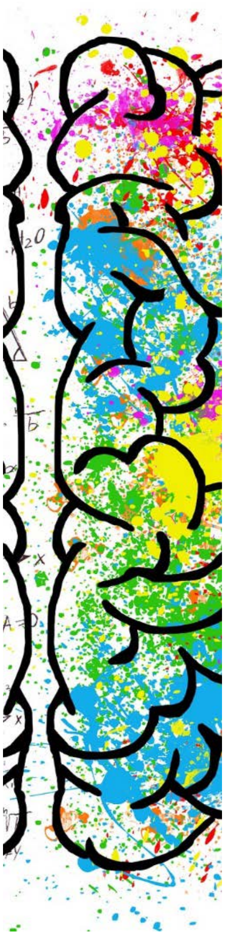
We used the metaphor of fertility to provide a visual metaphor for the **Enabling Environments** (Appendix 7: Enabling Environment for Creativity; Appendix 8: Enabling Environment for Curiosity), provided as Appendices to this report.

We further created **Reflective Quizzes** (Appendix 11: Educator Creativity Quiz; Appendix 12: Educator Curiosity Quiz) that can be used as reflective tools by individuals or groups to evaluate the extent to which they create an enabling environment and to stimulate discussion on what they could do differently.

These are also Appendices to this report and include numerous examples of how different elements of the Frameworks might be brought into the classroom.

Second, the **Transcripts** (Appendix 9: Transcript for Creativity; Appendix 10: Transcript for Curiosity) that we have designed balance the desire for evidencing to be learner-centred and to encourage agency, with the need to incorporate some form of teacher validation. We have combined both elements and require learners and teachers to use language from the Thermometers in their responses.

We further wanted to optimise the meta-cognitive potential of learner reflection, particularly in response to the ability to observe how their creativity and curiosity strengthen or weaken depending on different



situations. To do so, we have added a **Reflection** to each transcript – for use after the main transcript has been used a few times, to encourage learners to reflect on the approaches they take when their curiosity or creativity is stimulated, and how they could apply these when the external context, or their internal state of mind, is less conducive to creativity and curiosity.

To reflect the needs of learners enrolled in International Baccalaureate programmes, we have tried to ensure that all of the materials we have developed are suitable for learners aged 3 to 19, and in any of the 159 countries in which IB programmes are implemented.

To help teachers navigate the suite of resources for each domain, we have developed a one-page **Guidance Summary** (Appendix 16: TEACHER GUIDANCE CREATIVITY; Appendix 17: TEACHER GUIDANCE CURIOSITY) to indicate how teachers can use each one. These are shown on the following two pages.

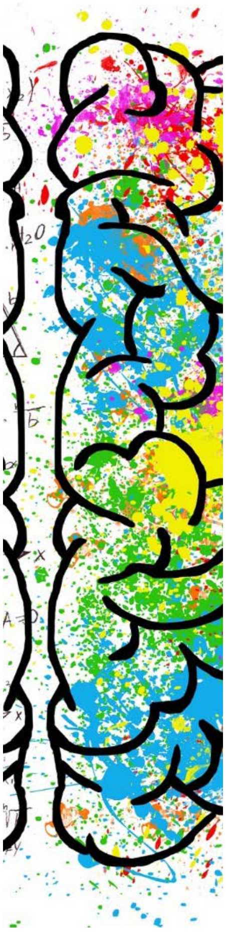
We sincerely thank the International Baccalaureate Organisation and Jacobs Foundation for the opportunity to undertake this project and hope to be able to support continued work in this exciting area of research.

CONTEXT

This project was situated in several important contexts that are worth defining prior to moving to the substance of this report.

TRANSVERSAL COMPETENCIES

In education systems around the world there is a growing focus on how best to prepare learners for their future lives. This includes an ever-stronger focus on a set of skills, competencies or attributes that are often referred to as 'transversal', 'generic', 'holistic' or '21st century'. There is increasing awareness of the importance of ensuring that learners are given opportunities to gain or strengthen these during their schooling.



This poses two major dilemmas for educators. First, what do they need to do to support learners to gain or practise transversal competencies? Second, how do they gather evidence on the extent to which learners have gained or improved them? The answers to these questions are made challenging by the very nature of transversal competencies themselves.

The use of the term 'transversal competency' is problematic as there is little consensus around whether they are skills or competencies or attributes (or a combination of all three). Moreover, unlike mainstream domains such as mathematics, reading and science, there are no widely-recognised definitions of what each competency means. What do terms like 'creativity' or 'curiosity' or 'problem solving' or 'critical thinking' convey to teachers and learners? The answer is likely to be, 'many different things'.

GLOBAL EDUCATION

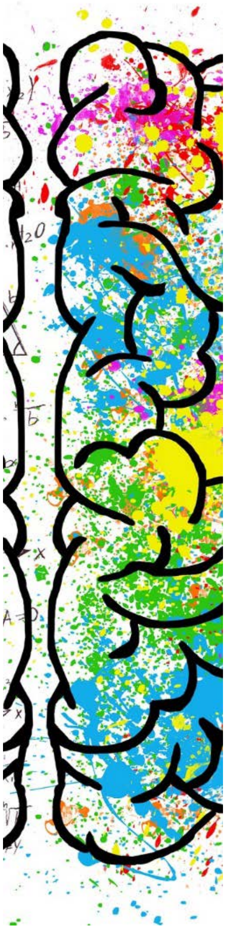
A second important context for this project has been the increasing globalisation of education systems around the world. This means that they tend to be increasingly like each other, partly under the influence of global assessment programmes such as ICCS, ICILS, PISA, PIRLS and TIMSS. This leads to what can be regarded as both positive and negative outcomes. One of the benefits is the encouragement and dissemination of good practices between countries, as well as growing focus on more 'holistic' education worldwide.

The International Baccalaureate plays an important role in the centre of global education. Its innovative and forward-looking approach to education is highly influential. With IB programmes implemented in 159 countries, encompassing nearly two million learners, it is also a fertile environment in which to develop novel approaches that both meet contemporary educational needs and that are also suitable for global uptake.

ASSESSMENT AND DIGITISATION

Two related moves in education systems worldwide are to shift from a focus on summative examinations to the gathering of ongoing data to measure learner progress. Digitisation enables the use of varied approaches to tracking learner achievement over time and provides platforms and data sets to help drive empirically-based decision making in schools and classrooms.

These moves have also enabled attention to be focused on approaches to evidencing learning that transcend what has been possible on paper. They encourage greater use of portfolios, self- and peer-assessment and the use of real-world problems in authentic assessment tasks. This set the scene for our design of the transcript in this project.



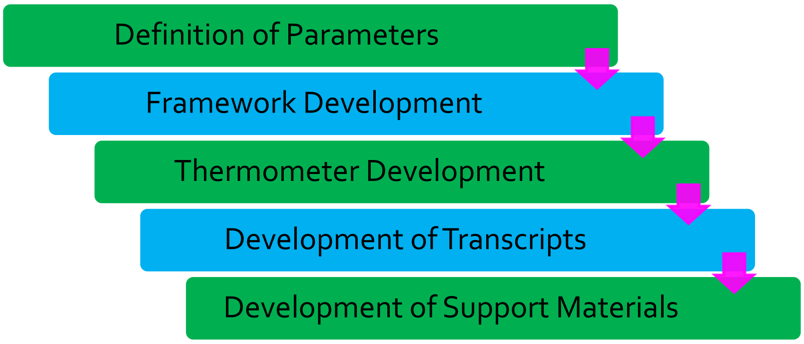
CORONA VIRUS

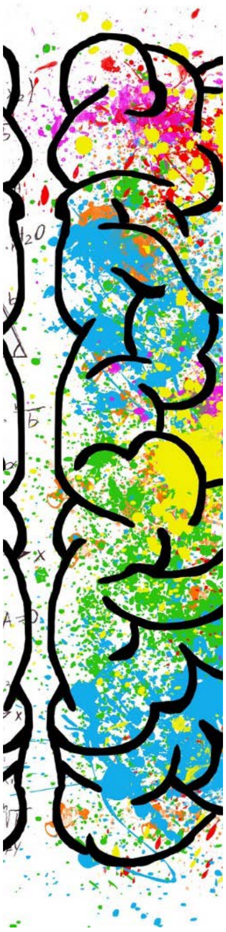
The final – and certainly unwanted – context for this project has been the Covid-19 pandemic. This has disrupted schooling in almost every country around the world. It has kept learners and teachers separate and needing to rapidly transition to virtual engagement. It has caused stress, trauma and exhaustion and its implications continue to be felt.

Inevitably the pandemic has shaped how we have conducted this project – particularly consultations with schools – bringing both opportunities and limitations. At the same time, it has helped educators imagine newer models of education, in which a focus on competencies traditionally regarded as 'outside of the domain of schooling' can be incorporated.

METHODOLOGY

This project has proceeded through five discrete but interlinked phases, each of which has been underlain by consultation with relevant stakeholders.





DEFINITION OF PARAMETERS

The project commenced with a three-day virtual symposium in September 2020 that brought some of the leading scholars in the fields of curiosity and creativity together with leading educators from schools around the world offering IB programmes, with coordination from Dpict.

We were fortunate to be able to engage with renowned researchers in creativity and curiosity from around the world including Jamie Jirout, Jiajun Guo, Kou Murayama, Lani Watson, Mary Ainley, Michael Hanson, Remke Klapwijk, Shelby Clark, Teresa Cremin and Vlad Glaveanu.

Through three sessions of intense engagement, facilitators guided groups of participants through focused discussions. All discussions were recorded in note form, and also by visual scribes – providing valuable records of the discussions in graphic form. The sessions were specifically designed to inform this project and discussions focused on:

- Defining creativity and curiosity and their sub-components
- Considering how creativity and curiosity can be evidenced in schools
- Considering cross-cultural and cross-programme contexts for creativity and curiosity
- Considering what kind of evidence should be collected, and by whom, and,
- Considering key parameters for a mastery transcript.

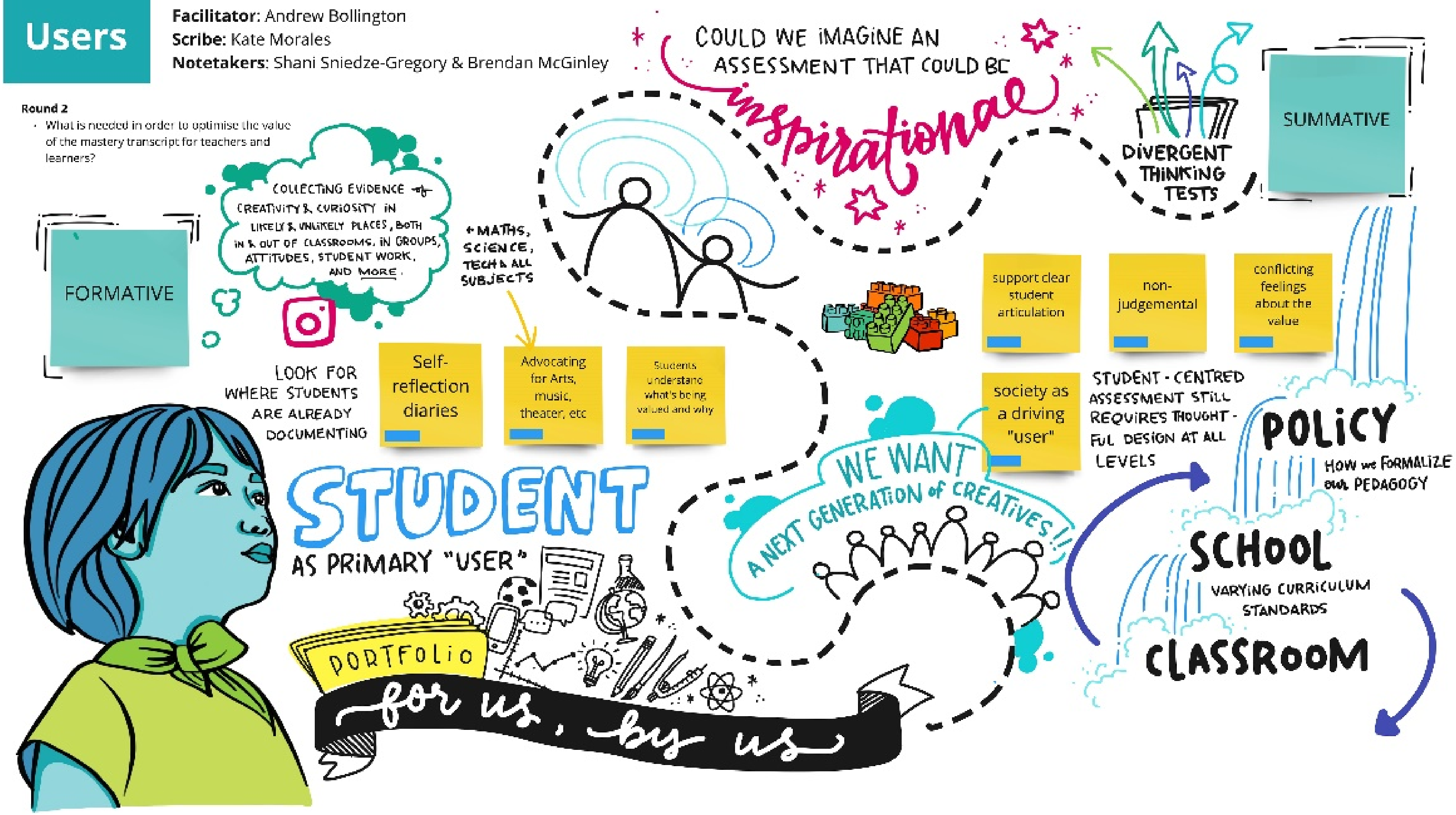
Key parameters for the project emerged from the symposium and these have informed our approach throughout. They are summarised in these graphical records created during the symposium:

Users

Facilitator: Andrew Bollington
Scribe: Kate Morales
Notetakers: Shani Sniedze-Gregory & Brendan McGinley

Round 2

- What is needed in order to optimise the value of the mastery transcript for teachers and learners?

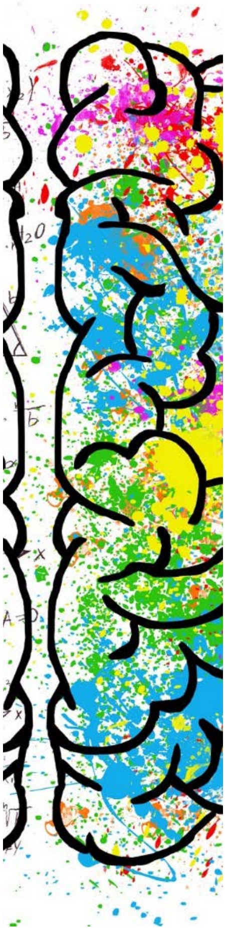


Group 2.

Facilitator: Sarah Richardson
Scribe: Liisa Sorsa
Notetakers: Sladana Krstic & Edlyn Chao

Key parameters we took away from these discussions were:

- Our approach must be learner-centred
- The approach to evidencing should be non-judgemental
- There should be a focus on the school and classroom environment
- We should emphasise opportunities for learners to be creative and curious
- Constructs need to make sense to learners and teachers
- The approach to evidencing should draw on learners' unique strengths
- Evidencing should encourage further growth and learning



L I T E R A T U R E   R E V I E W S

Once the symposium had concluded the second phase involved an in-depth review of the scholarly literature on creativity and curiosity. The **Literature Reviews** (Appendix 1: Creativity Literature Review Appendix 2: Curiosity Literature Review) can be found towards the end of this report.

Each literature review was conducted separately, but the lead authors regularly discussed the direction in which their work was heading to try to ensure that a similar structure would be achieved.

Our overall goal was to draw from the most important academic literature to identify how each construct was defined, what its key characteristics were, how it was distinguished from other concepts (such as the distinction between curiosity and interest) and how it could be seen in everyday activities, including in learning.

Search terms included:

- Key domain name (i.e., 'creativity' or 'curiosity')
- Definition
- Learning
- Learners OR Pupils
- School OR Primary OR Secondary OR High School
- Measurement OR Assessment OR Evidencing

The most recent literature (2015 onwards) was emphasised but seminal works or works that were building blocks of more recent publications were also reviewed. EBSCO Host Academic Search Complete and Google Scholar were the databases that were used as the primary starting points for the literature review.

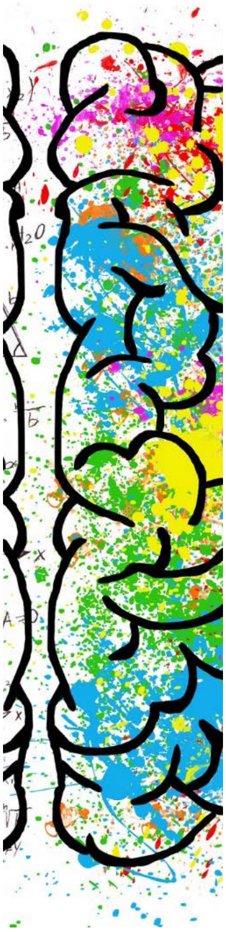
As the literature reviews were conducted, key issues arose that were subsequently reviewed and included. An example is the debate over curiosity and interest, and efforts to identify how each construct is distinct to, yet interacts with, the other.

FRAMEWORK DEVELOPMENT

Once the literature reviews had been completed, work moved on to the development of draft frameworks for both constructs. Each framework was comprised of similar elements:

- A working definition of the construct that was suitable for use in schools
- Key dimensions for each construct
- Sub-dimensions for each dimension

The working definition of creativity was **initially**:



> *Creativity is a material, mental and/or social process that leads to the production of novel and useful ideas, approaches and solutions. It involves the exploration, generation and evaluation of both problems and ideas, made possible through divergent, experimental and convergent thinking.*

After consultations and revisions this became (revisions underlined):

> *Creativity is a material, mental and/or social process that leads to the production of novel and useful ideas, approaches and solutions. It involves the <u>generation and exploration of ideas</u> made possible through <u>both experimental and evaluative thinking</u>.*

The dimensions and sub-dimensions for creativity were **<u>initially</u>** defined as:

- Problem finding
  - Discovery orientated behaviour
  - Formulating a problem

- Generating ideas
  - Fluency
  - Flexibility
  - Experimentation

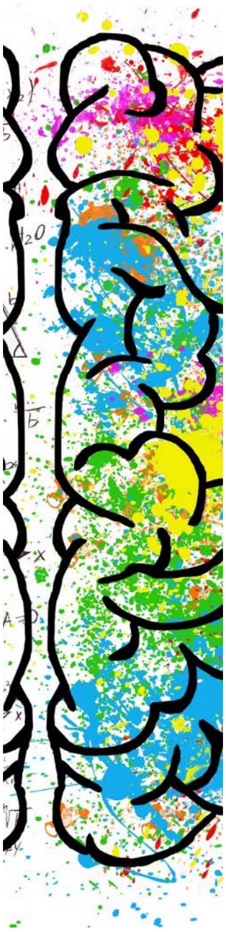
- Verifying ideas
  - Evaluating solutions
  - Seeking feedback
  - Refining ideas

- Quality of ideas
  - Originality
  - Fitness for purpose
  - Elaboration

After consultations and revisions, the changes were to alter 'problem finding' to 'problem definition' (to reflect feedback from consultations that creativity was not always in response to a previously identified problem) and to remove 'verifying ideas' and its sub-elements (due to a re-think by developers).

The working definition of curiosity was **initially**:

> *Curiosity involves the recognition of a meaningful gap in one's knowledge or understanding, the desire to fill that gap and the motivation and intrinsic satisfaction of doing so. A meaningful gap is one where closing it is a substantive task that is likely to lead to richer, deeper or broader conceptual understanding. Curiosity is an intrinsic part of a process of self-motivated development of knowledge and understanding. This process includes inquiry skills, critical thinking, open-mindedness, risk taking, self-efficacy and reflection. Curiosity provides the incentive and reward for seeking new knowledge and understanding, requiring other skills to ensure that this learning is rich, sustained and productive.*



After consultations and revisions this became significantly shorter and with some key changes (revisions underlined):

> *Curiosity <u>is a cognitive state that</u> involves the recognition of a meaningful gap in one's knowledge or understanding, the desire to fill that gap and the motivation and intrinsic satisfaction of doing so.*

The dimensions and sub-dimensions for curiosity were **initially** defined as:

- Focusing curiosity
  - engages with, and explores, conceptual conflicts
  - enhances motivation (<u>to learn</u>)
  - refines questions of value
- Resolving knowledge gaps
  - Explores answers and thinks critically
  - Sustains effort
  - Evaluates learning

After consultations and revisions, the only change was to add 'to learn' after 'enhances motivation'.

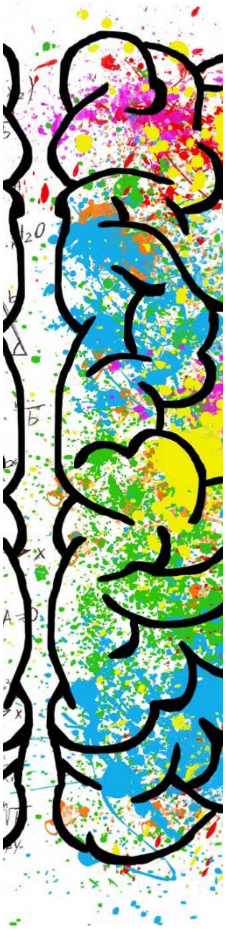
Once the draft frameworks were developed, ACER commenced a period of consultation with schools around the world. The approach used and feedback received is found in the section on consultation below.

The final **Frameworks** (Appendix 3: Creativity Framework; Appendix 4: Curiosity Framework) can be found towards the end of this report.

DEVELOPMENT OF THERMOMETERS

Education systems are underpinned by an understanding of learning as a linear progression, from less skill and knowledge to more skill and knowledge. This assumes that the more a learner studies, the more skill and knowledge they gain.

When dealing with transversal competencies, however, this understanding does not necessarily hold true. It could be possible to argue that the more time someone spends being creative, the more creative they will become. Equally, creative ideas can emerge from anywhere, at any time, and may not need to be foreshadowed by creative 'practice'.



Similarly, curiosity tends to be sparked by internal and external stimuli. Importantly, these vary from one person to another. Hence, one learner may be full of curiosity about the life cycle of a moth, partly due to a broader interest in insects and possibly also due to a teacher introducing the topic in an engaging way.

Another learner in the same class may be completely lacking in curiosity about this topic but may be deeply curious about the movement of the planets, or something else entirely.

As we worked on developing the frameworks for creativity and curiosity, it became increasingly clear that while we could identify different degrees of creativity or curiosity in terms of learner actions, we could not suggest that there was a linear progression. Instead, creativity and curiosity wax and wane.

After grappling with this concept, and suitable metaphors that we could use to encapsulate it, we focused on the concept of thermometers. These reflect different temperatures, but those temperatures are influenced by stimuli such as earth tilt, daylight hours, cloud cover and latitude.

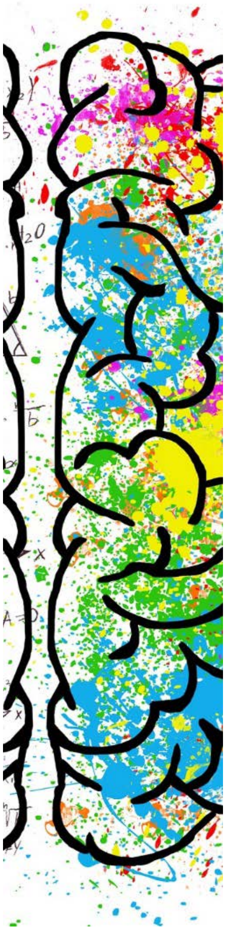
Therefore, we cannot say that one temperature is superior to another. Instead, they reflect the combination of stimuli and both internal and external factors related to a particular place and time.

Plants and animals change their behaviour according to the temperature, for example hibernating in cold weather or growing blossom as the temperature rises. We often extend these to language metaphors, in that plants and animals move or regenerate more slowly as temperature falls and more quickly as temperature rises.

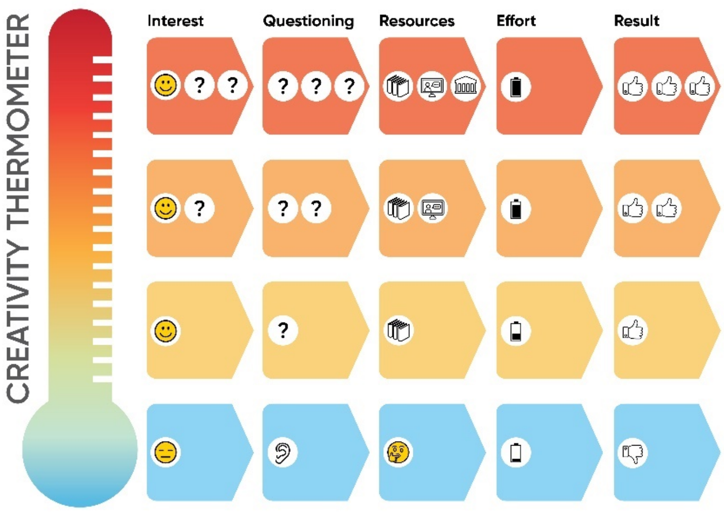
While humans cannot control the external temperature, we are able to exert a degree of control over temperature. We can use sources of heat to increase temperature and air-conditioners to reduce it, for example. Hence, temperatures both reflect contextual factors but are also something that we can exert agency over, in terms of modifying our response.

While not perfect, we felt that out of all the metaphors that we explored, this one was best suited to helping learners and teachers understand creativity and curiosity, in addition to other – but likely not all – transversal competencies.

We developed a series of **Thermometers** (Appendix 5: Creativity Thermometers; Appendix 6: Curiosity Thermometers) for learners of different age levels, varying from detailed text for upper-senior learners to icons and images for the youngest learners.

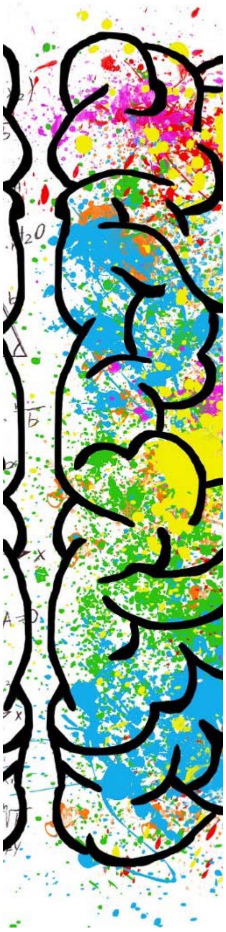


Each thermometer contains descriptors that reflect different levels for each of the dimensions and sub-dimensions. They are designed to provide tangible and learner-suitable explanations that they can recognise in themselves (at older ages) and that teachers can use with learners (at younger ages). For illustration, these are the curiosity thermometers for the most senior and most junior learners.



DEVELOPMENT OF TRANSCRIPTS

In developing **Transcripts** (Appendix 9: Transcript for Creativity; Appendix 10: Transcript for Curiosity) for use in this project we were guided by comments from the symposium – particularly that there should be no 'judgement' involved (i.e., we should avoid putting teachers in a position to value one expression of creativity or curiosity above another). We were also guided by the understanding that transcripts should be learner-centred and should encourage growth and learning.



Transcripts traditionally incorporate a list of grades. Efforts to represent achievement in transversal competencies tend to remain focused on the 'level' of achievement. This includes the Mastery Transcript Consortium that has broadened the notion of a transcript to include transferable skills and global citizenship but continues to represent these in levels.

We considered several different possible approaches, and drew on insights from consultations, before identifying the format that we ultimately designed. The key features of the transcripts are:

Selection of a Task – learners can select which tasks to use to demonstrate their creativity or curiosity. Individual schools will be able to advise learners on the types of tasks they can select – this may be a piece of schoolwork or could even be something done outside of school. Learners are also asked to indicate the length of time taken to complete the task.

Use of Thermometer – learners are then asked to indicate the level of their creativity or curiosity during the completion of the task, using symbols from the thermometer. For example

My level of curiosity about this task [tick box]:

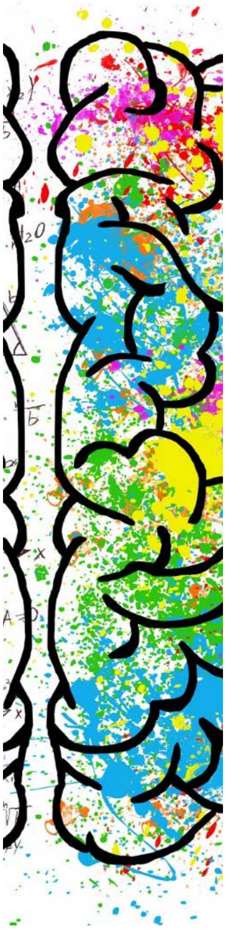
Reflection on Task – learners are asked to identify which elements of curiosity or creativity they feel that they have demonstrated during the task and are directed to refer to the language in the thermometer to support their response. They are given nine lines of text in which to do this. They are further asked to identify elements that they still need to focus on (2 lines) and any barriers they encountered (2 lines).

Inevitably, the ability of learners to complete this section on their own will be limited to their school level and experience with reflection tasks. While many learners will be able to complete this with minimal support, learners in any year level may need assistance to practice and improve their reflection skills and may need alternative means of recording their reflection.

Teacher validation – following on from the learner reflection, teachers are asked to validate the learner's reflection. Like learners, they are asked to reference the thermometer levels in reflecting on the learners' level of creativity or curiosity in completing the task. They are further asked to select one of three options in relation to the learner's reflection:

Agree – has demonstrated the elements mentioned above
Partly Agree – has partly demonstrated the elements mentioned above
Disagree – has not demonstrated the elements mentioned above

Teachers are then given a few lines to make comments to justify their response.



All the above is contained in a single A4 page. In practice it is likely to take the format of a digital record, with similar length of responses enabled as in the paper form.

Extended transcript - Each transcript has a second 'page', which is a further reflective activity. The intention is that this would be used after multiple uses of the first page, for example after learners have completed six of the transcripts. It is designed to stimulate meta cognition, prompting learners to think about what they have learned about how 'hot' or 'warm' curiosity or creativity help them to learn.

They are asked to respond to a series of statements:

- When my curiosity is hot or warm, this helps me learn because:
- When my curiosity is hot or warm, these are the elements of curiosity that I am best at:
- What do my transcripts tell me about my curiosity? What could help to warm it up?
- I can take the strategies I use when my curiosity is hot and apply them to times when my curiosity is cold. I plan to do this by:
- My school and teachers can help to support my curiosity by:

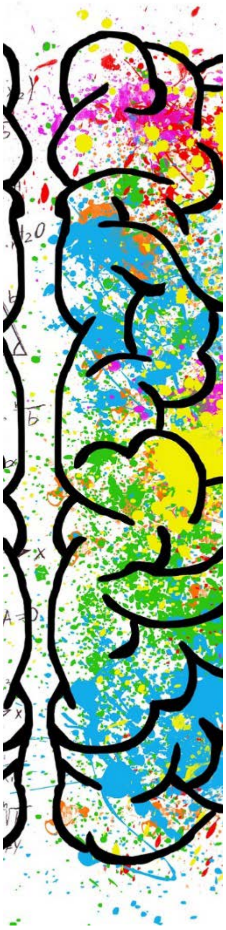
The intention is that at the same time as reflecting on how the 'temperature' of creativity or curiosity helps them learn, the transcripts also encourage learners to learn from situations in which this occurs and to try to apply this in situations which their creativity or curiosity are less stimulated.

The final statement reflects on the importance of an enabling environment for learners to practice their creativity and curiosity, and the ways in which schools and teachers can help shape that environment.

EARLY YEARS FOCUS

A particular challenge in this project has been the need to develop materials that are suitable for learners aged 3 to 19. This implies the need to focus on learners with several different levels of cognitive and skills development.

ACER's work regularly requires us to cater to learners throughout primary and secondary years, so the requirements this entailed were comfortable for team members to address. It is less common for resources for early-years' learners (aged 3 to 5) to be integrated with primary *and* secondary continuums, however. Hence, we made additional efforts to address the needs of this cohort.



In doing so we gained helpful insights from Mary Ainley's (2019) work on the way in which curiosity and interest arise out of the exploratory behaviour of children in infancy and early childhood. We further sought input from ACER staff with experience teaching early-years and early-primary children in schools in different countries, and from teachers of children of all levels in IB programmes in schools around the world.

As stated above, the materials developed for this project have yet to be subjected to large-scale piloting with learners. Until data and feedback is collected from piloting, we will not know how successful we have been in catering to learners of all ages. Nevertheless, it is important for us to indicate what steps we have taken to make the work we have done as suitable for early-years learners and teachers as possible.

1) Learner Agency

We have targeted our materials at the IB's PYP, MYP and DP programmes. The PYP is inclusive of learners aged 3 to 12 and we have ensured that our materials reflect the emphasis of the PYP on learners as agents of their own learning. Thus, we have placed learners' ownership of their learning as central to the approach we have used, including the integration of ongoing assessment.

Our approach has further been influenced by the PYP's emphasis on allowing educators "*to make choices to best enable learners to flourish*". Hence, rather than directing PYP teachers to use different approaches for learners of different ages, the PYP philosophy is that teachers should select and target approaches based on the needs of learners, and we have given them the freedom to do so.

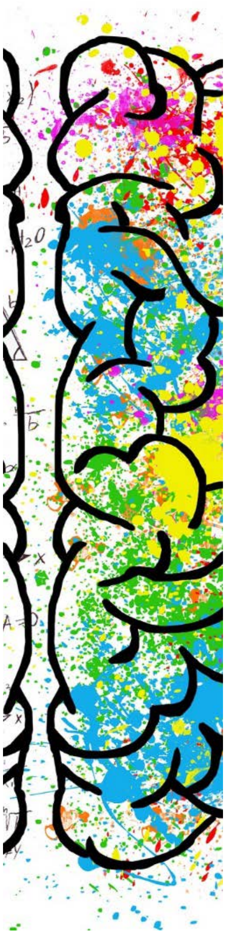
2) Adaptation of learner materials

The learner-facing materials we have developed have been adapted to suit learners at a range of ages. Six different versions of each of the **Thermometers** (Appendix 5: Creativity Thermometers; Appendix 6: Curiosity Thermometers) have been developed to cater for learners at different ages and levels of reading proficiency and with the use of colour and symbols to enhance accessibility for all learners:

- Full text paragraphs
- Full text dot points
- Short text
- Short text and symbols
- Word and symbols
- Symbols only

3) Adaptation of Transcripts

We have also created two versions of transcripts – the first assumes that learners can fill it in themselves and are able to write fluently. The second version makes greater use of symbols and simpler language. It is suitable for younger learners to complete if confident with some degree of written expression.

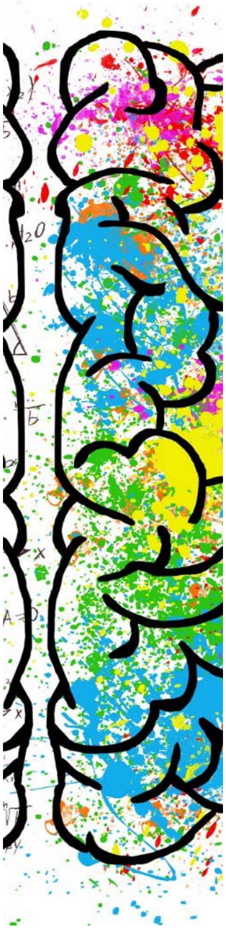


Where learners are not able to write down their thoughts, the second version is also suitable for learners to point at the symbols and/or for teachers to record their thoughts. Inevitably, for the very youngest learners, teachers may need to complete the transcripts themselves, but we hope that some degree of learner engagement in reflective conversation can be encouraged.

DEVELOPMENT OF SUPPORT MATERIALS

While this project has primarily focused on the development of a framework and transcript, we also wanted to provide teachers with some support in terms of how they could create an enabling environment for creativity and curiosity in their schools and classrooms. This has been approached in three ways:

1) Enabling environment summary
2) Supporting ideas within the Frameworks
3) Reflective quizzes



Enabling environment summary

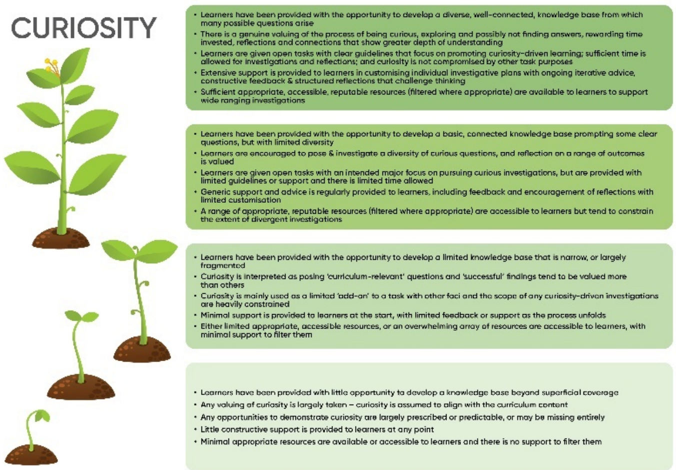
There is debate around the extent to which transversal domains can be learned or taught, and the extent to which teachers can create the right environments for learners to practice skills in these domains.

Similar to the creativity and curiosity **Thermometers** for learners, we developed an 'enabling environment' summary to help teachers and schools understand the importance of support that learners need to be creative and curious.

Each enabling environment summary is comprised of five key elements, each of which is subsequently broken down into four levels of enabling, from low to high:

- Foundational knowledge: extent of prior knowledge taught/established
- Valuing creativity and/or curiosity: valuing the process, recognising, rewarding and encouraging
- Task opportunities: nature & focus of task
- Support: extent of guidance, feedback, opportunities to reflect, and
- Access to resources: relevant, readable for learner, available, sufficient.

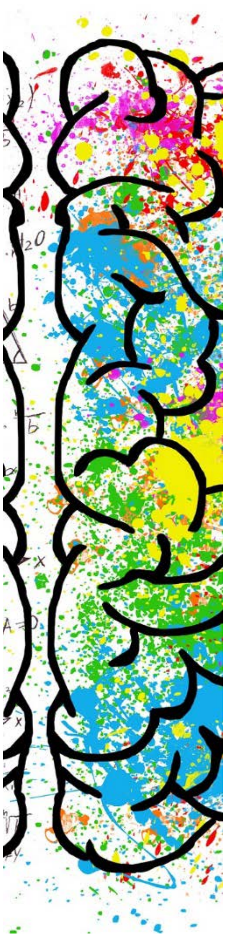
Both of the '**Enabling Environments'** (Appendix 7: Enabling Environment for Creativity; Appendix 8: Enabling Environment for Curiosity) can be found towards the end of the report – the curiosity version is shown in illustration.



<u>Supporting Ideas in Frameworks</u>

For each of the dimensions and sub-dimensions in the frameworks we have included class ideas for learners of different levels. This was in response to feedback from teachers during the first round of consultations. Our intent is not to suggest what teachers should do, but simply to give a range of examples of what might be possible.

For example, in relation to the sub-dimension '*formulating a problem*' in the creativity framework, three examples for class ideas are given



- A primary school teacher has posed the question, "What could we as a class do to help local endangered species?" Having explored the question, three groups of learners formulate the problem differently. One group of learners has decided that habitat loss is the major problem and so will investigate ways to reduce it or its effects. Another group considers that the problem is one of a lack of community awareness and may be improved by humans changing certain behaviours. A third group sees the problem as one of introduced species and so wonders if there is anything they could do to minimise the impact caused by these.

- A senior photography learner is presented with the theme of "Change" for their next project. They see the challenge of this theme as not simply deciding what they will photograph that will explore the theme in interesting ways, but also how a photograph – which captures a moment in time – can represent a process that takes place over time. They include this formulation of the problem in their process journal.

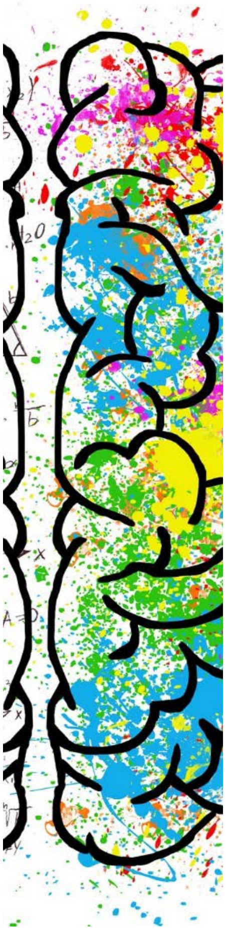
- To emphasise the practical importance of science, and to teach learners to apply the experimental method, a teacher has asked her class to design an experiment that could "save lives". Learners explore what this could mean via a brainstorm. As a result, some learners consider the task by looking at how a science experiment might detect allergens in food. Other learners consider whether testing the safety of certain materials might be a way to approach the problem. Yet other learners consider the challenge from the perspective of either providing or testing for potable water. All three groups of learners have formulated the problem differently

<u>Reflective quizzes</u>

In addition to these two elements, we have also developed reflective quizzes for teachers. These quizzes provide a series of A and B options. All of these options are practices that reflect good teaching practice, but half are those that would be *more* conducive to creativity or curiosity.

At the end of each quiz, teachers are given explanations around which items relate to which sub-dimensions (as explained in the creativity and curiosity frameworks), and an explanation of the ways in which certain practices support creativity or curiosity more than others. For example, in the Curiosity Quiz, two of the items are:

- I / we expect learners to follow an agreed formula in arriving at answers.
- I / we expect learners to take risks in the process of arriving at answers.



Neither of these options are 'wrong', but in this case the second option is the one most likely to encourage curiosity. In the explanation, teachers can see that these statements relate to the sub-dimension 'sustains effort', and the explanation is given that:

> *"Curious learners do not necessarily take the easiest route to finding answers to their questions but may instead prefer to try out lots of different approaches … Some of these approaches may seem foolish, but experimentation and risk taking are important aspects of curiosity".*

These resources were developed before – and separately to – OUCEA's project outputs but there are interesting areas of similarity. In defining ways to foster creativity and curiosity in primary school classrooms, the OUCEA project identifies a range of elements also seen in the Reflective Quizzes including:

- **Fostering collaboration,** encompassing aspects such as helping learners to explore their own curiosity, emphasising the importance of diverse ideas and multiple approaches, provide learners with agency over how they approach tasks

- **Nurturing an inquisitive mind**, encompassing aspects such as modelling curiosity, helping learners to make connections between the lesson and their everyday lives, identifying and filling knowledge gaps and encouraging learners to identify ways to build their knowledge base.

- **Providing choice in self-expression,** encompassing aspects such as modelling and valuing multiple modes of expression, integrating opportunities for learners to take risks and linking creativity to curiosity

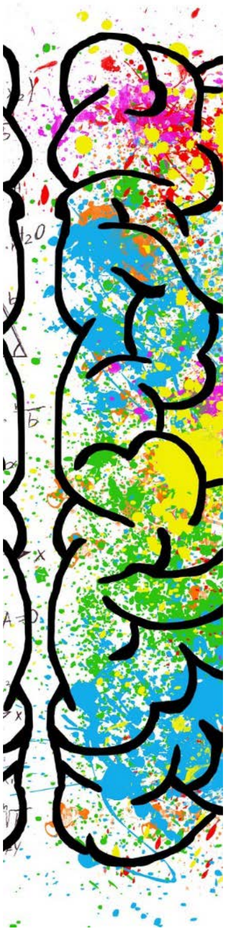
- **Diversifying feedback pathways,** encompassing aspects such as emphasising reflection on both the creative process and creative product, creating a space where divergent thinking is welcomed and valued, indicating how ideas can be transformed or improved and encouraging learner contributions, ideas and questions.

CONSULTATIONS

FRAMEWORK CONSULTATION

After the draft frameworks had been developed, it was important to gather feedback on them. We had initially planned to do so via virtual discussions with groups of teachers in two schools in each of seven regions of the world.

Due to the Covid-19 pandemic, and subsequent school closures, this proved very challenging. Six virtual consultations were completed - in Canada, Australia, England, Jordan, India, and China - but we also wished to gather further feedback.



We thus developed a virtual survey to enable asynchronous feedback, giving teachers greater flexibility to respond to our questions. The survey is included in

Appendix 13: REPORT from First Round **of Consultations (FRAMEWORKS)**Teachers from 100 schools responded to a request sent out by the IB for expressions of interest in participating in consultations. A virtual survey tool was created with a total of 40 questions, reflecting the same themes as included in the virtual discussions.

These covered all elements of each draft Framework. Respondents were given the choice of providing responses on the Creativity Framework, the Curiosity Framework or both. Survey tool items included both closed and open response types.

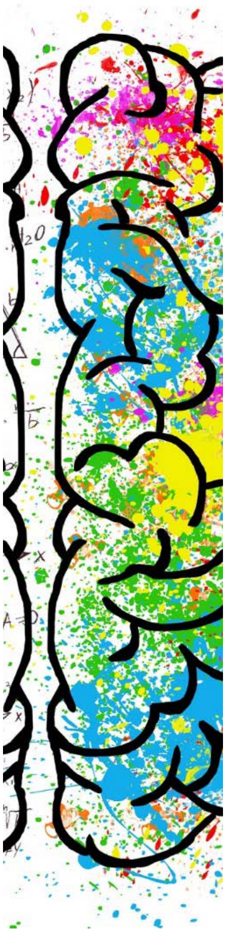
The survey tool was sent to the 100 respondents who had previously indicated interest in taking a part in consultations, with two reminders sent in the following couple of weeks. At face value, the response rate was 27%, however, responses indicated that, in some cases, groups of respondents in a single school discussed the questions together and agreed on their response, hence in some cases one survey response represented multiple respondents.

Two respondents taught in government or public schools, and the rest in independent or private schools, within: Australia, Canada, Colombia, India, Jordan, Latvia, Oman, South Korea, Sweden, Turkey, the United Arab Emirates, and Vietnam.

All respondents were teachers. On average they had over 15 years' experience. 68% taught in the Primary Years Programme, 40% in the Middle Years Programme, 32% in the Diploma Programme and 8% in the Career-Focused Programme (note – it is common for teachers to teach in more than one IB programme).

Creativity Framework
The percentage of respondents who agreed with each statement about the definition of creativity in the Creativity Framework is provided here:

	(%)
It is easy to follow	67
It makes sense to me.	82
It is a comprehensive definition.	91
It is written in plain English.	91
It is relevant for using with learners in my school.	73
It is equally applicable to the youngest and oldest learners in my school.	76
Cultural factors do not prevent this definition from being applicable in my school	95



Comments included:

> *"We think that the definition is comprehensive and it includes the key features of creativity and the definition is directed toward the process of purposeful learning in real world situations."*
>
> *"We thought that it was informative, clear and we could all understand your definition."*

Similar levels of agreement were recorded for the dimensions and sub-dimensions within the Creativity Framework. Some respondents felt that the Creativity Framework could be shorter, however, and some indicated the language used to describe the progressions could be clearer. There were also suggestions about providing examples such as:

> *"Supporting examples from classrooms will help the learning community to see aspects in context and make deeper connections for effective implementation."*

Curiosity Framework
The percentage of respondents who agreed with each statement about the definition of curiosity in the Curiosity Framework is provided here:

	(%)
It is easy to follow	88
It makes sense to me.	94
It is a comprehensive definition.	94
It is written in plain English.	94
It is relevant for using with learners in my school.	94
It is equally applicable to the youngest and oldest learners in my school.	94
Cultural factors do not prevent this definition from being applicable in my school	88

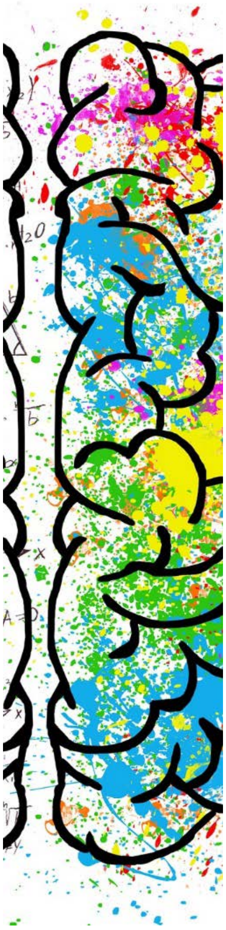
Comments included:

> *"It is a comprehensive and easy to understand definition."*

Similar levels of agreement were recorded for the dimensions and sub-dimensions within the Curiosity Framework. Some respondents felt that the use of the word 'gap' in the definition of curiosity was problematic and, once again, there was a request for practical examples. In illustration, one respondent suggested

> *"Apart from feedback – "feedforward" is a term used by IB educators to nurture learners' curiosity and set new goals for themselves to self-regulate themselves".*

With reference to the different definitions of different levels of creativity and curiosity, most respondents agreed that these were clear. Again, examples were requested, such as:



> *"Perhaps you can give some examples (teacher/learner friendly) in some areas to make it an even more practical guide and ensure consistency and ease of implementation".*

> *"Maybe we can summarize the curiosity framework and include more real-life examples so readers can relate".*

Recording learning

An important part of this project has been to design a way of recording learner achievement in creativity and curiosity, and to enable this to be tracked over time. Respondents were asked to provide ideas on how to develop this and what features it should include. Respondents were uncertain about how a Mastery Transcript, should appear.

The most popular suggestions were online portfolios or something similar.

	%
Online portfolio	88
Online form or spreadsheet	82
Video	47
Paper form or spreadsheet	12
No idea	12

Respondents did identify some concerns about the possibility of grading creativity and curiosity – and provided suggestions about how this could be avoided:

> *"Perhaps descriptor level (0-4) could be amalgamated across all subjects, and an overall comment for each aspect is recorded. This avoids using levels which are likely to be perceived as assessment rankings".*

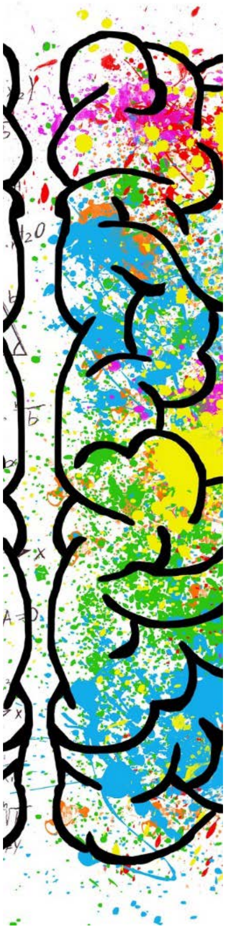
> *"As a progression- I am not sure that there should be mastery- more like a continuum to indicate progress. As these skills are fluid and not static at any point".*

> *"I guess creativity and curiosity may not be graded".*

Respondents also identified how the transcript could be used. Comments included:

> *"The learners could modify and use appropriate evidence collected during their school years".*

> *"It will show the universities and employers the skill progression of a person. Perhaps this will be a better window of a person's growth and journey instead of a personality test".*



> *"This could be a unique portfolio capturing learning dispositions and thought process celebrating creativity and curiosity. CP supports ATLs especially in their reflective projects which is an extended research work on issues. This will help build their portfolio with such meaningful elements that have relevance and significance in the learning journey and real world".*

SUPPORT MATERIALS CONSULTATION

Following the development of the support materials, another round of consultations with teachers and subject coordinators of IB programmes was conducted. A summary of data can be found in Appendix 14: Data from Second Round of Consultations (Support Materials).

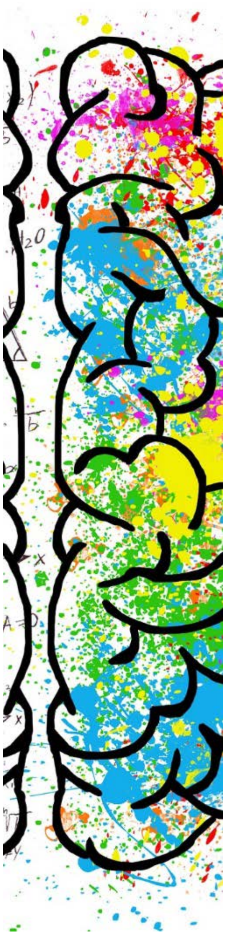
The same schools that had responded to the request for expressions of interest in participating in consultation on the study were contacted. In order to save time, offer flexibility and reduce burden on teachers, they were sent a link to a survey tool for their feedback, instead of being virtual consultations.

Respondents were asked to provide feedback on the revised Curiosity and Creativity Frameworks, and in particular their attention was drawn to the development levels section as that was deemed especially relevant for them to review. They were also asked to provide feedback on the Thermometers that define different levels of creativity and curiosity for learners of different ages.

In addition to the frameworks, respondents were sent creativity and curiosity quizzes that were developed for schools and teachers to help them identify the extent to which they are providing conducive environments for creativity and curiosity. They were asked several questions about the quizzes in order to elicit feedback.

The survey tool also included a draft transcript for learners to use to identify how they think they have demonstrated creativity or curiosity, with space for teachers to validate students' claims. The survey provided space for feedback on what teachers thought of these, and how well they thought that the transcripts would work with their own learners.

For each part of the survey tool, respondents were asked to provide feedback by responding to both closed and open questions. There were over 20 questions in total, seeking input about each element, and allowing space for more detailed comments. Participants were also asked to comment on what steps they would need to follow to integrate the framework into their classroom practice, and if there is anything else that they would like to see that would help them navigate these areas.



The survey link was sent to 100 respondents of IB programmes across the world who previously expressed interest in being involved in consultations. Twelve respondents provided full feedback, with a few more partially completing the survey. Once again, we think that in some schools the survey respondents were from a group of teachers*.

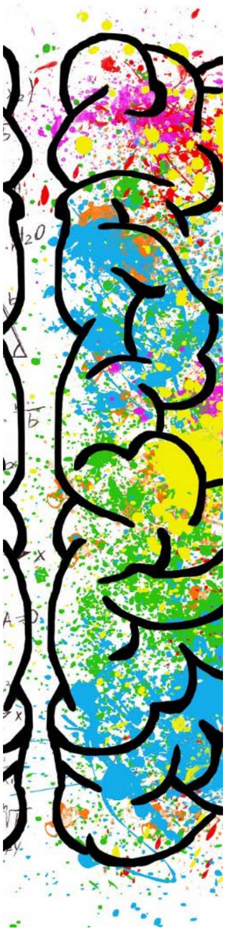
Respondents provided positive feedback on all of the materials. Since the number of respondents was so low, it is not possible to suggest that these are fully representative of all IB teachers, however, and further research in the next phase of the project is recommended.

	%
Enabling Environment	
I find the development levels appropriate	100
Factors that affect opportunities for creativity and/or curiosity are comprehensive and useful	100
Thermometers	
I find the different levels of heat easy to distinguish	92
The approaches targeted at different age groups make sense	100
The language used is appropriate for each group	92
Quizzes	
Using quizzes would be useful for me	92
These quizzes are clear	100
These quizzes are easy to understand	100
Transcripts	
The transcripts are suitable for students to complete	83
The teacher validation element is suitable	83
I found the information provided in these materials accessible	100
I found the information provided in these materials easy to digest	83

*Unfortunately, items about country and school type were accidentally omitted from this survey so we are not sure of the profiles of respondents, although anticipate that they are reflective of those who responded to the initial survey.

Feedback included that:

> *"[the quizzes are] Excellent tools for self-assessment and self-reflection. Would help in teacher evaluation processes to figure out PD needs of staff".*
>
> *"I think the thermometers are great, self-reflection is crucial and knowing the student's process is integral - either digitally, through journaling, discussions and visually".*
>
> *"The transcripts are brilliant and are strongly aligned with student agency where the student takes ownership of their own learning".*



Several respondents enquired about having a much simpler version of the thermometers for early years' learners to be able to use for self-reflection. We are undertaking additional work with early years' experts to ensure age-appropriate materials for the youngest learners.

Several suggestions were made for the steps that the teachers would need to follow to integrate the frameworks into their classroom practice, such as:

- explaining and expanding on the framework to the learners
- teachers and learners needing to engage in the process and not just use the frameworks to measure creativity and/or curiosity, and,
- training teachers on how to use the frameworks in practice so they can make them accessible to their learners.

SMALL SCALE TRIALLING

While the Covid pandemic meant that many schools were closed during the two phases for consultation for this project, others were not and expressed an interest in using the draft materials with their students. Ultimately, two schools did so – both in India - and this led to some interesting insights.

The agreed methodology for trialling was as follows:

- ACER sent the full set of materials to each school
- Schools put a core team together to review the materials
- Schools evaluated their current practices against the Enabling Environments summaries and discussed areas for development around these, keeping the Framework guidelines in mind
- Schools provided professional development opportunities to teachers to implement materials in classrooms and to map evidence of implementation and impact, and
- Schools reported to ACER.

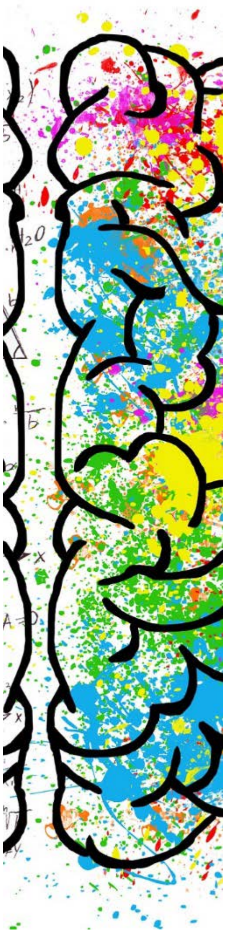
Four exemplar Transcripts are provided in Appendix 18: EXEMPLAR TRANSCRIPTS, illustrating situations in which teachers agree, and those in which they disagree, with the learner's self-assessment of their creativity or curiosity. There are also three learner reflections shown. An overview is detailed below.

School A

A Middle School teacher used the Creativity Transcript with learners in her integrated humanities class with 40 Grade 7 learners (aged 12-13).

The assignment focused on a city and learners selected different sites in the city, such as a particular landmark, a particular building or a particular transport hub. Learners researched the history of their site, created a factsheet about it and then developed a monologue.

Learners were asked to write the monologue from the perspective of the site itself, and to decide the point in time at which the site was expressing itself. They then created a video in which they performed their monologue and used a range of media to add interest. All videos were uploaded to a portal for other learners to view and provide feedback on.



Learners were also asked to use the Creativity Transcript to evaluate their own creativity. Teachers reported that they liked the Transcript, with one stating:

> *"I love the look of it – it's something middle schoolers will get excited about … the idea of using temperature to mark level of creativity is useful"*

Teachers were concerned that – as with any self-assessment – some learners would over- or under- estimate their creativity but felt that the teacher validation part of the Transcript "*is a great thing*" and also liked that students had to identify what they still needed to work on. They also reported that learners liked the transcript and found it easy to follow. Suggestions from teachers included:

- Scaffolding is needed to help learners understand how curiosity or creativity can be observed in the classroom.
- Learners need guiding in how to estimate their level of creativity and it would help if the Transcript was used after a few tasks has been completed to enable them to compare their creativity across tasks.
- The reflection calls for more maturity and is suitable for use once learners are comfortable using the Transcripts.

School B

School B completed the Curiosity Quiz among teachers and analysed the results for their developmental plan. They also surveyed students in Grade 3 to 5 on ways in which curiosity could be nurtured in the school.

The survey items that teachers developed were:

-Are you a curious learner?

-Why do you think you demonstrate curiosity?

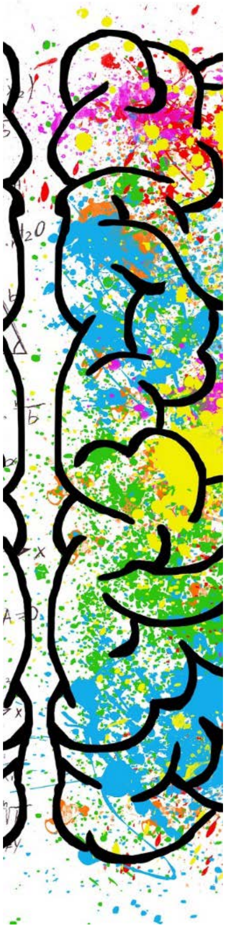
-List the key attitudes, behaviours or dispositions/traits to create a profile of a curious learner. Just write words that you feel are important for this profile.

-List any two experiences/ opportunities in class that promoted or developed curiosity.

-Suggest any one approach/strategy to nurture curiosity in school.

Learners responded to the question 'Why do you think you demonstrate curiosity?' in a number of ways, including:

> *"I ask difficult questions which my brother can't respond to, so I ask it to others until I get an answer or I just search it on the net".*
>
> *"I think I am a curious learner because everybody I know says that I ask questions a 1,000 kph and I have the urge to ask questions".*
>
> *"I think I demonstrate curiosity because I listen and ask relevant questions. I also think I demonstrate curiosity because I research on my questions, ask them, and get curious while we are learning new topics".*
>
> *"I always want to learn something new and if it's good to do I won't just leave it like 'this is none of my business' I will follow it".*



Some of the ideas that learners suggested would help nurture curiosity were:

> *"One can do a project about any topic they are curious about and share it in the class".*
> *"Make a curiosity day in which you tell 1 thing you are curious about, and it will be solved".*
> *"In every class we should make a goal to tell everybody to ask 1 question in each period or class".*
> *"Let students do most of the inquiry on their own (teachers for guidance)"*
> *"School should provide lots of books in every classroom - general books"*

Learners also recounted school experiences that had helped promote curiosity. Examples included:

> *"Today in class, I asked my teacher that what is the difference between Human Rights and Child Rights as children are also humans".*
>
> *"Sometimes ma'am gives us some personal inquires so when we research on it we got our answers but we still have some questions in our mind that still out there so then we get more curious about the topic".*

The two learner transcripts, two teacher validations and one reflection provided as exemplars in Appendix 18: EXEMPLAR TRANSCRIPTS illustrate a range of aspects that will need to be addressed in implementing these tools in schools:

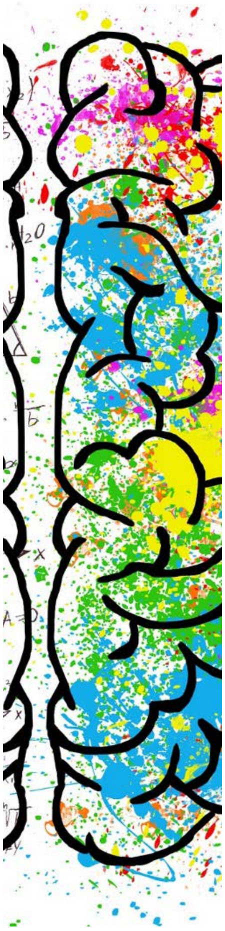
- While some learners refer to the Creativity Thermometer but also write in their own words, others simply takes the language from the Thermometer directly
- Some describe challenges and elements they need to work on with no reference to the Thermometer directly.

Given that this is the first time that learners were exposed to any of the material it is unsurprising that these aspects emerged, but it indicates the need for teachers to familiarise learners with not only the language in the thermometers but also its meaning, and to support learners in how to reflect on their work.

LIMITATIONS

As with any research activity there were limitations to this one. It is important to note that the focus of this study was on developing definitions and materials to enable the evidencing of learners' creativity and curiosity. Trialling of the materials was not included in the initial scope of this project, and it is intended that full, intentional trialling will occur in a future phase.

While feedback received from consultations indicates that we have developed materials that meet the intended goals, we have not yet been able to validate these empirically. We anticipate that a degree of revision of the materials will be required after trialling is completed.



Consultation with schools

During the development of the methodology for this project we included a two-phase consultation plan with schools. This involved identifying two schools in each of seven regions and carrying out initial consultations followed by having schools undertake some small-scale trialling of the materials with their learners. The goal was to help inform revisions to the instruments, and team members intended to be present at the trials of instruments in schools in Australia and the United Kingdom.

Due to the negative impact on schools caused by the Covid-19 pandemic, our desired approach to consultation was not possible, and engaging schools at all proved extremely challenging. Many schools were closed for much of the duration of the study, and teachers were struggling to juggle remote learning, social disruption and the high death toll in many countries. This context forced us to reconsider our approach to consultation.

At the outset, we created outreach material for dissemination to schools. The International Baccalaureate Organisation utilised a variety of social media and communication platforms to ask for school involvement. This stimulated some responses from schools but some types of schools – particularly public schools in the United States – proved extremely hard to engage. Even schools that expressed interest in consultation initially found it hard to engage, or did not respond to follow-up communications.

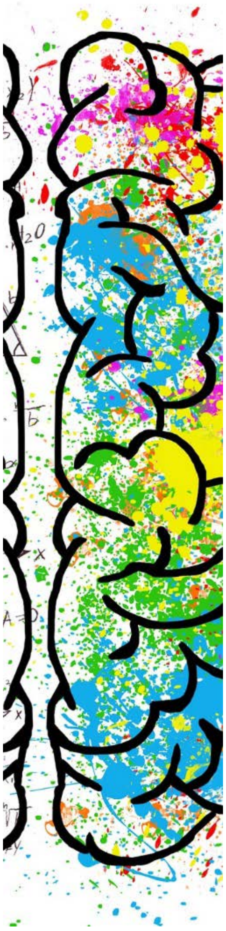
In the end we were able to carry out six virtual discussions. As a workaround we developed a virtual survey which included the consultation questions and received responses from 37 teachers in 12 countries.

The length of time taken to arrange virtual discussions and for survey responses to be received, meant that the second-round of trials was limited. As discussed in the consultation section of this report, some schools did utilise the materials in their classes, but this was more limited than had been anticipated. In-school research activities were also impossible due to restrictions on visitors being imposed. Nevertheless, we persisted with virtual surveys and gained insights from teachers at different phases of the study which have informed revisions.

Overall, this means that the practice implementations of instruments we had hoped for did not properly eventuate. While the intention had simply been to inform the design of the materials – not to collect data or validate them – we nevertheless regret that this was not possible.

Early years learners

The intention of the project was to develop materials suitable for use with learners around the world, and with learners aged 3 to 19. Due to consultations with schools in many countries, we are quite confident that the materials are suitable for use in a range of cultural contexts. We are also quite confident that the materials are suitable for learners aged 6 to 19.

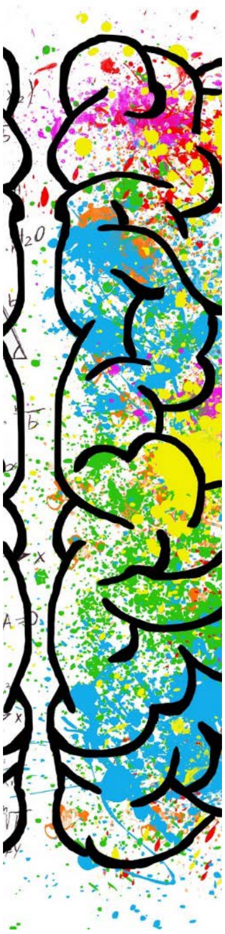


We are less confident of their relevance for learners aged 3 to 5, however. We have consulted with early-years experts and made adaptations accordingly but nevertheless feel that the materials will need to be trialled further with teachers of the very youngest learners in order to identify the extent to which they are suitable as they are, or whether they may need to be further revised to suit that age group.

RECOMMENDATIONS

Potential next steps from this project would build upon the research activities and learnings generated. These next steps could focus on developing environments and pedagogies for creativity and curiosity even further or could develop similar frameworks and support materials for other transversal skills.

Each one of the resources produced for this project has been trialled in some schools (notwithstanding the limitations noted earlier), with the resulting feedback from teachers being a critical factor in their development.

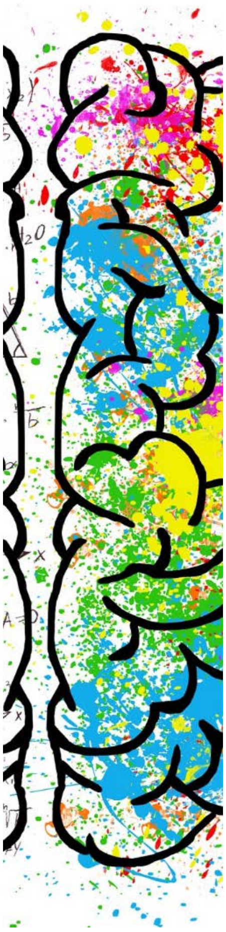


At the time of writing this report, however, the Frameworks, Thermometers, Transcripts, and other materials have not yet been implemented long-term or been subjected to validation studies in schools. This is a key opportunity for future research and development:

- Longer-term implementation of the Frameworks, Thermometers, Enabling Environments guidance, Transcripts and other supporting materials (for example, the Reflective Quizzes) will provide rich data for both teachers and the IB.
  - This data may show how the creativity and curiosity resources can be used across a variety of subject areas and units of work, and how the incorporation of creativity and curiosity ebbs and flows along the natural course and development of curriculum.
  - The explicit incorporation of creativity and curiosity will vary across schools and contexts, and this will also provide a rich source of examples of practice.
- Validation studies, as per their name, aim to validate whether an initiative achieves its intended purpose. In the case of this project, each of the resources could be assessed, individually or in combination, for fitness for purpose.
  - This type of study would involve the creation of assessment criteria that are aligned with the purpose of the resources – for example, the purpose of the Thermometers, or the purpose of the Transcripts – and that could be used by teachers before, during and after implementation of the resources.
  - The validity of the resources according to the assessment criteria would also be supported by a description of the school context, whether there are any specific contextual elements that enable or hinder the resources, and an opportunity for teacher reflection on their own particular use of the resources.

This project has developed a comprehensive suite of resources to help schools encourage creativity and curiosity in their learning contexts. These resources include:

- a Literature Review
- discrete Frameworks for creativity and curiosity
- Thermometers to help indicate levels of creativity and curiosity
- guidance about creating Enabling Environments
- Reflective Quizzes to assist teachers in their own understanding and implementation practices, and
- Transcripts for teachers and learners to reflect upon and record their own ongoing expression of creativity and curiosity.

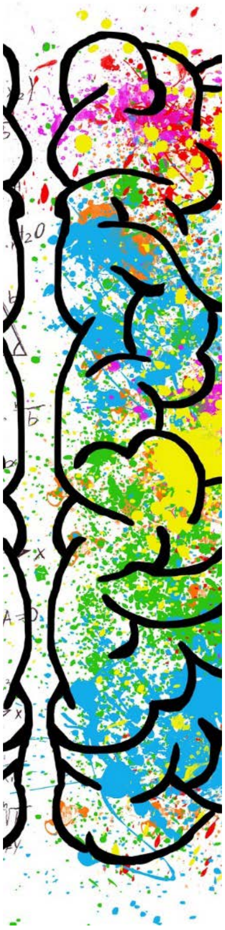


From here, similar projects could be developed for other transversal competencies such as:

- Communication
- Collaboration
- Critical thinking
- Self-regulation
- Social competence
- Intercultural competence

These projects could draw upon best practice from the Creativity and Curiosity project, combined with ongoing feedback from teachers and schools, to generate further best practice. They could also draw upon existing research that ACER has undertaken related to the development of frameworks in these areas.

APPENDICES



APPENDIX 1: CREATIVITY LITERATURE REVIEW

CREATIVITY LITERATURE REVIEW – FRAMEWORK FOUNDATIONS

Australian Council for Educational Research, 2020

> *To be creative you have to do something. Creativity is very practical. I think of it as applied imagination, putting your imagination to work. (Ken Robinson)1*

Symposium

The *Defining and Evidencing Curiosity and Creativity* virtual symposium was held between 29 September and 1 October 2020. It was funded by the Jacobs Foundation and facilitated by dpict; attendees included staff from the Australian Council for Educational Research, the International Baccalaureate, and the University of Oxford Department of Education, as well as notable academics and researchers in the fields of curiosity and creativity from around the world.

The aim of the symposium was to facilitate collaborative inquiry and discussion around questions such as:

- How do we define creativity and curiosity?
- What does creativity and curiosity look like across age ranges?
- What evidence needs to be demonstrated?
- What teaching approaches show most promise?
- What cultural differences should we consider?
- What would a mastery transcript need to include?

On the first day, a group of attendees specialised in creativity defined creativity as,

> *"Creativity is a material, mental, and/or social process that leads to the production of novel and potentially meaningful ideas and solutions. Creativity may incorporate multiple perspectives on the world to make progress toward a goal, generate novel (or culturally novel) concepts or ideas, as an emergent consequence of interaction with the perspectives of others. The creative process involves exploiting previously unperceived affordances of ideas and materials through open-minded, flexible thinking."*

Teams also considered how creativity can be evidenced in schools. They suggested that creativity could be evidenced through the strands of *openness*, *generating* and *exploring;* these strands could include indicators that would assist in making learners' creative thinking and creativity visible and therefore able to be captured in some way. One group suggested an "eVALUEation" framework that promotes celebration as well as indicating progress.

[1] https://playgroundology.wordpress.com/2012/05/06/sir-ken-of-tedalot-on-play-and-learning/

The following sections elaborate on these two symposium outcomes. Section 2 elaborates on the definition of creativity as found in the research literature, as well as contextual information that impacts creativity such as the immediate environment, more-abstract influences and the pedagogical context. Section 3 elaborates on the sub-constructs of openness, generating and exploring creativity. Section 4 begins to interrogate ways forward in terms of capturing, evidencing, and measuring creativity.

Definitions of Creativity

People who are professionally engaged in creative activity hold implicit theories of creativity similar to those of laypeople (Glück et al., 2002), but their descriptions of creativity are usually more complex and elaborate. Both Sternberg (1985) and Glück et al. (2002) have demonstrated this complexity of expert definitions. Whereas laypeople usually define creativity using a person-centred approach (Pavlović et al., 2013), experts highlight the role of Rhodes' "4Ps" – person, process, product, and press[2] (Rhodes, 1961), as well as the role of preparation and effort (Amabile, 2001; Karwowski, 2014: 63).

Runco & Jaeger (2012) review the different definition of creativity and conclude that this construct is substantiated by two elements: originality and effectiveness. These, in turn, are liable to be differently defined, thus they have different empirical indicators.

> *"Drawing on the articles that did explicitly define creativity, as well as those that provided enough contextual information from which a definition could be inferred, we were able to identify several reoccurring, constituent elements that could serve as a basis or generating a synthesized definition of creativity. Our proposed definition is: Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context" (Plucker et al., 2004: 90).*

In a paper that subsequently became one of the most popular references in the creativity literature, Mel Rhodes wrote:

> *"The word creativity is a noun naming the phenomenon in which a person communicates a new concept (which is the product). Mental activity (or mental process) is implicit in the definition and of course no one could conceive of a person living or operating in a vacuum, so the term press is also implicit. The definition begs the questions as to how new the concept must be and to whom it must be new" (Rhodes, 1961: 305).*

[2] For more on the "4Ps" see Section 4.1

Current definitions of creativity – of which there are more than 60[3], with no single authoritative and agreed upon definition (Furnham & Bachtiar, 2008) – also highlight the value of the product. Thus, the creative product must be both novel and appropriate (Gruszka & Tang, 2016). In other respects, our thinking about creativity remains largely unchanged from Rhodes' (1961) early definition. Namely, that creativity is demonstrated through a new product, concept or idea, which has emerged via a person's mental processes, mediated by their environment.

2.1 "Big C" vs "small c" creativity

"Big-C" creativity, historical creativity, or eminent creativity is the rare kind of 'breakthrough' thinking that most people are familiar with (Barbot et al., 2011: 58). On the other hand, "small c", "little-c" or "mini-c" creativity, or everyday creativity describes the small ideas that enhance and enrich our lives, and is a lot more common. Many people may not even consider these accomplishments as a form of creative thinking.

The relationship between education and creativity has come to the fore in the policy-making agenda, especially in western countries (Shaheen, 2010). The purpose of promoting creativity, at a general level, can be seen as a means of meeting the challenges posed by a changing world and its unknowns. 'Big C' creativity is fundamental for economies to foster development and face competition successfully.

Studies have shown non-experts are able to distinguish between Big-C and small-c creativity, for example, showing that non-experts can generally describe themselves as "little-c creative" but not "Big-C creative" (M. Karwowski, 2009). In addition, non-experts may not only discern different levels of creativity when describing themselves but also hold distinct ideas around different levels of creativity in general. That is, perceiving oneself as a successful person and having self-esteem was strongly associated with little-c creativity; Big-C creativity correlated with fixed traits such as being gifted and talented (Maciej Karwowski, 2014: 63).

There are three types of creativity that emanate from the creative process – creative personal expression, creative boundary pushing, and creative task achievement (Lassig, 2012). Building on Big-C and little-c creativity, by incorporating creativity applicable to professionals (Pro-c) and creativity judged solely by its creator (mini-c), a new form of creativity has been identified; educational creativity or *ed-c*, which acknowledges the constraints of educational contexts. This

[3] Batey & Furnham (2006) offer a short list of definitions grouped into the following categories: new and useful, product oriented, part of a process, componential conceptions of creativity.

new form of creativity particularly acknowledges the limitations of assessment tasks, criteria, teacher input that may impact a creative outcome.

2.2 Influences on creativity

The variables which affect creativity are important to understand to enable learners to be creative in schools. Research shows creativity manifests itself not only in rare, high impact events but recurs in knowledge-building and everyday activities (Hennessey & Amabile, 2010; M. Karwowski, 2009; Maciej Karwowski, 2014; Kaufman & Beghetto, 2009).

At the micro- and macro-levels, many different things affect creativity (Hennessey & Amabile, 2010). Positive emotions, for example, can increase creativity. Training positively affects creativity too, especially if it makes use of realistic scenarios for the exercises aimed at developing relevant skills and mindsets.

A systems approach to identifying phenomena can be used to show different influences on creativity. A theoretical framework made up of different levels, for example, ranging from the *individual* to *society and culture*, can identify different phenomena as influencing factors on creativity (Hennessey & Amabile, 2010: 571).

Individuals are more creative if they have intrinsic motivation (defined as "the drive to engage in a task because it is interesting, enjoyable, or positively challenging"), which is not just a context-dependent factor but can also be a deep-seated personality trait (Amabile, 1983; An et al., 2016; Hennessey & Amabile, 2010: 574). Social context can influence motivation, which in its turn affects creativity (Hennessey & Amabile, 2010). Although intrinsic motivation is deemed to be a leading cause of creativity, and extrinsic motivation considered a negative effect, these influences are not necessarily exclusive. Extrinsic motivation can enhance creativity as an additional boost to those who are intrinsically motivated (T. M. Amabile, 1983; Hennessey & Amabile, 2010). In addition, research provides evidence of a positive link between some psychopathologies and creativity (for example, schizotypy).

One relatively well-researched field of creativity study is motivation. Due to its strong impact, intrinsic motivation has been identified as one major component that is conducive to creativity (Woodman & Schoenfeldt, 1990). Highly creative people tend to be totally absorbed in and devoted to their work, and that people who were doing what they loved were more creative in their pursuits. Furthermore, highly creative people possess an intense commitment to their work, and are energized by challenging tasks (Gruszka & Tang, 2016).

This does not imply that extrinsic motivation undermines creativity. The motivators such as expected performance evaluation, competing for prizes or contracting for a reward can also lead to high levels of creativity (T. Amabile, 1996). She found that synergistic extrinsic motivators, which provide information or enable the person to better complete the task and which can act in concert with intrinsic motives, can be beneficial for creativity.

In general, evidence suggests creativity is better pursued by individual learners rather than in groups. However, some research suggests that mixing groups of different types of thinkers, such as those who excel at divergent thinking and those who excel at convergent thinking, can work together for creative *problem-solving* purposes (Brophy, 1998). It appears to be also true, however, that in workplaces groups outdo individuals in terms of creative *performance*, moderated by intervening variables such as team diversity. Brainstorming is shown to be more creative when it allows group members to process and reflect on brainstorm session outcomes on their own (Hennessey & Amabile, 2010).

Neurological and biological processes substantiating or leading to creativity are yet to be ascertained. The cognitive processes influencing creative behaviour are not yet clearly established. These factors may be interrelated and should be studied further through a multidisciplinary approach to understand. Environmental influences such as time pressure can adversely affect creativity (Hennessey & Amabile, 2010). There seem to be no significant differences between genders when it comes to creativity.

2.3 Domain specific vs domain general

There are two theoretical perspectives regarding the nature of creativity – one seeing it as domain-general, namely, a unique set of capacities and skills that go across disciplinary boundaries; the other one defining it as domain-specific (J. Plucker & Zabelina, 2009) where creativity skills are specific to a particular discipline. Both are supported by research, but they are equally contested on theoretical and methodological grounds. However, two theories appear to provide a valid synthesis of the two perspectives. One is the Amusement Park Theory (Kaufman & Baer, 2005).

Theme parks serve as metaphors for general areas in which an identifiable type of creativity manifests itself. Each area can then be broken down into related domains and subdomains which represent vertical divisions (from general to specific) and where creativity is displayed through more and more detailed and circumscribed skills.

Others contest that creativity can be both domain general *and* domain specific, and is a resource individuals can develop while striving to solve problems (J. A. Plucker & Beghetto, 2004). More circumscribed contexts, matched with personal expertise developed through experience and interest, are likely to see a higher level of personal commitment to be creative in order to solve problems. However, working in a specific context can lead to an incapability to transfer any highly domain-specific skills developed. The problem education faces is the need to strike a balance between domain-specific and domain-general skills, to allow for skills developed to be apt in different situations.

2.4 Pedagogical context

The relationship between learning contexts and creativity is important to understand, since the intent of this review is to inform IB classroom practice. While creativity is generally acknowledged as a capacity worth developing, some researchers see it as different from learning, and sometimes competing with learning when it comes to resources available to schools (Beghetto & Karwowski, 2018). An alternative framework called the "creative learning perspective" reconciles them (Beghetto & Karwowski, 2018: 148), indicating that learning and creativity are thought to mutually affect each other in a positive way, both at the individual and social level.

A learner can develop a new understanding of learning and creativity through exposure to a new stimulus, given pre-existing knowledge and education experience as intervening variables. The individual's creative output, once shared, in its turn can positively influence other learners' knowledge development (Beghetto & Karwowski, 2018).

Individuals are more creative when they both perceive themselves as being creative *and* believe that creative performances are acknowledged by their organizations (Hennessey & Amabile, 2010). Within classrooms, this could mean learners are more creative after receiving some recognition of their creativity thus far, which could perhaps inspire more creative thinking and performance. Flexibility in educational approaches and the need to make learners feel that their creative contributions are valued should help a creative learning environment flourish (Beghetto & Karwowski, 2018; Hennessey & Amabile, 2010).

Further ideas related to the pedagogical context and its relationship with creativity are elaborated in section 4.2.

Creativity Sub Constructs

3.1 Openness

Some studies have suggested that creativity could be perceived as a malleable construct and that perceiving creativity as a malleable characteristic translates into higher levels of creative self-concept (Maciej Karwowski, 2014). There seems to be, however, an agreement that openness to experience is one of the "engines" of creativity (Maciej Karwowski & Lebuda, 2016).

3.1.1. The Big Five theory

The field of psychology suggests that the basic dimensions of personality are described by the *Five-Factor Model* (FFM) or the *Big Five.* The five factors are the following: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness.

For the past couple of decades, many studies have investigated the link between these personality traits and creativity. While the aims and methodologies of these studies vary, the findings tend to have many similarities in showing that Big Five personality traits, such as intrinsic motivation, broad interests, independence of judgement, and creative self-concept, are result of the positive correlation between openness and creativity (e.g., Feist, 1998; Karwowski & Lebuda, 2016; Werner et al., 2014).

Other studies support the view that certain personality traits such as extraversion and openness to experience are related to creativity (Aguilar-Alonso, 1996; Furnham & Bachtiar, 2008; Wuthrich & Bates, 2001). Extraversion, for example, is found to improve divergent thinking by increasing stimulation-seeking and risk-taking (Batey & Furnham, 2006). An openness to experience can increase divergent thinking by improving imagination and openness to novel ideas (Batey et al., 2009). In contrast, some personality traits have been found to differ as a function of domain in their contribution to creativity; creative scientists, for example, tend to be more extroverted and open to experience than less creative scientists. However, creative artists tend to be more neurotic and less extroverted than less creative artists (An et al., 2016).

In most cases, any given trait is conducive or inhibitive to creativity depending on the domain-specific context. For example, neuroticism is usually paced higher in artistic populations whilst conscientiousness seems to contribute to scientific excellence but not so much to artistic performance (Feist, 1998). Many other contexts may actively encourage certain traits depending on the need of the particular role.

3.1.2. Openness trait

There is consistent evidence that creativity and openness are positively correlated (Feist, 1998; Kaufman, 2012), as are creativity and extraversion (Furnham & Bachtiar, 2008). Studies show that of the five personality measures, openness was the only variable that positively correlated with almost all measures of creativity, and with the highest correlation coefficients (Feist, 1998; Werner et al., 2014).

The reason why openness has such a strong relationship with creativity may be due to its links with cognitive traits (e.g., fantasy, imagination), affective traits (e.g., curiosity, intrinsic motivation), and behavioural manifestations (e.g., adventurous, actively trying new things), all of which are related to creativity (Werner et al., 2014). The same study found that the relationship is less strong between creativity and mathematics – possibly due to mathematics not being a domain that lends itself to creativity in a straightforward way.

Another study reported that in their meta-analysis of the relationships between creative self-beliefs (self-efficacy, creative personal identity, and self-rated creativity) and the Big Five, as well as the Huge Two personality traits (plasticity and stability) - openness was consistently the strongest predictor of creative self-beliefs. Furthermore, these creative self-beliefs can be seen as an individuals' convictions about their creative abilities that can predict creative activity and achievement (Maciej Karwowski & Lebuda, 2016); in a way, a case of self-fulfilling prophecy.

Furthermore, openness has been shown to predict self-reported ideational behaviour, domain-general self-rated creativity, and creative self-efficacy (Batey et al., 2009). The relationship between openness and creative self-beliefs is arguably so strong that it raises a question of whether measures of domain-general self-rated creativity or creative self-efficacy measure anything more than openness (Maciej Karwowski & Lebuda, 2016).

As Martindale (1989: 224) observed:

> *"one problem with the construct of openness to experience is that the adjectives that are used to measure it in self- and peer-ratings are not, on the face of it, directly related to openness per se. For example, of the adjectives loading on what McCrae and Costa (1997) labelled the Openness to Experience factor, four refer directly to creativity (original, imaginative, creative, and artistic), six refer to traits often used by creative people to describe themselves (complex, independent, daring, analytical, liberal, and untraditional), and only three are directly or indirectly related to openness (broad interests, curious, and prefer variety). It is not clear to me why the factor is labelled openness rather than just creativity. In other words, openness to experience and creativity would seem to be synonyms that are used to describe the same set of traits. If so, openness cannot be said to explain creativity".*

3.1.3. Cross-cultural differences

It is important to note that the dimensional structures of a creativity instrument as well as its relationship with Big Five indicators might differ for samples in different regions of the world. This may be due to different culture and cultural values and their effects on creativity in different domains, such as the concept of creativity, creative expressions, as well as cognitive style and personality. In terms of creativity conception, it was found that whereas Western cultures emphasize originality and disruptive innovation, Eastern norms prioritize usefulness (Werner et al., 2014). This different emphasis may influence people's self-rating of creativity in different domains. Therefore, the relationship between creativity and personality traits should be examined within the cultural context (Rudowicz, 2003). This notion is supported on a more-individual scale by Fields (2012) who showed that religion, culture and family are external factors that particularly influence creative potential.

As with many other domains, it is necessary to consider variations between different cultures. The cross-cultural research shows perceptions of creativity emphasizes which concepts are most associated with creativity in different cultures. Therefore, in the West, conceptions tend to emphasize unconventionality, inquisitiveness, imagination, humour, and freedom, whilst in the East, the focus tends to be on moral goodness, societal contributions, and connections between old and new knowledge (Kaufman, 2012). Fields (2012) provides a framework for questioning the extent to which religion, culture and family influence an individual's creative thinking and output.

3.2 Generation

Creativity is widely considered a generative process and is often closely linked with divergent thinking (Barbot et al., 2011; Guilford, 1950; Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020; Said-Metwaly et al., 2017). In fact, divergent thinking tests have become the most common way of assessing creative processes or creativity-relevant skills (Ramalingam, Anderson, Duckworth, Scoular, Heard, et al., 2020; Said-Metwaly et al., 2017). The main reason for this is that divergent thinking is essential for creativity (Guilford, 1975; Said-Metwaly et al., 2017).

Divergent thinking is the ability to see lots of answers to a question. It enables generating numerous ideas and increases the probability of a learner generating an original or adapted idea (Barbot et al., 2011). Divergent thinking is used in open problems to generate logical answers or alternatives (Said-Metwaly et al., 2017). Furthermore, divergent thinking involves the generation of novelty, which is linked with the ability to generate lots of possible answers and interpretations to a problem (Schut et al., 2019).

On the other hand, convergent thinking could be described as the opposite of divergent thinking, whereby a learner explores multiple ideas and selects the best idea as a response to a problem (Schut et al., 2019). Convergent thinking can be thought of as a more focused search than divergent thinking, involving more use of reasoning and analytic skills. Creative thinking can involve continuous switching between divergent and convergent thought processes, although Guilford (1975) considered divergent thinking to be more relevant to successful creative thinking (Said-Metwaly et al., 2017). A popular approach in measuring creativity relies on testing cognitive processes and structures that are conducive to creative production (Barbot et al., 2011); the most widely used tests for measuring creative processes are divergent thinking tests (Said-Metwaly et al., 2017).

3.3 Exploration

Exploration is where learners have the opportunity to investigate their creative ideas further. This is the phase of creativity where ideas that have emerged in the openness (creative mindset) and generation (creative thinking) phases can be explored for a variety of purposes, for example, transferability of ideas to concrete design, development and testing processes, or considering the potential consequences of ideas (Lucchiari et al., 2019; van Broekhoven et al., 2020).

During the exploration phase, learners require a number of skills and dispositions in order to be capable of exploring, interrogating and evaluating their ideas. It is useful to identify creativity exploration skills as these can subsequently be incorporated into intentional teaching and learning activities in the classroom, as well as being monitored for assessment and feedback. To explore creative ideas, learners should learners should learn how to do the following (Lucchiari et al., 2019; Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020; van Broekhoven et al., 2020; Yunlu et al., 2017):

- View new perspectives of a creative idea, or view their idea in different contexts
- Develop new interpretations of a creative idea
- Use design thinking to design, develop, and test their creative ideas
- Modify, elaborate, experiment with, manipulate, and transform their creative ideas
- Consider the consequences and limits of their creative ideas
- Evaluate their creative ideas – whether they are fit for purpose, novel and useful.

Equally, dispositions for creativity exploration need to be identified, however, these tend to be more akin to aspirational attributes and may need to be considered 'ideal outcomes' that take significant time to develop. While identifying and describing dispositions will be useful to guide learners in their creativity development, it may or may not be appropriate to formally assess dispositions. The following dispositions will be helpful in encouraging and enabling creativity processes (Cremin & Chappell, 2019; El Turkey et al., 2018; Lucas, 2016; Yunlu et al., 2017):

- Curiosity and inquisitiveness, that can be used as an exploration prompt or tool
- Persistence, to explore a creative idea fully
- Openness to new connections, both within the creative idea being explored and in collaborating with others to engage and explore from different perspectives
- Disciplined, to ensure developed ideas draw upon existing knowledge, concepts, skills, and techniques
- Openness to taking risks, including being mindful of potential consequences

Measurement

4.1 Measuring creativity and making it tangible

Whilst the previous section has provided some more or less accepted definitions of creativity and its link to openness, there is much less clarity on how creativity should be operationalized and measured.

The measurement of creativity is difficult, and some evidence suggests predictors or variables associated with creativity may be specific to the measure used (Reiter-Palmon et al., 2019), questioning the external validity of creativity studies.

Since the 60s, the word creativity has been used to refer to the phenomenon in which a person communicates a new concept (which is the product), with the value aspect of the product added later on. Thus, creativity amounts to the product; creativity is the creative product. Therefore, a person is considered creative if they are associated with the creative product, with creative products usually being tangible enough for objective measurement (Gruszka & Tang, 2016).

The measures of creativity may also depend on the construct being examined. For example, An et al. (2016) found that although both divergent thinking and creative expert performance have a common construct – general intelligence – divergent thinking is more influenced by personality whereas creative expert performance is more influenced by motivation as it affects the development of domain knowledge. Therefore, it is suggested that two separate models would be needed to explain creativity when defined as divergent thinking and creative expert performance.

It is difficult to measure creativity efficiently across, or to determine, the main thematic areas. An alternative approach is to investigate how individuals view and report their own creativity. Several studies have explored the structure of creativity based on reported behaviours, ratings, and self-assessments, and different focus used in different studies. Some tests have emphasised personality (Gough, 1979), idea generation (Runco et al., 2001), or identity (Jaussi et al., 2007).

Others have used self-report scales that focus on creative activities. Investigation into correlations between the five personality traits (mentioned previously) and the five creativity factors (Self/Everyday Creativity, Scholarly Creativity, Performance Creativity, Mechanical/Scientific Creativity and Artistic Creativity) has shown that openness to experience significantly correlated with all creativity domains but Mechanical/Scientific (Kaufman, 2012). It is important to emphasise however, that perceptions of creativity are not the same as actual ability.

Other research shows that people do not necessarily have sharp self-insight into their own creativity and that they may have a high opinion of themselves because they are creative, or because they have unusually high levels of self-esteem or narcissism (Kaufman, 2012).

Regarding 'creativity', evidence suggests that no single assessment can test total creative ability or performance in all domains. Therefore, using multiple measures and triangulating the results should provide a more accurate profile of a learner. Assessment becomes assessment at the point of comparison (how well someone does something compared to others, compared to themselves at different time points, or compared to benchmarks or criteria descriptors). Measuring creativity may be feasible providing the criteria is clear, there is openness about what criteria are relevant, and considering the context within which the work is produced.

4.1.1 Measurement of divergent thinking

Divergent thinking tests have been most widely used for measuring creativity (Said-Metwaly et al., 2017) although their ability to reliably do so is uncertain. Divergent thinking tests measure ideational fluency which is the ability to rapidly produce ideas relating to a specific condition or object. Therefore, the tests usually include open, domain-general problems which require learners to generate multiple ideas as a response or solution.

Scoring divergent thinking tests usually involves four areas: fluency (the number of responses), originality (statistical rarity of responses compared to other learners), flexibility (the number of different categories the learner's responses span), and elaboration (the amount of detail the learner provided) (Said-Metwaly et al., 2017).

The Torrance Tests of Creative Thinking (TTCT) (Torrance, 1966) and the Wallach-Kogan Creativity Tests (WKCT) (Wallach & Kogan, 1966) are two examples of divergent thinking tests which are still widely used today (Acar & Runco, 2012; Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020; Said-Metwaly et al., 2017). TTCT are a mix of verbal and non-verbal tasks using verbal and non-verbal stimuli (Kim, 2006; Torrance, 1966).

The tests yield a composite score (a Creativity Index) although it was never intended to be used as measure of a learner's creative ability, but rather to highlight strengths to understand and nurture a learner's creativity (Kim, 2006; Torrance, 1966). This highlights the need for different types of measurements, to begin to understand a learner's creative ability, and that some measures (such as TTCT) may have additional strengths, such as being used for instructional planning.

The WKCT are a battery of three verbal and two figural tests inspired by the Guilford et al. (1968) battery. WKCT are comprised of the following:

- Alternate Uses (verbal) test includes "List the different ways you could use a chair", newspaper, or shoe.
- Instances (verbal) test includes "name all the things you can think of that move on wheels as possible", "things that make noise", and "square things".
- Similarities (verbal) test whereby the learner is verbally asked to list as many commonalities as possible between two objects. One example is for the learner to list the ways in which a potato and a carrot are alike.
- Pattern-meanings (figural) test whereby learners are shown cards with drawings and asked "tell me all the things you think this could be".
- Line Meanings (figural) test with eight items which is a more abstract version of the pattern-meanings test (Acar & Runco, 2012).

Divergent thinking tests' abilities to measure 'creativity' have been the subject of debate amongst researchers for a long time. Their reliability has been established but validity for measuring creativity has not (Said-Metwaly et al., 2017). However, for measuring 'generation', divergent thinking tests are specifically relevant as they measure ideation, which is the formation of ideas or concepts. Therefore, we can be more confident in divergent thinking tests' validity for measuring 'generation' than for 'creativity' as a whole.

Divergent thinking tests consider the number of appropriate responses as well as the quality of those responses. The importance of measuring both to gauge a form of creativity was reflected in ACER's creative thinking framework (Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020). Within the strand of generation, the two aspects (to focus for teaching and assessment) were the number of ideas, and the range of ideas.

Regarding the number of ideas (or responses) a learner may present while being tested for generation, testing across domains is recommended as there is uncertainty whether the generation of ideas is domain-specific or domain-general. Generating an appropriate or useful idea may also be factored into a measurement of 'generation'. There is a long-standing consensus that the end result should be appropriate, useful, and fit for purposes (Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020).

The more ideas (or responses) a learner produces, the more likely a truly creative idea will be among them, providing distinct ideas are produced (Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020). If the ideas a learner generates are similar to each other, they probably required the same kind of creative thinking. Therefore, *more-creative* thinking may be exhibited by generating ideas of different types and across different categories. This highlights the need to account for the *range* of ideas learners present, and the importance of the *range* being accounted for dates to early seminal works (Guilford et al., 1968; Torrance, 1966; Wallach & Kogan, 1966).

4.1.2 Other measurement considerations

Creative expert performance is method of measuring generation within creativity. It is measured using expert judgments of creative performances within the applicable domains and is therefore a domain-specific measure (An et al., 2016). The learner's performance is assessed using experts' own sense of what is regarded as being creative. The learner's skill within that domain, and their motivation for task performance will also determine their assessment score. Furthermore, the learner's motivation to engage in creative behaviour can be assessed through two measures of creative activity and ideation (An et al., 2016).

Creative activity can be measured using a Creative Activities Check List (CACL) (An et al., 2016). The original version of the CACL was a 50-item scale with five domains: writing, music, crafts, science, and public performance (Okuda et al., 1991). This Check List is arguably closer to a real-world measure of creativity than divergent thinking tests, although possibly less relevant as a measure of generation. Ideational skills, originality, and evaluative skills (defined as "the ability to recognise original and worthwhile ideas" (Okuda et al., 1991: 52) also affect learners' scoring.

Creative ideation can be assessed using the Runco Ideational Behavior Scale (RIBS) (Runco et al., 2001). This scale was developed to make up for some possible shortcomings of divergent thinking tests regarding ideation. Most of the RIBS items describe actual behaviours (i.e. overt actions and activities) that reflect an individual's skill and use of ideas (Runco et al., 2001).

Exploration and elaboration of one's creative ideas is another point where assessment can be incorporated into a creativity framework. Creative reasoning, where learners utilise iterative stages of convergent and divergent thinking to test and refine an idea, has been proposed as a skill that can be developed and assessed (Welter et al., 2017). They note that creativity, however, unlike intelligence, tends to have an irregular pattern of development – improving and plateauing at irregular intervals – which must be taken into consideration when developing indicators of improvement.

Other researchers indicate that the measurement of exploration, refinement and development of creative ideas can be conducted through end-point measures of the extent to which an idea is original <u>and</u> appropriate. That is, creative ideation can also be assessed after the idea has been fully developed and elaborated. This may include indicators of effectiveness, feasibility, originality, novelty, elegance, and elaboration (Lucchiari et al., 2019; Ramalingam, Anderson, Duckworth, Scoular, & Heard, 2020; van Broekhoven et al., 2020; Welter et al., 2017).

Some researchers have constructed detailed assessment systems that aim to assess creativity in the context of both the task and the immediate environment. In addition to the quantitative ratings of patent numbers, professional recognition and social recognition, Batey (2012) uses Rhodes' (1961/1987) "4Ps" – Person, Process, Product, and Press – alongside others' indicators to form a three-dimensional taxonomy for assessment of creativity. His taxonomy includes the 4Ps aligned with the measurement approaches of 'objective', 'self-rating', 'other-ratings', and with the levels of 'individual', 'team', 'organisation', and 'culture'.

Cropley & Cropley (2016) also begin with the 4Ps, emphasising their importance in the teaching, learning and assessment cycle. They then examine how the Product might be assessed, proposing 21 items for assessment of product creativity, organised within five categories for assessment:

- Relevance and effectiveness (output is fit for purpose)

- Problematisation (output helps define the problem/task at hand)
- Propulsion (output sheds new light on the problem/task)
- Elegance (output is well executed)
- Genesis (output changes how the problem/task is understood).

Klapwijk (2018) built upon the 4Ps and the ideas of Cropley & Cropley (2016) but emphasised the need for formative assessment for learners to be able to engage with and improve their creativity skills. She particularly notes that affective considerations need to be addressed, particularly the need for learners to feel safe and relaxed to enable creative thinking.

Domain-specific formative assessment of creativity is further exemplified by El Turkey et al. (2018), who uses two progress rubrics designed to encourage increasing proficiency in creativity. These rubrics are specific to the context of learners' creative exploration of mathematical proofs and emphasise the necessity for the formative nature of creative progress.

Fields (2012) integrates a cognitive psychology approach with external influences to produce a conceptual framework for the assessment of creativity. She presents the cognitive psychology categories of *Cognition and Communication*, *Uniqueness*, *Challenging the status quo*, *Problem-solving*, and *Dimensional-thinking* to assist in the identification of creativity-specific skills and traits. *Religion*, *Culture*, *Family* and *Country of origin* are used to assist in identifying external influences on an individual's creativity.

When transferred to the tertiary context, a number of cognitive psychology categories are added – *Experiment and combine*, *Associate and communicate*, *Separate*, *Synthesis*, *Awareness*, *Detachment*, and *Similarity* – along with *External motivation* and *Sensitivity* as additional external influences (Fields, 2012). Dispositions towards creativity may not be as appropriate for measurement, however, Lucas (2016), provides indicators and descriptors that are useful in assisting learners to understand and develop their own creative and academic dispositions. Indicators include learners developing the habits of being imaginative, inquisitive, persistent, collaborative, and disciplined (Lucas, 2016).

The Victorian Curriculum and Assessment Authority (VCAA) also provides indicators and descriptors that guide teachers and learners towards developing creative thinking skills. These are integrated with critical thinking skill development and are organised under the categories of *Questions and Possibilities*, *Reasoning*, and *Meta-Cognition*. The VCAA categories are loosely aligned with the creativity concepts introduced earlier of openness and generation (questions and possibilities) and exploring (reasoning, and meta-cognition).

4.2 Approaches to encouraging and evidencing creativity

In order for creativity to be evidenced or measured, it must first be made 'visible' so that learning evidence is available (e.g. Hattie, 2012; Ritchhart et al., 2011). This has implications for teaching and learning practice in the classroom, namely, that teachers will need to provide opportunities for learners to demonstrate their creativity, whether this is in a product, or during the creative process. This demonstration of creativity could be via several methods, including a tangible product or components thereof, conversations with the teacher or peers about their creative process, or formative journaling.

The published research on evidencing generation, particularly in classrooms, is relatively scarce. However, research on measurement can provide some potential indicators of evidencing. For example, the CACL (used by Okuda et al., 1991) includes five creativity indices which lend themselves to learners and classrooms: writing, music, crafts, science, and public performance. Therefore, instructing learners to conduct tasks within these domains may encourage creative activity; learning a musical instrument, for example, or writing a story.

While conducting activities and tasks within those domains, learners may face some obstacles in their creative thinking and need help moving forward in their creative process. It is important that teachers can encourage creativity, for example, by asking enabling questions. If teachers critique and push a learner towards convergent thinking, this can stifle creativity. Within some domains, teachers "eliminating ambiguity by giving feedback that pushes towards convergent actions through clarification, can provoke learners to become defensive and try even harder to convince everyone of the quality of their design" (Schut et al., 2019: 4). Convergent feedback, where learners feel they must justify their decisions, can prevent creative thinking.

From the field of design, Eris' (2004) question-driven design model provides different levels of questions across various categories that may be useful to consider in other domains. Figure 1 encompasses divergent and convergent questions asked when designing in teams, and is an adaptation of Eris' original model.

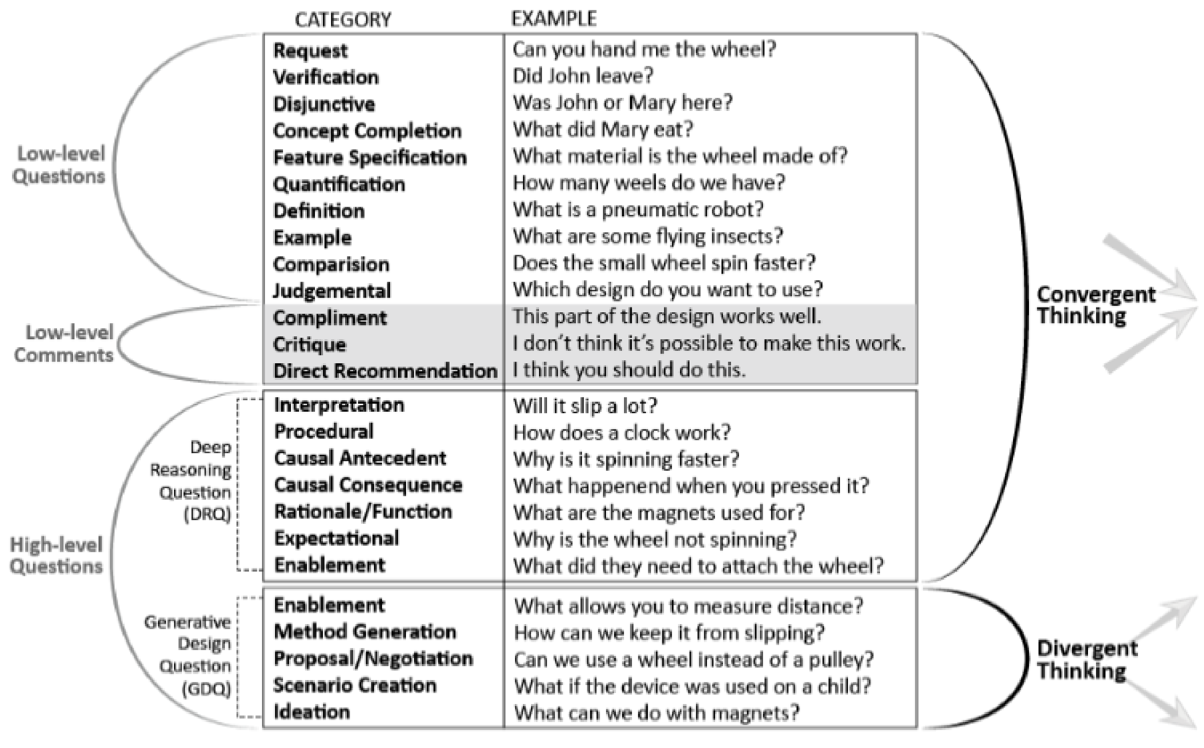


Figure 1. Adapted version of Eris' Question Driven Design Model (Schut et al., 2019: 10).

In this example, most feedback was convergent and about clarifying things, i.e. "what is X for?" "What does Y do?"; this prevents creative thinking (Schut et al., 2019).

Within classrooms, learners need to know what to do with feedback. Learners need guidance to be or remain creative, such as (partly) accepting or (partly) rejecting feedback (Schut et al., 2019). Critical thinking skills can assist this process. Young learners are likely to reject feedback, but instead, would benefit from 'temporarily accepting' the feedback, exploring its merit (exhibiting openness) and then deciding which action to take. By immediately rejecting feedback, learners may experience stagnation of divergent and convergent thinking processes within the teams, resulting in a lack of critical reflection and a loss of openness, hampering the creative process (Schut et al., 2019).

Using models such as the original or adapted model by Eris, teachers can learn how to give feedback and enable learners to continue to generate ideas through divergent and convergent thinking.

> *"Feedback conversations should be constructed carefully, as they are sensitive and filled with fragile egos, sensitive identities and insecure learning processes. What is being said and by whom, and the reactions that follow, create a complex minefield in which all participants need to learn to navigate" (Schut et al., 2019: 18).*

Therefore, it is clear both teachers and learners need to learn how to give and receive good feedback.

4.3 Encouraging creativity in the classroom

The uniqueness of the individual is an important part of understanding creativity. One study found that creative people are more open to new experiences, less conventional and less conscientious, more self-confident, self-accepting, driven, ambitious, dominant, hostile, and impulsive. Out of these, the largest effect sizes were on openness, conscientiousness, self-acceptance, hostility, and impulsivity (Feist, 1998).

Understanding creativity, however, also has a real-life impact on education. Studies show that creativity is related to social and emotional factors in schools (Robinson, 2011). Two key aspects are persistence and openness to experience, and studies show these are positively associated with improved education and future job prospects (Kautz et al., 2014).

A particular challenge of for assessing creativity in schools is that teachers often focus on the subject-specific teaching and learning. Therefore, to assess creativity, there needs to be a focus on ways of thinking and acting, that are adopted when learners are learning.

To promote creativity in the classroom means providing a safe psychological space – a space in which learners know that it is acceptable to express their ideas, even if strange and to pursue their interest by staying motivated. They need to have space to be both stimulated and able to quietly reflect (Abdulla & Cramond, 2017).

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APPENDIX 2: CURIOSITY LITERATURE REVIEW

CURIOSITY LITERATURE REVIEW – FRAMEWORK FOUNDATIONS

Australian Council for Educational Research, 2020

Introduction

A vast body of work spanning many decades, and several research domains, provides the foundation for the work that we will be undertaking around evidencing curiosity in this project. From personality to cognition, psycholinguistics to child development, psychology to educational measurement, theorists and scholars around the world have been grappling with the construct of curiosity and its potential applications. Among these, investigations into the relevance and importance of curiosity in the domain of learning is one that has received sustained interest with curiosity being referred to as a "*thirst for knowledge*" (Grossnickle, 2016, p. 26). As Shin and Kim (2019, p. 854) suggest:

> *"… when individuals feel curious, they engage in persistent information-seeking behavior. Curiosity has been recognized as a powerful motivator for not only learning but also creativity and subjective well-being".*

While the popular image of a curious child is one that asks lots of questions, there is a great deal more that lies under the surface, with curiosity regarded as a trait, a state and a psychological attribute depending on perspective. Curiosity lies at the intersection of medical, social, psychological and educational research. In the latter, educators have become increasingly interested in what are known as transversal, holistic, generic or twenty-first century skills.

Yet the slippery nature of curiosity has meant that it has run rings around those who try to pin it down, largely eluding formal measurement in educational settings. This results in continued calls for the "*next generation*" of studies into curiosity in the classroom (Alexander, 2019).

The continued nebulousness of curiosity should not be taken to suggest that a focus on curiosity in educational contexts is new. Indeed, Dewey (1933, p. 144) identified the importance of curiosity in stimulating learning almost 90 years ago:

> *Curiosity rises above the organic and the social level and becomes intellectual in the degree in which it is transformed into interest in finding out for oneself the answers to questions that are aroused by contact with persons and things.*

Despite all of the scholarly work that has been done since then, the fulcrum of curiosity as it is now understood looks remarkably similar to Dewey's formulation. Hence, curiosity remains regarded as a nascent field (Kidd & Hayden, 2015b).

In this review, we have attempted to pull together the most salient insights into curiosity from the literature. The goal has been to inform the development of a framework that will enable curiosity to be evidenced in primary and secondary classrooms around the world. In doing so, we have attempted to refer to the most recent literature, and that which is most pertinent to educational contexts. There are, however, references to other domains of scholarly investigation from which the concept of curiosity has drawn its contemporary characteristics.

Key characteristics of curiosity

Four broad themes emerged from a review of the literature on curiosity. The first theme deals with the very nature or concept of curiosity (Ainley, 1987; Kashdan et al., 2004; Litman & Silvia, 2006; Maw & Maw, 1966; Schulz, 2012). The second theme deals with the types of curiosity, based on the drives that result in specific behaviours that humans exhibit to satiate their curiosity (Kashdan et al., 2017; Levitt et al., 2009; Litman et al., 2005; Litman & Spielberger, 2003; Piotrowski et al., 2014; Rossing & Long, 1981; Schulz, 2012; Sher et al., 2019; Tessa J. P. van Schijndel et al., 2018; Wagstaff et al.)

The third theme is the debate on whether curiosity and interest are identical, similar, or different psychological constructs (Ainley, 2019; Aschieri et al., 2020; Bougie & Ichise, 2020; Fayn et al., 2019; Murayama et al., 2019; Pekrun, 2019; Schmidt & Rotgans, 2020; Shin & Kim, 2019). The fourth theme deals with implications of curiosity in a learning context such as a classroom.

This touches on three key elements: how learners respond to new knowledge, set learning goals and enjoy the process of learning while developing metacognitive strategies; the pushing of boundaries and exploration of novel experiences; and the response to uncertainties while using metacognitive strategies such as planning ahead (Baker et al., 2015; Beachboard & Dause, 2020; Fiamengo, 2013; Hulme et al., 2013; Jamie, 2020; Jirout & Klahr, 2012a, 2020; K.G et al., 2020; Kolb et al., 2014; Menning, 2019; Nadelson et al., 2019; Rossing & Long, 1981; Sakaki et al., 2018; Sheldon et al., 2015; von Stumm et al., 2011; Wagstaff et al.; Whitehouse et al., 2018).

2.1 What makes us curious?

Shin and Kim (2019) argue that a variety of contextual features or what Berlyne (1960, 1978) coined "*collative variables*" can be used to describe triggers of curiosity. These include novelty, complexity, incongruity, and uncertainty. More recent researchers are divided into whether these trigger curiosity or interest, and indeed whether curiosity and interest are separable or not (Murayama et al., 2019; Pekrun, 2019; Shin & Kim, 2019) and this is considered in some depth below.

Curiosity is regarded to have emerged as the human body's defence mechanism against the uncertainty that early humans faced in their environment in the form of novel stimuli such as unfamiliar animals, plants and natural phenomena (James, 1950; Russell, 1973; Wilson et al., 2005). Exploratory approaches and behaviour had the impact of reducing uncertainty, hence restoring cognitive calm and emotional satisfaction (Shin & Kim, 2019).

Curiosity is tied to our primitive brains and recent studies have focused on how curiosity affects the hippocampus and the noradrenergic and dopaminergic system (Kang et al., 2009; Oudeyer et al., 2016) which influence cognitive functioning, well-being, and vigour (Gruber et al., 2014; Sakaki et al., 2018). This leads Ruan et al. (2018) to conclude that curiosity and the drive it generates to explore novel experiences and continued learning may even have a role in protecting our minds in old age.

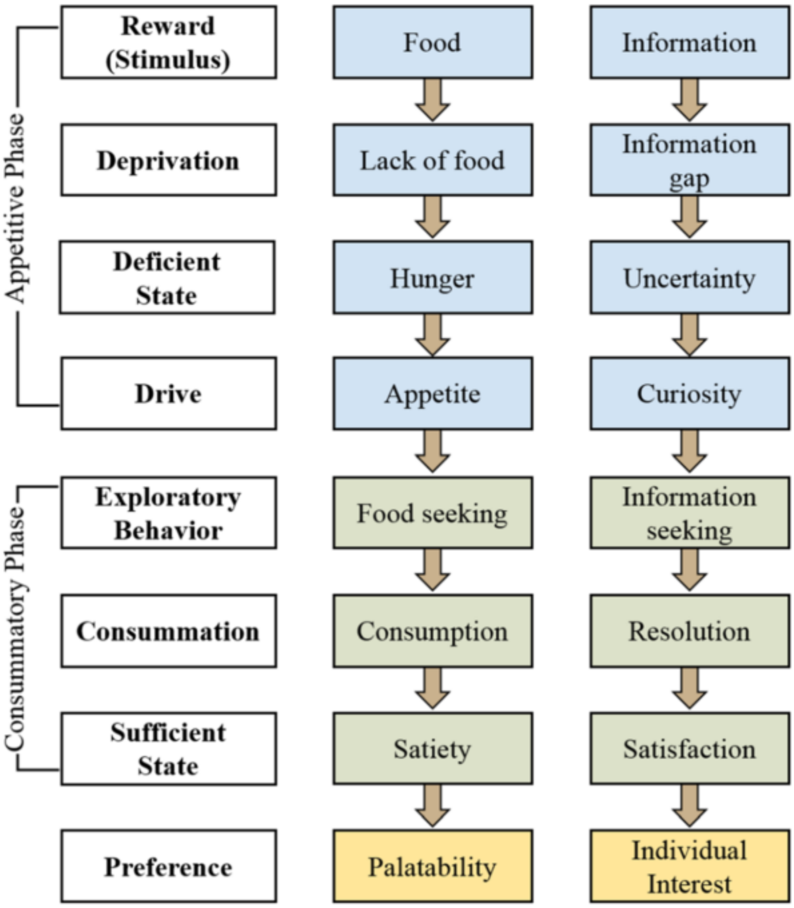
A polarity found in the literature is around what curiosity feels like – whether it is pleasant or unpleasant. Some researchers regard curiosity as a pleasant sensation of arousal that motivates people to seek or gather more knowledge about a topic they do not know much about (Spielberger & Starr, 1994). In contrast, other researchers consider curiosity as an unpleasant sensation which drives people to seek knowledge in order to eliminate discomfort (Berlyne, 1954, 1960a; Loewenstein, 1994b).

Some authors are uncomfortable with the ascription of negative emotions to the stimulation of curiosity (Alexander, 2019), with questions about the point at which early negative feelings stimulate curiosity that leads to positive feelings. There is evidence that the search for information to satisfy curiosity is associated with positive feelings, and not only when the answers are found (Peterson & Cohen, 2019). Similarly, Murayama et al. (2019, p. 886) suggest that "*there is little direct and conclusive evidence supporting the aversive nature of curiosity*".

An alternative understanding is that "a *complex web of both positive and negative feelings [are] related to curiosity"* (Bowler, 2010, p. 1339) and that either individuals need to use metacognitive skills to find a workable balance between resolve these feelings or to accept that they are two sides of the same coin, in which "*a positive feeling of interest*" and "*a negative feeling of deprivation*" coexist (Aschieri et al., 2020, p. 105).

Whether the sensation that drives knowledge seeking is negative or positive, the result of satisfying curiosity has been found to be regarded as rewarding by the brain, providing pleasure and leading to hedonic happiness. Loewenstein (1994) coined the metaphor "*cognitive appetite"* to demonstrate the powerful drive and underlying biological mechanisms related to curiosity. This signals that the human brain responds to information in similar way as it's response to food or sex (Gruber et al., 2014; Jepma et al., 2012; Kang et al., 2009). Shin and Kim (2019) explain the behaviour mechanism or drive for food and information diagrammatically, as illustrated in **Figure 1**.

Figure 1: Appetite Analogy for Curiosity (Shin & Kim, 2019, p. 856)



2.2 *The Power of Curiosity*

Curiosity, along with interest and intrinsic motivation, is regarded as being crucial for developing competence, knowledge, and expertise. Scholars list many ways in which curiosity can help lead to a fulfilling life, such as "*intelligence, physical health, happiness, and beneficial social interactions and relationships*" (Silvia & Kashdan, 2009, p. 791). Similarly, Valji et al. (2019) note several studies that demonstrate how curiosity enhances long term memory.

Empirical links have been made between curiosity and a range of aspects that facilitate learning, with positive correlations with curiosity in studies of learners ascribed to inquiry (Murayama, 2019; Murayama et al., 2019; Pekrun, 2019), knowledge acquisition (Kashdan et al., 2018), memory and effective learning experiences (Gruber et al., 2014b), engagement (Vracheva et al., 2020), academic achievement and meaning of life and life satisfaction, perhaps because curiosity enables individuals to better deal with complex and ambiguous situations (Kashdan & Steger, 2007).

Other studies have found that simply utilising the word 'curiosity' to prime learners in knowledge exploration leads to more attention being paid, and deeper learning (Sher et al., 2019). Together, these studies and more suggest that "*promotion of curiosity in classrooms should be of paramount importance*" (Jirout et al., 2018, p. 3). The extent to which curiosity is encouraged in educational settings is debatable, however (Jirout, 2020a).

Despite its benefits, acting on curiosity is not inevitable. Sweeny et al. (2010) suggest that when people perceive the cost or the effort of satisfying curiosity to be high, they are discouraged from engaging in behaviour which will minimise the knowledge-gap. Estimating what that effort or cost is likely to be required is partly influenced by competence and partly by perceived competence, hence self-efficacy is an important factor (Peterson & Cohen, 2019).

With reference to learning in a particular domain (in this case mathematics), Peterson and Cohen (2019, p. 821) suggest that learners who have skills, knowledge and self-efficacy in a domain are more likely to use curiosity to drive problem solving related to their domain than those who do not. Thus, as learners progress:

> *"What is unknown to a student at one point in development can be learned, closing one specific gap and revealing potentially more complex knowledge gaps".*

In consideration of academic achievement, von Stumm et al. (2011), further explain the role that curiosity plays by suggesting the combination of conscientiousness (as a marker of effort) and intellectual engagement with a topic (as a marker of curiosity) rival the impact of intelligence in predicting academic achievement. This can partly be explained by the key role that curiosity seems to play in the development of metacognitive strategies (Efklides, 2017; Litman, 2009; Metcalfe et al., 2017; Wade & Kidd, 2019).

2.3 Types of Curiosity

Efforts to pin down what curiosity is have led to various efforts to define different types of curiosity. Some of these constructs have endured and become firmly established in the domain. Others are more recent and represent attempts to grapple with how curiosity can be made tangible, both in order to measure it but also in order to intervene in schools and workplaces to encourage or enhance it.

As a starting point, an often-quoted definition of curiosity is that it is something that occurs

> *"... when an individual's reference point becomes elevated in a certain domain, drawing attention to an information gap. Curiosity is the feeling of deprivation that arises from the perception of the gap" (Loewenstein, 1994a, p. 93).*

The 'elevation' appears to have initially arisen as an essential response during evolution in which creatures explored their environments in search for information. Some of this led to sensory curiosity in which novel stimuli cause arousal and exposure to these stimuli gradually lessened arousal (Berlyne, 1954). Beyond this, however, is what Berlyne 1954, p. 179) refers to as epistemic curiosity, and defines as:

> *"a drive reducible by knowledge rehearsal ... its principal features being (1) an account of questions as 'thematic probes' which evoke drive-producing meaning-responses, and (2) the attribution to learned conflict of the curiosity aroused by strange, surprising or puzzling situations or questions".*

What Berlyne refers to as epistemic curiosity leads to awareness about the difference between the current level of uncertainty and the lesser level of uncertainty that would likely arise from information gain (Gottlieb et al., 2013). This awareness may be stimulated by "*novel, complex, or ambiguous stimuli*" (Litman & Jimerson, 2004, p. 147) and lead to feelings of discomfort, anxiety or uncertainty.

Discomfort will lead to information searching behaviours if "*arousal potential is only slightly supraoptimal and thus easily brought back to its optimum*" (Berlyne, 1960, p. 195), meaning if the level of discomfort is moderate. Spielberger and Starr (1994) refer to this as the "*goldilocks' zone*" in which the knowledge gap is not so large as to be discouraging or too small to fail to stimulate action to close it.

Berlyne (1960, p. 198) further specifies that it is important that "*the arousal is promptly followed by relief*". With reference to education, he reinterprets Piaget's famous notion of equilibrium to suggest that learning consists of a series of instances of drive and reward in which awareness of a lack of understanding or knowledge is addressed by a search for information to fill that gap and reduce the uncertainty, before the next awareness arises. Hence, Berlyne (1960, p. 302) concludes that "*conceptual conflict*" is a critical element of learning

In contemporary literature, it is common to find references to I- and D- type curiosity. These are distinguished as dispositional interest-curiosity (I type) and deprivation-curiosity (D type). As Litman (2008) explains, I-type curiosity relates to the addition of idea or concepts, motivates exploration and involves the enjoyment that derives from a desire to enhance intellectual achievement. In contrast. D-type curiosity refers to a state of discomfort that leads to explorative actions with a goal of solving problems. Importantly in an educational context, the latter is "*associated with setting performance-oriented learning goals*" (Litman, 2008, p. 1595).

A common way of referring to the distinction between these two types of curiosity are to distinguish between curiosity which is an enduring disposition (trait curiosity), or whether it is a temporary phenomenon that depends on the situation (state curiosity) (Boyle, 1983; Grossnickle, 2016). Trait curiosity is seen as a characteristic of individuals in their "*readiness or predisposition*" towards curiosity (Beswick & Tallmadge, 1971). It is measured by items that ask people about their usual behaviour or general feelings, such as "*I feel absorbed in the things that I do*" and "*I like to experience new sensations*" (Naylor, 1981).

State curiosity, by contrast, is regarded as a momentary experience that arises based on environmental stimuli that are novel, surprising, complex or ambiguous (Litman et al., 2005; Loewenstein, 1994). This is measured by the intensity of curiosity experienced at the particular moment during an event (a careers lesson or science lesson in Naylor's study), with responses to statements such as "*I want to know more*" and "*I feel like asking questions about what is happening*" (Naylor, 1981).

The two conceptions of duration are not mutually exclusive. Indeed, studies have found that trait and state curiosity are related (Litman et al., 2005; Thomas & Callahan, 2004). Trait curiosity may only manifest in response to certain situations and may involve experiencing state curiosity more frequently, across a greater variety of situations and for a longer duration (Beswick & Tallmadge, 1971; Kashdan & Roberts, 2004; Litman & Silvia, 2006).

The duration dimension of curiosity thus seems to both involve elements that are always present in an individual's disposition, and some that are temporary and influenced by the situation and whether it involves novelty, complexity and ambiguity (Loewenstein, 1994b).

While Litman et al. (2019) suggest that D type curiosity is more closely correlated with intense state-curiosity and the persistence of efforts to fill the information gap than I type curiosity, there is also evidence that D and I type curiosity are correlated (Ainley, 2019). Ainley (2019) suggests that I and D type curiosity likely wax and wane during a learning activity, but at this stage little is known about how learners transition between these during an activity, nor precisely how educators can create conditions that stimulate either I or D type curiosity.

Another approach to considering curiosity is to focus on breadth and depth (Silvia and Kashdan, (2009), with breadth relating to seeking variety in experiences and interests (Ainley, 1987;

Loewenstein, 1994b), while depth occurs when individuals "*hold on*" to a particular objects, events or ideas and delve deeply in order to understand them (Ainley, 1987; Levitt et al., 2009). These are not regarded as separate classifications with the notion that depth follows breadth. (Silvia and Kashdan, (2009).

Depth of curiosity may reflect the intensity of a motivational state, whilst breadth may be more a personality trait (Langevin, 1971; Levitt et al., 2009). The two may be somewhat dichotomous, in the sense that an individual with many interests may be unable to explore each of them in depth (Langevin, 1971).

Recent empirical research on depth of curiosity measured the depth of curiosity amongst university students (Aktas & Ustun, 2017; DemïRel & Coşkun, 2009) and teachers (Bahadir & Certel, 2013). Breadth of curiosity scores were found to be higher than depth of curiosity, which was interpreted by the researchers as implying that individuals were open to a variety of different subjects but did not have sustained interest in these subjects.

Another study examined the lived experience of those with a strong curiosity about a particular subject that has lasted more than a year (Levitt et al., 2009). It found that deep curiosity is a pleasurable experience, marked by passion and reinforcing further exploration, except when questions become too relentless and then it is an uncomfortable experience that can lead to fear, frustration and helplessness.

The methodology that quantified depth and breadth as dimensions of curiosity has been criticised by some researchers, however, with suggestions that this distinction is better captured by the state-trait dimension (Boyle, 1989; Byman, 1993).

In recent years attention has been paid to social curiosity, which relates to the extent to which people are curious about others (Kashdan, Stiksma, et al., 2018). This can be both overt – "*being curious about people's feelings, thoughts, and behavior*" – and covert – watching people surreptitiously (Kashdan, Stiksma, et al., 2018, p. 4). At face value this could be considered less relevant in an educational context than other conceptualisations of curiosity, but this would underestimate the social nature of learning, and the social practices that underlie it.

Overt social curiosity – also known as empathetic curiosity (Nadelson et al., 2019) – is linked to healthy psychological outcomes (Kashdan, Stiksma, et al., 2018) such as open-mindedness, agreeableness and interpersonal competencies, values tolerance and benevolence and predicts "*feelings of autonomy, competence, and belonging*" (Kashdan et al., 2020, p. 8). Menning (2019b) suggests that this form of social curiosity is important in education as it underscores relationships between learners and with teachers, while Phillips (2016) suggests that it is of particular importance in diverse contexts.

In contrast, covert social curiosity is linked to quite distinct behaviours such as spying, prying and gossiping and the likelihood of ego entanglements during conflict (Kashdan et al., 2020). This suggests that not all curiosity is positive and that, as Kashdan suggests, "*there is a pressing need to better understand what curiosity is, what curiosity offers, whether curiosity is malleable, and how to best enhance curiosity*" (Kashdan et al., 2020, p. 9).

Other authors have conceptualised curiosity in novel ways that have yet to gain much of a foothold in scholarly work but which have the potential to do so. Shin and Kim (2019) conceptualise two different variants of curiosity – '*backward*' and 'f*orward*' and identify the former as the one involving deeper engagement. In their construct, 'f*orward*' curiosity is driven by uncertainty and a lack of knowledge, focuses on what questions, aims at knowledge acquisition and is relatively superficial. In contrast, '*backward*' curiosity is driven by incongruity and surprise when a prediction is found to be incorrect, focuses on why questions and aims at knowledge revision. They argue that both should be encouraged in the classroom as both help in making learners learn and grow.

Another way of conceptualising different types of curiosity is '*stretching'* and '*embracing*' (Kashdan et al., 2009). Stretching curiosity is regarded as the search for information and experience while embracing curiosity is about a willingness to embrace the unknown and is strongly correlated with openness to new experiences.

In an empirical study, Kashdan et al. (2009) found support for both of these dimensions and suggest that anxiety about knowledge gaps often leads to avoidance. While they find that both stretching and embracing curiosity are correlated with openness to experience, personal growth, psychological flexibility and persistence, they further find that the correlations are strongest with stretching curiosity and suggest that:

> *"It is intuitive that people embracing uncertainty should show greater self-awareness and a willingness to be open to and receptive of both internal and external stimuli across the full range of positive and negative valence" (Kashdan et al., 2009, p. 996)*

2.4 Curiosity vs. interest

While there is a broad level of agreement about the importance of nurturing curiosity among learners, this is often muddied by confusion between the concepts of curiosity and interest. Some theorists assert that curiosity and interest are difficult to distinguish, and hence a focus on knowledge acquisition would be more fruitful than attempts to separate them (Murayama et al., 2019).

Others suggest that while it could be possible to view curiosity and interest as "*identical twins*" that refer to the same psychological mechanism, they further suggest that this could be incorrect, and that there is a need for greater research around the commonalities and differences between these concepts (Schmidt and Rotgans (2020).

A third group, and perhaps the most dominant one, however, assert that not only can curiosity and interest be distinguished, but also that it is worthwhile to do so. This is useful in the context of the current study as it facilitates more precise definition of curiosity, and how it can be distinguished in practice. It is certainly true that a number of commonalities can be identified (Alexander, 2019; Hidi & Renninger, 2019). Both curiosity and interest:

- Can be transitory or fleeting, often referred to as '*state curiosity'* and '*situational interest*
- Can be more stable, often referred to as '*trait curiosity*' and '*personal interest*
- Generate motivation, energy and enable the processing of information
- Relate to a similar knowledge base, objectives, self-efficacy, strategies and metacognitive skills
- Involve goal-directed and self-regulatory behaviours
- Do not require extrinsic rewards to be activated
- Drive information seeking behaviour that is intrinsically rewarding
- Involve the recognition of information gaps or gaps in understanding
- Can be instinctive or intentiona,; and
- Evolve over time, both changing and diversifying.

As Ainley (2019, p. 790) suggests:

> *"The features of an in-the-moment experience of interest look very similar to those associated with in-the-moment experiences of curiosity; arousal, positive affect, and exploratory behaviour directed toward the object that has drawn attention".*

When related to learning, however, clear distinctions can be seen. Pekrun (2019, p. 905) defines curiosity as "*a psychological state that includes three components: recognition of an information gap, anticipation that it may be possible to close it, and an intrinsically motivated desire to do so*". In considering these three elements we can identify distinctions between curiosity and interest.

1) Recognition of an information gap

2) Anticipation that it is possible to close the information gap and
3) Intrinsic motivation to close the information gap.

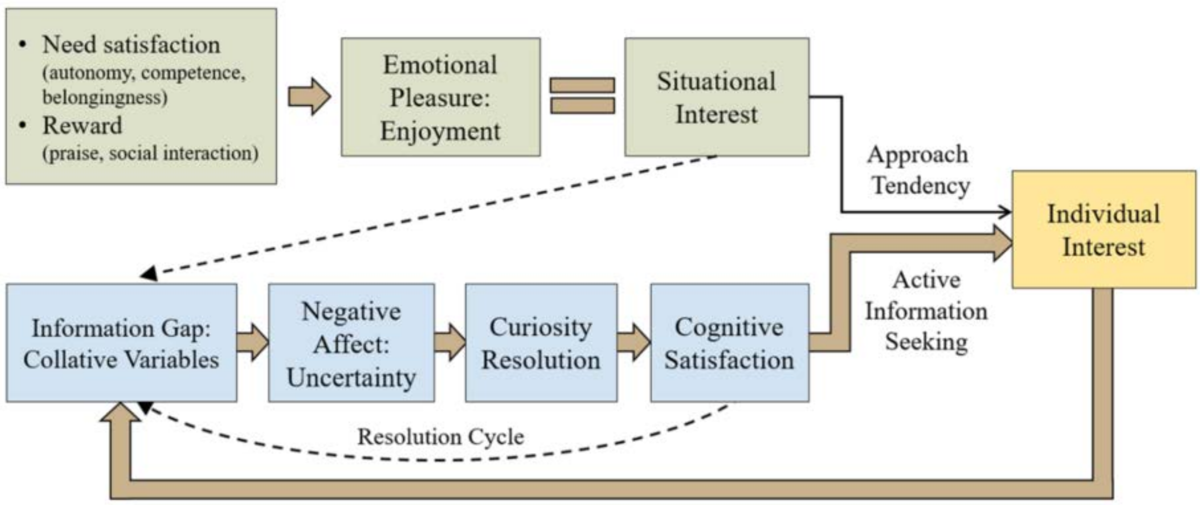
Interest is regarded as a psychological state in which learners wish to know more about a subject in general whereas curiosity refers to the desire to close an information gap (Markey & Loewenstein, 2014, p. 231). The authors suggest that curiosity occurs

> *"… when an individual's attention is drawn to a potential state of knowledge different from, and specifically greater than, their current state".*

Thus, acknowledging the 'information gap' points to curiosity and differs from interest in terms of the specific knowledge that is desired (versus general knowledge in relation to interest). Moreover, curiosity is stimulated by wanting to know more, while interest is regarded as being generated by a particular set of conditions or by persistent predispositions which may not be related to the direct topic or experience but in fact may be brought about by something else in the environment or experience.

The confusion about curiosity and interest is compounded by the use of various terms – situational interest, individual interest, epistemic curiosity and curiosity. Shin and Kim (2019) attempt to bring clarity by using a diagram to show how they are related but different:

Figure 2: Relationship between situation interest, curiosity and individual interest (Shin & Kim, 2019, p. 859)



Other scholars suggest that curiosity feels different to interest – with curiosity driven by deprivation and interest being more pleasurable (Markey & Loewenstein, 2014). As Hidi and Renninger (2019, p. 836) suggest, "*the psychological state and physiological responses of each are related but not interchangeable*".

While it would be tempting to delve further into the distinctions between curiosity and interest, yet if our purpose here is to focus on the role they play in learning, the interrelationship between them is actually of more value. As Murayama (2019, p. 7) suggests, both curiosity and interest are able to drive knowledge-acquisition, and both have "*inherent rewarding value, which reinforces our information-seeking behavior even without relying on explicit extrinsic rewards*".

Ainley (2019) acknowledges a paradox that has important implications for educational practice. Namely, while curiosity is driven by the desire to seek information about something that is unknown, we are often most curious about things that are already of interest. In this way curiosity can be regarded as wishing to find out about, for example, a particular animal, within a broader interest in animals in general.

Hence, curiosity reinforces interest and interest reinforces curiosity. This implies that, for example, in a classroom setting it would be very difficult for a teacher to distinguish whether either interest or curiosity were driving learners to ask particular questions. Equally, the teacher's encouragement of questioning is likely to stimulate *both* curiosity and interest. Curiosity causes attention to be paid to gaining more information and this can lead to situational interest. On the other hand, once the curiosity has been satisfied, that may be the end of the search for information. This is important in the context of education. As Hidi and Renninger (2019, p. 841) suggest:

> *"Promoting curiosity is unlikely to lead to the kind of self-initiated information search that results in longer term, deep involvement with content … [but] curiosity can provide a basis for triggering interest and for the continued development of interest"*

The likelihood that curiosity will drive sustained engagement is increased if a learner is interested in the topic in general and if teachers encourage further curiosity with questions. The less a learner has intrinsic interest, the more external support is required. Intrinsic interest is likely to be boosted by engaging learners in activities that are complex and multifaceted (Hidi & Renninger, 2019).

Another way of looking at curiosity is as "*the co-occurrence of interest and confusion*" (Fayn et al., 2019, p. 1029). In this approach, empirical research has found that if people are open they tend to be more motivated to close information gaps with new information, and are more comfortable with uncertainty (Fayn et al., 2019).

This degree of overlap between curiosity and interest is clearly challenging for those who wish to identify or measure curiosity as discrete from interest. For educators, the overlap between interest and curiosity could be seen as problematic or, alternatively, as helpful. Some scholars suggest that pedagogical interventions and approaches need to be specific to nurture curiosity independently of interest. For example, one such strategy is for teachers and caregivers to design meaningful contradictions in the learning curriculum to arouse curiosity and inspire children to search for answers that explain the contradiction (Shin and Kim (2019).

One of the challenges in classroom practice, however, is that approaches to stimulating interest are better understood than those that might result in enhanced curiosity. While it is true that particular pedagogical approaches may stimulate interest rather than curiosity (Hidi & Renninger, 2019), is this a bad thing? With reference to metacognitive skills, Alexander suggests that (2019, p. 900):

> *"... learners who have a richer strategic repertoire can employ efficient and effective procedures to seek relevant information when their curiosity is aroused or their interest piqued".*

Hence a focus on the enhancement of metacognitive skills among learners is likely to lead to more effective methods of satisfying *both* curiosity and interest.

Curiosity in action

As the previous sections have indicated, there are a clear set of steps that are associated with curiosity. Returning to Dewey's (1933, p. 144) original quote on curiosity it is interesting to highlight particular element

> *"Curiosity rises above the organic and the social level and becomes intellectual in the degree in which ...*
> *... it is transformed into interest in ...*
> *... finding out for oneself ...*
> *... the answers to questions that are aroused by contact with persons and things".*

This indicates a set of phenomena. First, a stimulus that creates what Dewey terms interest, but which is now commonly regarded as a sense of lacking something (Markey & Loewenstein, 2014). Second, a process of filling the identified gap in order to reduce uncertainty (Grossnickle, 2016). This is commonly represented as questioning, with a willingness to take risks and an openness to novel experiences, part of the idea of curiosity requiring effort to resolve (Peterson & Cohen, 2019), regarded as factors that support the process.

Finally, the end point – answers or some other form of resolution. A key area of interest for educators is whether this is as far as curiosity goes, or whether it is possible to convert it into sustained interest.

The previously referred to nascence of the field of curiosity as a topic of research in educational practice means that much remains to be learned. It is not possible to draw concrete conclusions about many of the elements that relate to the interaction between curiosity and learning. There is little clarity about what teachers can do to nurture curiosity, nor how they can recognise it in learners.

In recent years, however, a growing interest in holistic skills in education in general, has led to some findings about curiosity and learning that shed light on the role it plays in stimulating learning as well as the way in which certain practices can encourage it. In the absence of a clear set of sub-constructs for curiosity, this section focuses on the most salient elements when thinking about curiosity in the context of primary and secondary classrooms.

In this section we look at the relationship between curiosity and learning, the role played by uncertainty, the importance of questioning, the role of risk taking and barriers to curiosity in the context of learning environments.

3.1. Curiosity and learning

Educators have long acknowledged the importance of curiosity in learning. But how important is curiosity really? And is the perceived beneficial relationship between curiosity and learning borne out in reality? Before looking at this in more depth, it is first important to acknowledge the multiple dimensions of learning as a process rather than a destination, and the ways in which curiosity can positively influence this.

For example, in research with early-learning teachers, Menning (2019a) identifies four ways in which curiosity can support learning processes. First, it enables the building of relationships and the sense of belonging to a community of learners. Second, it enables self-determination, critical thinking, and questions about morality. As such, it can be regarded as a character strength.

Third, curiosity is regarded as a tool that supports learners to focus and engage in learning tasks, enabling them to gain knowledge and to explore. Finally, curiosity is regarded by these teachers as an essential and intrinsic element of childhood. It is important to bear these four conceptions in mind as the relationship between curiosity and learning is further explored.

It is likely that some learners have a benefit in learning environments in that they are simply naturally more curious than others. They have a "*hungry mind*" and this is strongly related to academic achievement (von Stumm et al., 2011). As Ainley (2019, p. 800) suggests:

> *"all models implicate relatively stable regulatory processes whereby a situation that is appraised as puzzling or complex initiates exploration and becomes an opportunity to expand existing knowledge".*

While this implies in-built benefits for those learners with trait curiosity, teachers are responsible for stimulating learning in all learners, and as Markey and Lowenstein (2014) suggest, this implies that finding ways to stimulate state curiosity in the classroom is of great relevance for educators. This highlights the importance of identifying the motivations for information-seeking behavior.

Kidd and Hayden (2015b) emphasise the role that curiosity plays in encouraging people to find answers, information or knowledge, and hence its role in stimulating learning, suggesting that "*curiosity is critical for learning and it reflects both external features and internal representations of own knowledge*" (Kidd & Hayden, 2015b, p. 457).

When the relationship between curiosity and learning activities is looked at closely, it is possible to see that curiosity does not positively affect all activities equally (Tanni & Sormunen, 2008). For example, research with secondary learners has found that curiosity plays an important role in task construction and task completion, but not in task performance (Heinström et al., 2014).

The research found that curiosity is correlated with the choice of unfamiliar topics, confidence in learners' ability in inquiry, their ability to critically assess sources and the use of sources with conflicting perspectives, with the suggestion that "*intellectual curiosity is driven by a need to find out (and perhaps forget)"* (Heinström et al., 2014, p. 1089). The authors suggest that, in contrast, deep learning strategies are correlated with an intrinsic interest in learning.

In a separate study with primary learners (Schijndel et al., 2018) results reflected the findings with secondary learners and indicated curiosity was related to inquiry-based learning in interesting ways. The research found that trait curiosity was positively related to learning, but not to the quality of learner exploration during the task.

This suggests that learners with natural curiosity were motivated by getting the result, not by the process of doing so. In contrast, the structure of the activity did influence the quality of exploration of the learners with less natural curiosity.

While these studies are relatively limited in their scope, they do suggest that there is not a linear relationship between curiosity and learning, suggesting that teachers need to use a variety of approaches to cultivating curiosity. Curiosity can be driven by nature, either on its own (Hidi & Renninger, 2019) or in combination with interest in a particular subject or domain (Peterson & Cohen, 2019). Both generate questions which lead to the pursuit of further information and hence they both have a clear link to the pursuit of academic inquiry.

An unresolved question about curiosity in the domain of education is whether it is something that has value in itself, with possibly unforeseen outcomes, or whether it should be regarded more as a means to enhance learning outcomes. A related concept to consider here is the strength of curiosity, often regarded as depending on importance, salience and surprise (Markey & Loewenstein, 2014).

These can be explained as: the amount of value placed by someone on the information or knowledge they have identified as being missing; the extent to which the context or environment emphasises the need for the missing information; and the extent to which the prompt causing the recognition of missing information is novel or unusual.

Hence, one approach to stimulating curiosity is personalisation. This reflects the importance of salience in curiosity, with the implication that personalising topics in learning is likely to stimulate curiosity, as is focusing on topics about which learners are already interested or that are of particular relevance to their lives (Markey & Loewenstein, 2014).

A further approach is to identify information gaps or controversies, to get learners to ask themselves questions and to have learners identify what they already know or can do and what they want to know or be able to do at the start of a learning activity (Markey & Loewenstein, 2014).

If someone has existing knowledge, for example about a particular subject, they are likely to be more aware of the gaps in their knowledge, and hence have an urge to fill them (Grossnickle, 2016). Their extant knowledge means that they are also more likely to regard the missing information as important. The more knowledgeable they are, the more likely that new insights will surprise them.

As Shin and Kim suggest (2019), if someone has a degree of knowledge already, and/or the skills to search for more, then acquiring more knowledge seems obtainable and this increases the value of resolving curiosity. Likewise, the inverse is true, for example if people lack confidence in their ability to close the information gap this will be a disincentive to try. Immediate feedback also stimulates curiosity. Beyond this, "*the partial resolution of curiosity can also boost both an individual's competence and their anticipation of resolving their curiosity and thus induce persistent seeking behavior*" (Shin & Kim, 2019, p. 857).

Critically, however, the information gap should not be so small as to be irrelevant or so large as to be unachievable as both of these will undermine curiosity. There is evidence that "*curiosity will tend to increase as one perceives oneself as close to filling an information gap*" (Markey & Loewenstein, 2014, p. 233). Similarly, Murayama et al. (2019) suggest that the likelihood that either curiosity or interest will lead to the search for knowledge is moderated by belief that the missing knowledge is obtainable, confidence that they can obtain the knowledge and the expectation of positive feelings.

3.2 Uncertainty

Overcoming uncertainty, or filling an information gap, is commonly referenced as the drive element of curiosity that action needs to satisfy. Indeed, uncertainty has been found to be more of a drive for curiosity than the expectation of reward (Ligneul et al., 2018). This indicates that stimulating uncertainty among learners is a useful way of generating curiosity, with some suggesting that to optimise learning it is essential that learners become comfortable with uncertainty (Jirout et al., 2018).

In a classroom setting it is possible for teachers to create an environment of uncertainty, but this must be carefully handled. One risk is that any uncertainty leads to only short-term benefits for learning, simulating passing curiosity only. In research with magnetic resonance imaging, Gruber et al. (2014) have identified that curiosity enhances the mid-brain and hippocampus.

This suggests that even if curiosity is relatively fleeting, it prepares the brain for learning. This raises the possibility that stimulating learning through uncertainty can make subsequent learning more rewarding, with skilful pedagogy, transforming curiosity into sustained inquiry (Hidi & Renninger, 2019; Jirout et al., 2018)

While a degree of uncertainty stimulates curiosity, it is critical to pitch it at the right level. Ainley reminds us of the need to consider that (2019, pp. 791–792) terms "*individuals' propensity to feel curious and seek new information in contexts high in collative variability*", that is, where there is a degree of perplexity or uncertainty (Shin & Kim, 2019). Importantly, too much or too little complexity are less likely to stimulate curiosity than the 'right' amount of complexity, which clearly has relevance for the way in which learning is scaffolded.

A similar finding has also arisen from research with young children who indicate a preference for "*the medium level of uncertainty, where there was some information given, over both the maximum and minimum levels*" (Jirout & Klahr, 2012, p. 151).

In a study with middle-school learners, prompts for activities that did not include information on how to solve a problem were found to engender an environment that "*begets motivated, curious learners*" (Lamnina & Chase, 2019, p. 101785). It also makes it more likely that learners can take the knowledge and skills they learn in one context and apply them in a different one (referred to as 'transfer'). Interestingly, while giving leaners forewarning of their likely feelings of uncertainty reduces the negative effect on them, it also lessens their curiosity, indicating the role that discomfort plays in triggering curiosity.

Until recently, research into curiosity has been relatively domain-agnostic, but there is growing interest in the way in which curiosity interacts with particular domains. Recent research on the domain of mathematics (Peterson & Cohen, 2019), for example, highlights the likelihood that learners who have skills, knowledge and self-efficacy in a domain are more likely to use curiosity to drive problem solving related to their domain than those who do not.

In relation to mathematics they suggest that as learners' progress, "*what is unknown to a student at one point in development can be learned, closing one specific gap and revealing potentially more complex knowledge gaps*" (Peterson & Cohen, 2019, p. 821).

They further suggest that learners will become increasingly skilled at identifying which gaps are worth the effort required to fill them. As learners gain understanding in mathematics they will be able to identify gaps and hence generate questions that can create knowledge (Peterson & Cohen, 2019). This is more likely to occur in self-directed exploration than in a more authoritative classroom where the teacher is regarded as possessing all knowledge.

Hence teachers can encourage curiosity by posing problems, encouraging questions, modelling curiosity and scaffolding exploration. Since, a complete lack of knowledge – or too much knowledge – about a topic are both demotivating for curiosity, pitching scaffolding at the right level for different learner abilities is highly significant.

In a study on how grade 6 learners demonstrate curiosity in science, three different types of curious learners were identified (Luce & Hsi, 2015). The first was learners who were curious about a wide range of science topics in order to better understand 'how the world works', with a particular focus on inconsistencies. The second was learners who were curious about one particular topic in science and wanted to explore it in depth. The third was learners who were generally curious about science but with a focus on more philosophical questions rather than mechanisms. In terms of evidencing curiosity, these findings emphasise that different learners will embody curiosity in different ways.

One extreme approach to stimulating curiosity could be seen as allowing learners to be bored. Unsurprisingly, however, this can be risky (Hsee & Ruan, 2016). Ruan et al. (2018) found that learners when left alone with no stimulation did indeed become curious about their environment and start to explore it. Unfortunately, this led to a combination of disturbing others and taking risks that could have resulted in harm.

Ultimately, as Shin and Kim (2019) conclude, there is insufficient evidence to draw a clear relationship between boredom and curiosity. Moreover, as Kashdan et al. (2020) caution, not all curiosity is positive and there remains a lot to learn about what conditions stimulate curiosity and the extent to which curiosity is malleable.

3.3 Asking questions

A key component of curiosity is that it stimulates action to close the knowledge gap that has been identified. 'Action' itself can take a number of forms. Ainley (2019, p. 790) considers curiosity as a response to '*novel and puzzling phenomena'* which she regards as emerging from infant interaction with the things and people around them which stimulates "*a regulatory system consisting of exploration, asking questions, or a desire to know what is currently unknown*".

She classifies curiosity as organic, social and intellectual, with organic relating to exploratory actions (touching, smelling, tasting), social relating to interactions with, and questions of, other people and intellectual relating to the desire to find our own answers.

To gain explanatory information that satisfies their curiosity, question-asking and causal intervention are likely to be most useful as they enable learners to discover cause and effect relationships and information about unobservable phenomena (Liquin & Lombrozo, 2020b). Asking questions allows learners to seek information to resolve their knowledge gaps (Ronfard et al., 2018).

Pre-schoolers have been found to ask on average between 26 and 76 questions per hour, encompassing both fact-seeking and explanation-seeking questions (Chouinard et al., 2007; Tizard & Hughes, 2008). Interestingly, the fact that they ask follow-up questions if they do not receive the information they seek highlights that asking questions is indeed motivated by obtaining answers, more so than gaining attention (Engel, 2011; Frazier et al., 2009).

When young learners reach school, their questioning changes. The rate of questions they ask slows, however, they are able to ask more targeted, problem-solving questions (Chouinard et al., 2007; J. Jirout & Klahr, 2011; Tizard & Hughes, 2008). Chouinard at al. (2007) note that the questions asked deepen from isolated, fact-based 'shallow' questions – such as '*Is a plant alive*?' – to interconnected, explanation-seeking 'deep' questions – such as '*How does a plant stay alive*?' – as learners develop, which suggests that they are building conceptual structures that link relevant facts and explanatory principles, allowing them to make predictions and relate the topic discussed to other knowledge about the world.

Learners as young as kindergarten have responded to training interventions designed to improve their question-asking and listening skills (Cosgrove & Patterson, 1977; Courage, 1989; J. Jirout & Klahr, 2011). Different types of questions include open-ended, 'understanding questions', about general areas of knowledge to gain in-depth responses, and 'identification questions' to fill smaller, specific, categorical gaps in knowledge (J. Jirout & Klahr, 2011). Being able to generate and ask questions reflects the presence of a complex set of cognitive abilities. Ronfard et al. (2018) propose that the process of asking questions can be divided into four steps: a) initiation, b) formulation, c) expression and d) response evaluation and follow-up.

In one study, learners received an intervention training them in either identification questions, understanding questions or giving them no training (Jirout & Klahr, 2011). The results indicated that the interventions facilitated question-asking and more curious learners performed better on the tasks of asking questions to identify a picture, categorising helpful and unhelpful questions, and generating questions about a topic (Jirout & Klahr, 2011). This highlights the role of modelling and scaffolding in facilitating learners' enactment of curiosity through asking questions.

Causal intervention involves learners experimenting to understand how things work (Liquin & Lombrozo, 2020b). Preschool learners have been found to choose actions to isolate variables to determine the cause and effect of processes, and develop hypotheses of how things work, which are then refined based on more information (Gopnick et al., 2001; Kidd & Hayden, 2015a; Schulz & Bonawitz, 2007).

Learners structure their play in a way that allows them to gain information by exploring causal structures, for example by exploring a box that played music when certain beads were pressed on top of it and testing which individual beads would result in the music playing or not (Cook et al., 2011).

One study gave primary school learners a variety of liquids and tasked them with discovering which caused colour changes or bubbles, finding that learners came to understand by themselves that isolating variables to test their effects is the most effective method of experimentation (Kuhn & Ho, 1980). This may suggest that learners enact their curiosity through experiments, which also allows them to learn scientific principles (Engel, 2011).

Curiosity can also be channelled in specific domains, like social sciences. In one study, learners were divided into groups to either learn facts about a topic or explore their position in relation to a controversy, whether strip mining is desirable and whether wolves should be classified as an endangered species (Lowry & Johnson, 1981).

The study found that the group who explored the controversial issue had sought more information about the topic, performed better in a test about the material, and was more engaged, to the point where they were more likely to miss their recess to watch a documentary related to the topic (Lowry & Johnson, 1981). This shows that learners benefit from uncertainty to engage their curiosity and facilitate their learning (Engel, 2011).

Engel (2013) observes that there is a remarkable gap in the curiosity levels of younger children and older children. Older children seem less curious in schools and this is primarily because teachers are often not receptive to learners' questions. As children age, they rely on adults to get cues for how curious to be. Engel (2013, p.38) states: "*children's curiosity can be fostered or squelched by the people they spend time with*".

Whitehouse et al. (2018) suggests that a good way to inculcate curiousity amongst learners is to provide learners with a number of wide experiences; the opportunity to critically analyse and discuss the experiences and make informed decisions which they are capable of changing when presented with new information. Whitehouse and colleagues agree with Engel's stance that teachers have the power to foster curiosuity and creativity in their classes. They state that

> *"Practitioners engaged in reflective practice should be able to develop….an epistemic culture that fosters an understanding of the importance of learning as a process and not an end goal, which in turn creates the right climate for developing questioning, reflection and consequently curiosity." (Whitehouse et al., 2018, p. 658)*

3.4 Taking Risks

Beyond asking questions, a further attribute of curiosity is the confidence to take risks, which teachers can create a safe environment for, and provide positive feedback on. The broader environment is also important, with evidence that "*environments that breed negativity, low self-efficacy, and confidence, whether via peer bullying, threatening teachers, or negligent parents, can suppress curiosity*" (Markey & Loewenstein, 2014, p. 236).

Research has also found that learners will persevere in challenging tasks and take risks to acquire new information when curious (Lauriola et al., 2015; Szumowska & Kruglanski, 2020). A correlation has been found between academic curiosity, measured by responses to statements such as "*I work hard when we start something new in class*", and academic persistence, measured by items like "*When I do badly on a test, I work harder next time*" (Neblett et al., 2006; Smalls et al., 2007).

When curiosity arises as a feeling of deprivation or a lack of knowledge, this is more strongly associated with persistence, which is measured in surveys, for example, by items such as "*I can spend hours on a single problem because I just can't rest without knowing the answer*" (Litman & Mussel, 2013).

Risk taking involves exploratory behaviour such as "*testing new ideas, evaluating new approaches and creating*", such as volunteering an answer or asking a question in front of the class (where there is a risk of looking foolish or uninformed) or working with unfamiliar classmates, or finding a new way to evaluate the success of a task in a classroom context (Reio, 2010).

In a classroom context, risk taking may therefore look like taking initiative or volunteering to share ideas despite the social risks of exposure in front of peers, where the learner's curiosity and feeling of safety in the classroom context has outweighed the social risks (Reio, 2010). In this way, curiosity is enacted by means of persistence at challenging tasks and through risk-taking, exploratory behaviours. These behaviours can also be counted as evidence.

3.5 Barriers to curiosity

Markey and Lowenstein (2014) suggest that while educators agree that curiosity is an important element in encouraging learning there is less agreement on how this can be done. Following on from Ainley's (2019) focus on curiosity in young children, it could be suggested that a key role of educators is to avoid setting up barriers to children's natural curiosity (Markey & Loewenstein, 2014).

Barriers to curiosity in the classroom come from school systems, a focus on performance and negative learner-teacher interactions. School systems characterised by quantitative targets, professional accountability and school performance management may hinder curiosity as these encourage teachers to prepare learners to be 'test ready' to the exclusion of intellectual exploration (Stern, 2018; Ward & Quennerstedt, 2019).

Direct instruction teaching methods can also discourage curiosity as they emphasise the transmission of knowledge from teachers to learners rather than allowing for learners' agency and voice in their learning (Whitehouse et al., 2018).

Curiosity can be seen as a form of distraction in classrooms, particularly where emphasis is placed on performance or learning for the purpose of achieving a skill or meeting an externally imposed standard (Hulme et al., 2013; Jirout, 2020b). In these environments, curiosity can be suppressed by teaching that there is only one correct procedure for finding an answer and focusing on learners' achievement on external standardised assessments over the process of learning (Jirout, 2020b).

Curiosity can be discouraged at different ages by certain practices. For young learners starting school, wonder can be suppressed by reducing their relationship with the world around them to a series of facts about causal relationships (Lindholm, 2018). For learners in high school, a focus on resolved questions and models abstracting and simplifying the complexity of real-world processes can lead learners to the misapprehension that 'everything is explained', particularly in science, leaving little room for curiosity (Lindholm, 2018).

Teachers' behaviour can also act as a barrier to curiosity. Teachers who are perceived by learners as threatening or uncaring or who use verbal put downs or sarcasm, can suppress the number of questions that learners ask, limiting the expresssion of their curiosity (Peters, 1978; Rocca, 2010). Furthermore, some teachers feel they lack relevant knowledge to support learners' intellectual exploration, such as using correct terminology, and may be uncomfortable with learners asking questions for which the teachers do not have answers (Post & Walma van der Molen, 2018; Spektor-Levy et al., 2013).

Conversely, where teachers model curiosity, provide opportunities for learners to find answers themselves, support learners in generating relevant questions and promote alternative ideas, they can support the development of learners' curiosity in the classroom (Engel, 2013; J. J. Jirout, 2020b).

3.6 Measuring curiosity

Using psychometric measures to gauge curiosity is challenging. While an outward manifestation of information-seeking behaviour can be observed, it is difficult to observe and measure the underlying thoughts, motives, and reasoning for certain actions (Litman, 2019). Most measures are based on assessing I type curiosity and D type curiosity(Litman & Silvia, 2006).

According to Litman (2019, 2005), curiosity can be measured based on it being a transient emotional- motivational state. He suggests that the primary function of curiosity is to energize an individual to seek out information and close the knowledge gap (Berlyne, 1960, 1978). To measure the information-gap as an attempt to measure curiosity levels points at making a 'metacognitive judgement' (Litman, 2019, p. 425). The greater the knowledge-gap, the greater the curiosity.

Murayama et al. (2020, in-print) propose a reward-learning framework of autonomous knowledge acquisition. The framework posits that knowledge acquisition serves as an inherent reward, which reinforces people's information-seeking behaviour through a reward-learning process. The authors suggest that both curiosity and interest work like extrinsic rewards and encourage the desire to gain more knowledge. Finally they conclude that future studies should directly address the reinforcement properties of curiosity and interest in the knowledge-acquisition process.

Most recently Wagstaff et al. (2020) also carried out a comprehensive review of the available literature from 2000 to evaluate the tools available to measure curiosity. Their criteria was to limit tools to those available in the open domain. **Figure 3** provides a snapshot of the 13 studies they reviewed. Interestingly, almost all focus solely on state curiosity, they use a number of different factors and all have a relatively high level of reliability.

The focus of these studies was to discuss the theory and practice available in the field of human resource development. While it may seem that this line of research does not directly tie-in with the agenda at hand, but it is indeed crucial to consider that researchers consider curiosity as one of the elements required for being successful in the real world and that this is what schools hope for their learners. Having a growing body of work solely concentrating on the value of curiosity for organisational success leads to the conclusion that curiosity as a trait must be valued and encouraged in our schools.

The aforementioned tools are limited because they cannot be used to measure curiosity in children. They rely on self-report measures and these usually do not function well with children. Studies which focus on measuring the exploratory behaviour of children such as Jirout and Klahr's (2012) underwater exploration game and Gordon et al.'s (2015) tablet app on free exploration or asking and evaluating the quality and relevance of questions (Ronfard et.al, 2018) asked can be considered to evaluate curiosity in schools but there is as yet little empirical data to support their robustness in measuring curiosity among diverse learners.

Figure 3: Curiosity measures (Wagstaff et al., 2020)

#	Measure Name	Reference/Author	Year	Trait/ State	# Items	Sample	Reliability α	Factor	CFA done	Language
1	Epistemic curiosity—Curiosity as feeling of interest (EC/D & EC/S)	Litman & Spielberger	2003	Trait	10	739 undergraduate students (546 women, 193 men)	0.71–0.85	Two dimensions: Diversive, specific	No	English, German
2	Epistemic curiosity—Curiosity as feeling of deprivation (CFD)	Litman & Jimerson	2004	Trait	15	321 undergraduate psychology students (248 women, 73 men)	0.64–0.84	Three dimensions with general factor: Intolerance, competence, problem-solving	Yes	English
3	Perceptual Curiosity Scale (PC)	Collins et al.	2004	Trait	16	320 undergraduate psychology students (220 women, 118 men)	0.73–0.87	Two dimensions: Diversive, specific	No	English
4	Curiosity and Exploration Inventory (CEI)	Kashdan et al. Kashdan & Steger	2004 2007	Trait/ State	7 (trait) 4 (state)	Undergraduates Sample 1: n = 214 Sample 2: n = 103 Sample 4: n = 100 Sample 5: n =97 Internet-based survey Sample 3: n = 213	0.63–0.83	Two dimensions: Exploration, absorption	Yes	English
5	Epistemic Curiosity Scale—(EC I and D types)	Litman Litman et al.	2008 2010	Trait	10	Undergraduate psychology students Study 1: n = 725 Study 2: n = 658 Study 3: n = 762 Study 4: n = 515	0.76–0.82	Two dimensions: Interest, deprivation	Yes	English, Chinese, German
6	Curiosity and Exploration Inventory-II (CEI-II)	Kashdan et al. Kashdan et al.	2009 2012	Trait/s tate	10	Undergraduate students Study 1: n = 311 Study 2: n = 150 Study 3: n = 119 Study 4: n = 578 (combined responses from studies 1–3)	0.75–0.86	Two dimensions: Stretching, embracing	Yes	English
7	Five-Dimensional Curiosity Scale (5DC)	Kashdan, Disabato, et al.	2018	Trait	25	Community sample (U.S. population) Study 1: n = 508 Study 3: n = 3,000 Internet-based survey (MTurk) Study 2: n = 403	0.81–0.90	Five dimensions: Joyous exploration, deprivation sensitivity, stress tolerance, thrill seeking, social curiosity	Yes	English, Hebrew
8	Five-Dimensional Curiosity Scale Revised (5DCR)	Kashdan et al.	2020	Trait	24	Internet-based survey (MTurk) Study 1: n = 483 (working adults) Study 2: n = 460 (no working requirement) None	>0.80b across sub-dimensions	Six dimensions: Joyous exploration, deprivation sensitivity, stress tolerance, thrill seeking, covert social curiosity, overt social curiosity	Yes	English
9	Social Curiosity Scale (SCS)	Renner	2006	Trait	10	312 university students and community members (151 younger adults, 160 older adults)	0.78–0.85	Two dimensions: General social curiosity, covert social curiosity	Yes	English
10	nterpersonal Curiosity Scale (IPC)	Litman & Pezzo,	2007	Trait	15	Undergraduate students Sample 1: n = 324 Sample 2: n = 229	0.71–0.82	Three dimensions: Curious about emotions, spying and prying, snooping	Yes	English
11	Work-Related Curiosity Scale (WCS)	Mussel et al. Mussel	2012 2013	Trait	10	Business apprentice program participants Study 1: n = 251 (57% women) University students Study 2: n = 395 (51% women)	0.83–0.85	One dimension	Yes	German, English
12	Entrepreneurial curiosity	Jeraj & Maricˇ	2013	Trait	14	850 entrepreneurs (636 United States, 214 Slovenia)	0.85–0.88	One dimension	Yes	Slovenian, English
13	M-Workplace Curiosity Scale	Kashdan et al.	2020	Trait	16	Study 1:2107 working adults—Community sample (1,067 United States/1,040 German) Study 2:800 working adults—Internet sample (initial 500 United States/300 German)	0.81–0.90	Four dimensions with general factor: Openness to people's ideas, stress tolerance, deprivation sensitivity, joyous exploration	Yes	English, German

3.7 Culture and curiosity

In the context of the International Baccalaureate (IB), with IB programmes implemented in 155 countries and with learners aged 3 to 19, it is vital that the construct of curiosity that is focused on can work across ages and countries. As Pekrun (2019) affirms, the development of the concepts that underscore curiosity has largely taken place in western countries. Hence it is unknown whether the conceptualisation would remain stable in non-western populations.

One approach is to consider that there is a degree of universality in curiosity, with its expressions varying widely between individuals within populations, as much as between them, but with the constituent components remaining stable (Pekrun, 2019). This may be regarded as somewhat of a dangerous assumption, however, as conjectures about universality have a tendency to be proven incorrect.

Some work has been done to look at curiosity in different cultural contexts. Kashdan et al. (2018) identified a five-dimensional construct of curiosity comprising joyous exploration, deprivation, sensitivity, stress tolerance, social curiosity and thrill-seeking. With a focus on curiosity in the workplace, they found that tolerance of stress and openness to people's ideas were elements of curiosity in the workplace that were correlated with positive experiences including engagement, satisfaction, positive relationships and high performance, and that this was equally true in Germany and the United States. Subsequent research with the same scale in Israel (Birenbaum et al., 2019) found that the curiosity dimensions and different profiles of curiosity were replicated.

Other studies have also found that curiosity tools work in different cultures. In China, Renner's Social Curiosity scale, which had originally been developed in Germany, was applied to Chinese university students and found to be effective in measuring social curiosity in that context (Yong Zhang, 2019).

Two other studies used the Curiosity and Exploration Inventory–II developed by Kashdan et al. (2009) and found that ethnicity partially mediated the relationship between curiosity and career self-efficacy among Asian-American tertiary learners (Kim & Choi, 2019) and that it was an applicable scale for use in measuring curiosity in Indonesia (Setyowati et al., 2020).

These studies are preliminary, however, in identifying the generalisability of curiosity across cultures, and none have focused on primary and secondary learners, so it is obvious that a great deal more research needs to be done before universality can be claimed.

Conclusion

The purpose of this review has been to summarise the scholarly research into the construct of curiosity, and to focus on features that are most salient in the context of educational practice. While ninety-years have elapsed since curiosity was first deemed important in stimulating learning, in many ways it remains in a relatively embryonic state, with more questions than answers about its function.

There is a degree of convergence on certain elements. That curiosity is stimulated by the realisation of a gap in knowledge or understanding. That this realisation creates a feeling – whether positive or negative – of a desire to fill that gap. That this leads to action – often through questions – to remove the identified gap.

Moreover, there is some evidence that those open to risk-taking – perhaps those most comfortable with feeling uncertainty – are most comfortable with taking action to satisfy their curiosity. A significant question relates to what happens once curiosity is satisfied. The complex relationship between interest and curiosity, one that remains a topic of debate, appears to be central in answering this question. Is it possible to convert curiosity into interest, and hence into sustained engagement?

Alternatively, can a step-by-step approach to stimulating more and more sophisticated knowledge gaps stimulate a series of states of curiosity that enable learning to be accrued? As every article on curiosity concludes, there is a need for much more research to expand our understanding of how curiosity impacts learning.

This paper is part of a broader study which is focusing on both curiosity and creativity. An interesting perspective on curiosity is that it has been found to stimulate creativity in some situations. As Hardy et al. (2017, p. 235) suggest,

> *"… curiosity primes individuals to adopt a broad focus of attention that facilitates breadth in information seeking and a cognitive emphasis on global information processing that is fundamental to idea generation"*

In addition, higher levels of both creativity and curiosity have been found to be correlated to flow – the intense concentration and absorption that happens when an individual is deeply engaged in an activity (Schutte & Malouff, 2020). These are only hints of the possible synergies between curiosity and creativity, and there are undoubtedly also linkages between curiosity and other twenty-first century skills that are yet to be uncovered.

It appears that curiosity has potential benefits to offer to learners, and that it is advantageous for teachers to encourage learners to activate their curiosity in the learning process. How teachers should go about this, and how they can recognise curiosity in learners, is the focus of this study and it is hoped that this preliminary literature review provides a useful foundation for these important areas of inquiry.

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APPENDIX 3: CREATIVITY FRAMEWORK

CREATIVITY FRAMEWORK AND EVIDENCING

Australian Council for Educational Research, 2021

INTRODUCTION

This creativity framework sets out to provide a practical definition of creativity useful to educators within the International Baccalaureate (IB). A practical definition and framework of creativity is one that will help to inform curriculum, pedagogy and assessment, enabling teachers in IB schools to observe evidence of creativity in learners and potentially to comment on how learners are developing in creativity. Given this overarching purpose, the intention of this framework is to describe creativity in a detailed way as it pertains to demonstrable behaviours in the classroom in relation to learning.

The framework development was informed by an extensive review of the academic literature in their field of creativity research. This literature was first analysed to identify the most common elements in definitions of creativity. The literature was further analysed to identify what are the observable skills and attributes specifically associated creativity.

These were organised into three dimensions of problem definition, generating ideas and evaluating ideas. This presents creativity as a process, with each dimension able to be considered a conceptually distinct phase. However in reality, these phases are iterative.

The creative process also naturally calls upon evaluative, convergent thinking skills to arrive at an assessment of the qualities (the novelty, the 'work-ability') of one's ideas, however these skills are not the preserve of creativity but also problem solving and critical thinking, and so are not here described.

Within this framework, a creativity thermometer allows learners and teachers to reflect on and collect evidence of learners' creativity. A related set of levels of development in creativity are offered for teachers to use to identify how creatively learners appear to be operating in their learning. The framework will help to inform the IB's curriculum, enabling teachers in IB schools to observe evidence of creativity in learners and potentially to comment on how learners are developing as creative thinkers, producers and problem-solvers.

While frameworks and definitions for creativity are in abundance, not all are suited or developed for this purpose. A major assumption underpinning this work follows naturally from the classroom focus: the need to present aspects of creativity that are teachable and learnable, and further, consider the skills in a malleable way allowing them to be described in relation to progress and levels of proficiency. This framework therefore represents a significant opportunity to assist IB teachers to understand and capture, in a detailed way, what evidence of creativity might actually look like in the classroom and in learners.

OVERVIEW – HOW TO USE THIS DOCUMENT

The International Baccalaureate believes both that creativity is fundamentally important and that it can be fostered, and developed through classroom teaching practice, and through explicit valuing of the skill in the school's ethos. This is made explicit in their statement that "*at the International Baccalaureate (IB), we believe every person has the ability, and the right, to be creative.*[1]"

The learner profile advocates for learners to be open-minded inquirers who take risks, all of which are strongly linked in the research literature to creativity. The IB's approach reflects a growing recognition worldwide that creativity should be considered a valued outcome of schooling[2].

The first part of this document provides a definition and a framework that breaks the construct of creativity down into dimensions and sub-dimensions, with a particular focus on aspects of creativity that are teachable and learnable. For each sub-dimension, three examples are offered to illustrate what these sub-dimensions of creativity look like in hypothetical school-based situations.

The second part of this document provides descriptions of what varying levels of creativity might look like and a self-reflection tool that learners can use to consider how creative they have been in a given situation. These descriptions provide the likely observable behaviours of learners who are more or less creative.

- For teachers, the level descriptions aim to make creativity as transparent as possible so that they can think about how to say something meaningful about how creative a learner has been.
- For learners themselves, the creativity thermometer can be used as a self-reflection tool: to answer the questions: How creative was I? What evidence can I point to, to justify this? Crucially, these resources are not to be confused with assessment rubrics for creativity; rather, they should be seen as tools for understanding what makes one creative.

The third part of this document provides information and resources to assist IB teachers in understanding what is required both to activate creativity in learners and to develop it. This includes a rubric teachers and school leaders can use to evaluate the extent to which their school/classroom provides the necessary conditions to enable maximal creativity, and general advice for how to foster greater creativity in learners.

PART 1 CREATIVITY FRAMEWORK

DEFINITION OF CREATIVITY

Creativity is a highly valued attribute in many cultures. It underpins major artistic, scientific and theoretical breakthroughs in the development of human history and is therefore often associated with genius[3] . This type of creativity is, in the literature, often referred to as "Big-C" creativity, historical creativity, or eminent creativity, and it describe this rare kind of thinking characterised by great leaps of imagination that fundamentally alter whole fields of science and culture[4] .

At the other end of the spectrum, "small c", "little-c" or "mini-c" creativity, describes the small, everyday creative ideas that enhance and enrich our lives, and is a lot more common[5]. An assumption that all learners are capable of creativity necessitates a definition of creativity that rests on expectations of "little-c" creativity.

Not only is Big-C creativity demonstrably rarer, but it is also correlated with fixed traits such as being gifted and talented[6] , discrepant with the desire in educational contexts to focus on what is malleable and therefore teachable and learnable.

It is also widely accepted that what we come to call creativity is actually a confluence of factors: aspects of the person (such as their personality and disposition) and the social, historical and cultural environment in which they operate, but also certain cognitive processes they undertake, and the resulting qualities of the product that results[7] .

This conception of creativity remains influential and is applicable within a school context: creativity is demonstrated by learners through the production of a new product, solution or idea, which has emerged via their mental processes, mediated and determined by their social, cultural and learning environment. However, given the focus in schools on the teaching and learning of creativity, the present definition is firmly focused on those things that can be learned – the qualities of creative products and the processes of creativity.

Keeping these things in mind, the definition of creativity for this framework is:

> *Creativity is a material, mental and/or social process that leads to the production of novel and useful ideas, approaches and solutions. It involves the generation and exploration of ideas made possible through both experimental and evaluative thinking.*

The key features of this definition are that creativity may involve working with things, ideas, or people – or any combination of the three. It is not a process of engaging in uncontrolled daydreaming (though this may enter into one's process), but rather, is a purposeful and directed activity focused on addressing 'problems' (broadly defined) and their solutions that takes account of real-world constraints.

What is meant by a 'problem', a 'solution' and a 'product'?

For the purposes of this framework, a problem is *any* task a person seeks to accomplish, that leads to a creative output (a strategy, a poem, a theory, a method, a design, an experiment etc. that is novel and fit for purpose). 'Ill-defined' problems are particularly conducive to divergent thinking, and are those in which the goal of, or solution to, the problem is not known or determined, and the solution pathway is not clear. A person's creative output can be deemed their solution to an ill-defined problem. The solution is therefore the product of the creative process. All of these terms can be applied regardless of subject domain.

These meanings are intentionally broad and need to be interpreted generously rather than narrowly. A problem does not necessarily mean something is 'wrong' or requires fixing; it could also be thought of as a challenge. A product does not need to refer to a tangible object or even anything realised; it could simply be an idea.

By these definitions, a problem does not need to be an externally-presented problem in the world. It can be intrinsically-developed – a challenge one sets oneself – even if that challenge is to create beauty, try something different or merely to be funny. Importantly, even acts of aesthetic and artistic creativity such as composing a piece of music, writing a poem or putting on a play can be seen as responses to personally-developed 'problems' or challenges that need defining and solving: What am I trying to express? How best to capture and

The product/s of creativity have key features: they are novel, and they are fit for purpose (useful or appropriate). As well as the generation of ideas and products, creativity involves an openness to explore the features of ideas: to consider them from different perspectives and to try to synthesise different ideas to come up with new ones.

This definition is further elaborated according to the dimension and sub-dimension structure as given in Figure 1. While the sequence of the three strands may, in the abstract, suggest a linear progression of stages in the creative process, it should not be assumed from this that the creative process in practice is being conceived as linear and non-iterative: indeed the reverse is often true.

For learners, a simplified definition of creativity might be:

> *Creativity is coming up with new and useful ideas and solutions. It involves playing around with ideas and considering things from many different perspectives.*

THE FRAMEWORK

This framework describes creativity in a deliberately constrained way: as a cognitive process that leads to a creative product. It does not seek to define creativity as an aspect of the person, or as a product of their environment, though it is acknowledged that these both are regarded as influencing creativity[8] .

DIMENSIONS

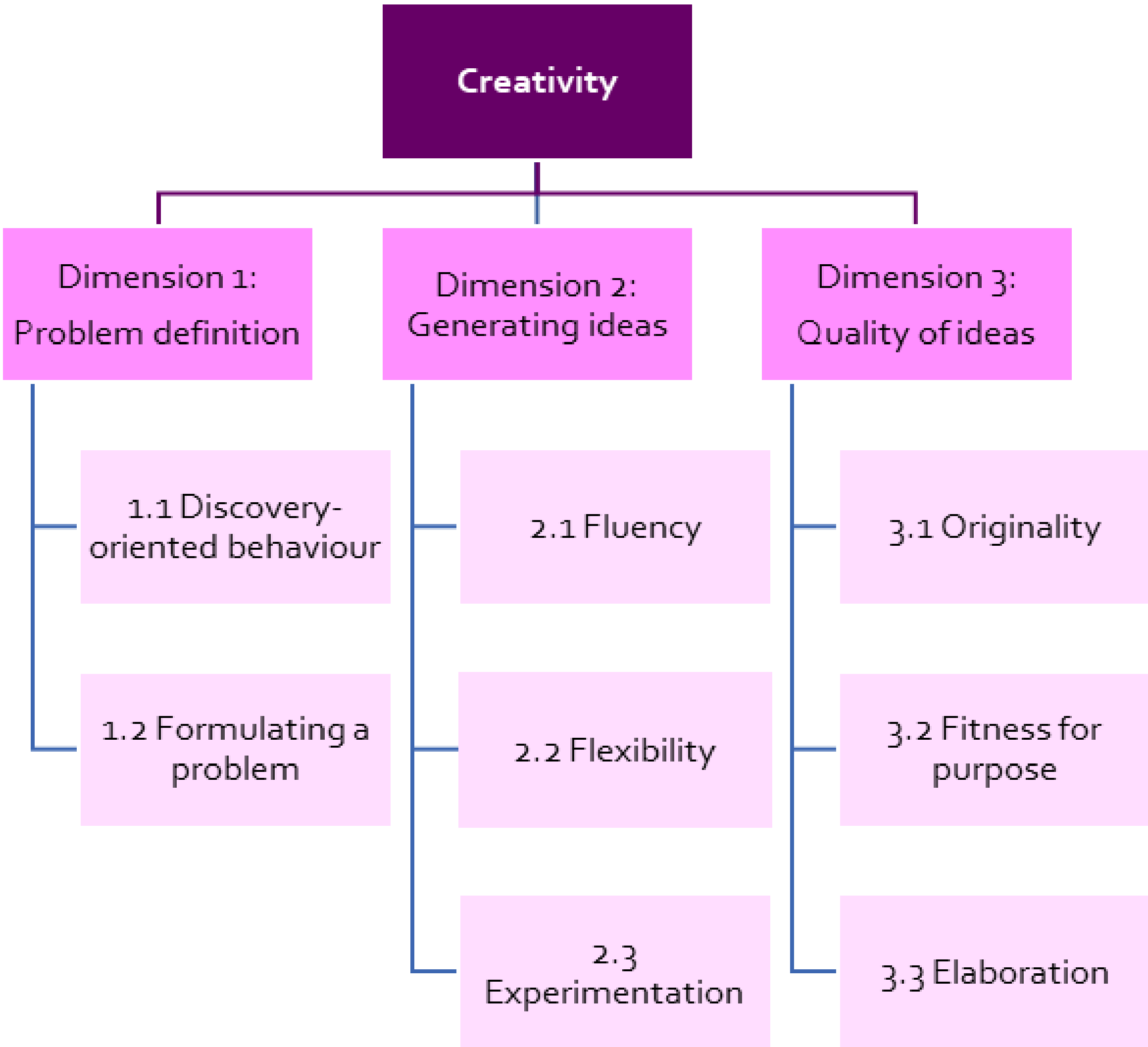
The three dimensions are:

- Problem definition: concerns the initial and potentially iterative stage of the creative process, during which the learner investigates the ill-defined problem they are met with to give greater personal definition to it.
- Generating ideas: concerns the stages of the creative process during which the learner engages in divergent thinking to explore many possible solutions.
- Quality of ideas: concerns the criteria against which the learners may begin to engage in convergent thinking to evaluate their ideas and arrive at their creative solution. They also constitute the criteria against which others may judge the creativity of a solution.

SUB-DIMENSIONS

Each dimension has two or three sub-dimensions as shown in Figure 1.

Figure 1: Creativity Framework



DIMENSION 1: PROBLEM DEFINITION

Problem definition refers to the capacity of individuals to define for themselves a worthy problem that will require a creative solution. A 'problem' can in its broadest sense be defined as any task a person seeks to accomplish, for which their creative output (a strategy, a poem, a theory, a method, a design, and experiment etc.) can be deemed their 'solution'[9] .

In this sense, according to Einstein and Infeld, creativity can be thought to emerge from the formulation of a novel and interesting problem to solve, and not always from the solution, which "*may be merely a matter of mathematical or experimental skill*"[10] .

Many models of the creative process as far back as the work of John Dewey[11] are marked by an initial stage of 'problem-finding': perceiving a difficulty and subsequently locating or defining the problem to solve. In a school-based learning context where tasks and projects are most often assigned, to expect learners to 'find' a problem may be ambitious. However, several researchers make a distinction between the uncovering of a problem 'out of nowhere' and its subsequent definition or formulation[12].

Problem definition in the classroom therefore relies not on learners finding their own problems to solve as much as on the presentation of problems and situations to the learner that are ill-defined, "*in which a greater burden is placed on the individual with respect to defining the nature of the problem*" that has been presented[13] .

Depending on how ill-defined the problem is, problem definition can differ in complexity while well-defined problems tend to suggest a much narrower range of possibilities in finding a solution, and so are unsuited to fostering creativity.

SUB-DIMENSION 1.1: DISCOVERY-ORIENTED BEHAVIOUR

Discovery-oriented behaviour describes the exploration of the nature of an ill-defined problem before attempting to come up with ideas to solve it, in order to find interesting challenges or ideas within it[14] . A stage of preparation in which individuals gather and consider information relevant to solving the problem is a long-standing component of creative process models[15] . In visual art[16] and in creative writing[17] greater amounts of discovery-oriented behaviour prior to commencing the creative process have been correlated with higher ratings of the resulting creative product.

Examples

- A primary school teacher who has been teaching his learners about plants asks his learners, "What could be an experiment we could run to test what we know about plants?" Before coming up with ideas for the experiment, learners are assisted by the teacher in a brainstorming exercise about everything they know about plants: types of plants, parts of plants, conditions they need and so on. This assists them to consider what aspect of their knowledge of plants could be a suitable basis for an experiment.
- A design teacher poses the challenge to her learners, "How could we use design to address the growing problem of homelessness in our city?" Before suggesting design solutions, learners begin to examine the causes of homelessness as well as its effects and look at the needs of homeless people. They consider aspects of shelter, mental and physical health, employment and other issues homeless people face.
- A drama teacher asks his learners in small groups to direct and perform "what modern audiences would see as the crucial scene" from the play they've been studying: The Crucible. Learners examine the play script, discussing and comparing each scene's importance. They start to consider what the teacher might mean by a "modern audience", identify themes in the play that have contemporary relevance and consider how these might impact the way they choose to direct and perform a chosen scene.

SUB-DIMENSION 1.2: FORMULATING A PROBLEM

To formulate a problem is to make sense of and articulate an ill-defined problem, for oneself or for others[18] . It requires the ability to express or give definition to the particular way one is conceiving of the problem[19] that is worth pursuing. The formulation of a problem may be called problem posing in mathematics[20] , hypothesis generation in science[21] or may simply be expressed as a question requiring a solution. At a high level, the formulation of a problem is complete to the extent that it gives a full account of the requirements, constraints and issues that will determine the appropriateness of the solution.

Examples

- A primary school teacher has posed the question, "What could we as a class do to help local endangered species?" Having explored the question, three groups of learners formulate the problem differently. One group of learners has decided that habitat loss is the major problem and so will investigate ways to reduce it or its effects. Another group considers that the problem is one of a lack of community awareness and may be improved by humans changing certain behaviours. A third group sees the problem as one of introduced species and so wonders if there is anything they could do to minimise the impact caused by these.
- A senior photography learner is presented with the theme of "Change" for their next project. They see the challenge of this theme as not simply deciding what they will photograph that will explore the theme in interesting ways, but also how a photograph – which captures a moment in time – can represent a process that takes place over time. They include this formulation of the problem in their process journal.
- To emphasise the practical importance of science, and to teach learners to apply the experimental method, a teacher has asked her class to design an experiment that could "save lives". Learners explore what this could mean via a brainstorm. As a result, some learners consider the task by looking at how a science experiment might detect allergens in food. Other learners consider whether testing the safety of certain materials might be a way to approach the problem. Yet other learners consider the challenge from the perspective of either providing or testing for potable water. All three groups of learners have formulated the problem differently.

DIMENSION 2: GENERATING IDEAS

At its core, creativity is about the generation of ideas[22] . This strand acknowledges the importance of this process, and the central role of divergent thinking. In essence, divergent thinking is the ability to see lots of answers to an open-ended question, situation or problem. It enables the generation of numerous ideas and increases the probability of a learner generating an original or adapted idea[23] .

Key to this strand is the ability to 'play' with ideas by actively considering them from different perspectives and exploring how the constraints might be reconsidered in order to maximise the space for possible problem solutions. This process of experimentation can lead to new ideas as existing ideas are adapted, or multiple ideas are synthesised [24].

SUB-DIMENSION 2.1: FLUENCY

The ability to generate a large number of ideas has been referred to as "ideational fluency". This concept has an established presence in research literature[25] . This aspect does not speak to the quality of ideas – it is certainly possible to produce a large number of ideas, all of which are unfit for purpose – however, the more ideas are produced, the more likely it is either that a genuinely creative idea that is both novel and fit for purpose, will be among them, or that the ideas may be combined in some way to form a new creative product, idea, or solution.

Examples

- A maths teacher presents the class with an integration problem and asks the class to brainstorm different methods that could be used to solve the problem.
- A Physical Education teacher asks learners to brainstorm as many changes to the rules of play in a particular sport as they can that would make the sport "better" in some way.
- A design teacher provides a fictitious brand to the class for whom they need to develop a new logo. Learners are required to make annotated sketches of as many logo designs and logo elements as they can think of for this brand.

SUB-DIMENSION 2.2: FLEXIBILITY

While generating a large number of ideas increases the likelihood that a creative one will be among them, if all ideas are similar to each other, a creative idea is less likely to emerge. This can result from a form of cognitive bias called functional fixedness[26] , where we only look at the task from one perspective and are unable to see other possibilities.

Domain specificity (looking at a problem only from the point of view of a single discipline) may similarly hamper the emergence of a range of solutions. Creative ideas often occur when thinkers are able to bring ideas from different disciplines and viewpoints. The capacity to instead generate a range of different types of ideas across different categories shows flexibility in the generative process and is a likely indication of greater creative potential. The importance of the range of ideas being accounted for dates to early seminal divergent thinking tests[27] and remains present in many modern assessments[28] .

Examples

- A science class has brainstormed ideas for an experimental design to ascertain whether plants need light to survive. The class work together to categorise the ideas and make judgements about how different the ideas are from each other. The categories might focus on for example, ideas with a common metric for considering survival or a common way of removing light. The teacher encourages the learners to think of any other types of ideas.
- A junior primary class are asked to think of fund-raising ideas for the class stall at the up-coming school fair. The teacher guides the class in identifying the ideas they came up with that are similar to each other; e.g. ideas that include selling food (e.g. a cake stall), selling a service (e.g. face-painting), selling objects (e.g. second-hand toys), etc. To increase their flexibility of thinking, she asks if learners can think of ideas that are not one of these 'selling' categories. Learners begin to offer ideas that are game-based (e.g. ring toss), chance-based (e.g. guess the number of jellybeans) and so on.
- A geography class studying hazard geography has been asked to apply their knowledge of a particular hazard to develop their own "hazard safety solution". Learners develop their own brainstorm first and are then asked to identify how many ideas they came up with in the following categories: prevention, detection, construction, restriction, adaptation, response, and any other categories they came up with. Where they have not come up with an idea for one of these categories, learners are encouraged to continue their brainstorm attending to these categories in particular.

SUB-DIMENSION 2.3: EXPERIMENTATION

Experimentation with concepts, solutions and products in the service of generating ideas requires flexible thinking. Novel ideas and solutions can emerge from this 'play' within the problem solving or conceptual 'space'. Combining concepts, products, features or elements that are usually considered unrelated, or rearranging elements within a concept, can produce surprising and effective results[29] . Similarly, to subvert and test the limits of a conceptual space by pushing the boundaries to explore and possibly change the rules of what is expected can result in creative idea generation[30] .

Creative ideation also emerges from using metaphoric representations[31] and analogous associations, or the transferral of ideas from one domain to another[32] . Cognitive processes such as these can lead to what is known as 'conceptual expansion', in which existing conceptual boundaries are broadened or relaxed to accommodate novel exemplars outside of the usual frame, thereby generating unusual ideas and relationships[33] .

Examples

- A music learner is learning the twelve-bar blues and notices most songs in that style are in a 4/4 timing. She wonders what would happen if she broke that rule and tried to play twelve-bar blues progressions in a 3/4 timing to produce a "twelve-bar waltz".
- Primary learners in small groups are undertaking a project-based learning task on how to develop a communication piece about the local history of the area that they have been studying. As they pool their best ideas, the teacher encourages them not to choose one best idea but to try to combine aspects of everyone's best idea. The learners in one team consider ways to combine aspects of a walking tour, a historical re-enactment, a website and a map and timeline.
- In a creative writing response to a text, a senior literature learner notices the themes of power and authority in the text are present in other non-fiction texts such as in contracts that use complex and confusing legal language, propaganda and in science writing. They also consider ways in which "power" is understood in nature, or in physics. They also notice how 2nd-person voice ("You") can make the reader feel like the subject of the narrative and see this as a possible metaphor for the exertion of power over the reader. They examine ways to combine these ideas in their written response.

DIMENSION 3: QUALITY OF IDEAS

While the processes of problem finding and generating and evaluating ideas are necessary to creativity, simply undertaking these processes may not in fact be sufficient. Creative problem-solving processes such as these are no guarantee of a creative solution. It is thus also critical that a proposed solution possess certain features to truly demonstrate creativity. This strand makes explicit what those features should be.

SUB-DIMENSION 3.1: ORIGINALITY

While there are still many issues in relation to creativity that are the subject of debate, there is consensus that critical to creativity is the development of original or novel ideas[34]. This aspect requires special consideration in the context of the classroom. It is unlikely that learners, especially young learners, will develop ideas that have never before been generated, however novelty should be considered in relation to social context, being defined by the rarity of a response compared to other learners[35].

If a learner generates an idea that is unusual when compared with their classmates' ideas, even if that idea is not new in an absolute sense, it can be considered original at a "mini-c" or "little-c" level[36] . A marker of significant originality might be the extent to which the learner has made a conceptually 'far transfer' between the presented topic, subject or material at hand and some other unexpected or seemingly unrelated topic or subject[37] .

Examples

The following examples are used to demonstrate all three sub-dimensions for Quality of ideas.

- Learners undertaking a problem-based learning task about refugee resettlement are asked to develop ideas for how refugees could be helped to settle more smoothly into the local community. Most learners' ideas revolve around providing them with basic necessities and services like food, shelter and language learning. One learner's idea is to create a refugee-staffed volunteer home gardening service for elderly residents in the community.
- A drama class are asked to write and perform some short two-to-four person plays on the theme of "conflict and tension", to be performed as an end-of-semester revue. Learners develop a wide and varying range of ideas, including premises such as moral dilemmas, armed conflict situations, domestic dramas and so on, and all demonstrate significant originality. However, rather than perform theirs on stage, one group decide to perform a scene of an argument between a couple in the front row of the audience itself, which spills over into conflict with other "audience members".
- A food technology teacher gives her class the ill-defined challenge to create "an original family recipe" for a main evening meal. While most learners start to consider recipes for dishes they in their family regularly consume, one learner who has (distant) French and Japanese heritage declares they will create a dish that blends these two cuisines to represent his heritage. He is considering developing a recipe for a 'Ramen-Soufflé'.

SUB-DIMENSION3.2: FITNESS FOR PURPOSE

While definitions of creativity are contested, there is fundamental agreement that, in addition to some degree of originality, it includes the notion of the end result being fit for purpose. Influential definitions have used the words 'appropriate'[38] and 'useful'[39] to express this idea. This aspect suggests that creativity has a purpose, and if the end-product is of no value or does not suitably fulfil a desired function (even if that suitability or value is only appreciated by the individual who created it, or in retrospect), then it does not fully demonstrate creativity.

Examples

- The idea to help smoothly resettle refugees by having them do voluntary garden maintenance for elderly members of the community was initially considered by the teacher to be unusual, and the benefits for the refugees was not immediately clear. However the more the teacher thought about it, the more they could see it could be an elegant solution and so fit for purpose. They ask the learner to explain their thinking…
- While the idea to stage elements of a performance in the audience rather than on the stage is certainly not new in the history of theatre, it was not an idea this drama teacher had encountered from his learners before. It was original in that sense, but will it work? Will the audience all be able to hear and see it? In other words, why not just perform the scene on the stage? To work out if the idea will be fit for purpose, the drama teacher asks the learner to explain the concept…
- The food technology teacher loves the idea of blending Japanese and French cuisines for the learner's "original family recipe", but wonders whether the learner has considered exactly how, or in what way, a Ramen and a Soufflé can be blended. The learner is also quite young and inexperienced, so she is unsure whether the learner has the skill necessary to create such a dish. She considers the idea very original but is not sure it will work, so decides to speak to the learner …

SUB-DIMENSION 3.3: ELABORATION

If a truly creative idea is developed, it may not be recognised as such if the generator of the idea cannot explain how it meets a given purpose or realises the cleverness or originality of the solution. Elaboration involves working out the details of an idea or solution[40], specifically how it would work. It is demonstrated when learners can share those details and sufficiently justify the potential and the significance of their idea.

While for some ideas the justification may seem immediately obvious, this aspect will be of particular importance where a creative idea is sufficiently imaginative and unusual that it is difficult for others to immediately recognise how it works or will work[41].

Examples

- The learner who came up with the refugee volunteer gardening service idea is asked to explain her thinking. She explains that she thought having the refugees perform a service to the community would help to make them more readily accepted and valued by the community and establish real connections with people. She also said it might help their communication skills and make them more employable later. She also noted that she wondered if, by helping elderly people in particular, this might help to reduce any fear or stigma the refugees might otherwise face, particularly from older people in the community. The learner could thus elaborate exactly what makes the idea fit for purpose.
- The drama learners who plan to perform their scene in the audience rather than on stage explain to the teacher their process. When they considered the theme of "conflict and tension" they noted how, often when there is conflict in public, it creates tension for everyone one else who witnesses it. A theatre is a place where best behaviour is expected, and conflict unexpected, so it could be a good way to try to make the audience feel more actively engaged in the conflict, and in the tension it creates. However, while the learners seem to be aware of the novelty of the concept and their intention in theory, they don't yet seem to be aware of the ways the performance might not succeed on a practical level. The teacher asks them questions about blocking, voice projection, and lighting and so on to prompt them to consider how their original idea might also work effectively.
- Upon discussing the 'Ramen-Soufflé' idea with the learner, it becomes apparent to the teacher that the he had not thought very deeply about what such a dish would look like, taste like or how it would work. The learner was not even aware of what a soufflé was, having never eaten one; it was simply the first French dish he thought of. Nevertheless, the teacher sees real potential for the idea, and directs the learner to do some more research about dishes, ingredients and flavours from each country that might pair well in a combined recipe.

PART 2: EVIDENCE OF CREATIVITY

This section considers evidence that may be collected about the extent of learners' creativity, as well as evidence of their creative thinking skills that are essential to effective creative problem solving.

Two resources are provided:

- Creativity thermometer
- Creativity: development levels

CREATIVITY THERMOMETER

While creativity can be found and demonstrated across all learning domains, and so to some extent is generalizable, it doesn't follow that learners can or will be equally creative in every learning domain. Even if learners follow a creative thinking process, they may not demonstrate significant novelty or 'cleverness' of ideas, and nor might they feel very creative in their thinking.

The creativity thermometer is a self-reflection tool for learners to answer the questions: How creative was I? What evidence can I point to, to justify this? Why do I think my creativity was this way in this context? The purpose of the creativity thermometer is for learners, and teachers, to develop a better understanding of how different learners experience and exercise creativity in different contexts, and how to possibly enhance this.

The creativity thermometer descriptions range from hot to cool, aiming to make the learner's sense of their own creativity more 'visible'. When supported with evidence, it allows teachers, and learners to develop an understanding of what constitutes creativity and how it might be enhanced. The aim is not for learners to always be "hot" in terms of their creativity. Rather, it is to increase learners' self-awareness of what being creative looks and feels like, and how to foster their own creativity in a positive and effective way in their own learning.

It is important that learners are provided with opportunities to be creative across different domains and contexts, so that all have opportunities to connect with things that activate their creativity as well as learning more about themselves in contexts where they struggle to be creative. The creativity thermometer is not a learning progression or skill rubric. Progressions and rubrics suggest uni-directional growth in skill or ability.

How much a learner demonstrates creativity during any given learning task, however, is only partly a function of skills they may or may not have, but much else besides. The learner may lack the base knowledge in the topic at hand necessary to be creative with it in their thinking. The task may not be sufficiently ill-defined, and the environment and resources not conducive, to allow free-form possibility thinking and risk-taking, or there may simply not be the time afforded to allow creative ideas to foment and coalesce.

Given the range of factors that can affect how much creativity a learner demonstrates, the creativity thermometer needs to be understood not as a tool used to assess the learner, but as a means of evidencing their creativity, with an understanding that creativity will differ in different contexts depending on each of these factors.

HOW TO USE THE CREATIVITY THERMOMETER

The creativity thermometer is a means of having learners think about evidence of their own creativity.

One approach might be to have learners answer a related set of questions and then, based on those answers, place themselves somewhere on this thermometer. The other is the reverse approach: they read the thermometer levels and go with their own intuitive hunch about how creative they know or feel they were, but then need to justify that level with evidence.

Either way, in a conversation with a teacher, the teacher may bring other evidence of what they saw of the learner's creativity, and the learner may re-adjust their self-assessment.

When using the thermometer, teachers and learners therefore need to be clear about three things:

1. How creative one is does change, depending on the learning domain or context. We are all more or less creative in different fields and learning domains. Not demonstrating high levels of creativity in one domain does not necessarily mean one lacks creative ability. This is also not an assessment, and it contributes nothing directly towards a learner's grades.
2. This difference in creative capacity is not a function simply of the learner's innate creativity, but of the learner's own grasp of the topic, their pre-existing skills, knowledge and experience, as well as external factors for which the learner should feel no personal responsibility, such as the subject, the topic, the presentation of the problem, the learning environment, the time and opportunity to explore and experiment, and potentially many other things.
3. Thus, knowing why one was more, or less, creative in a task or in one's thinking is the point of this self-reflection: both for the learner so as to develop a greater metacognitive awareness of their own creativity, but also for the teacher so they can support the learner to engage creatively in the learning.

Table 1: Creativity Thermometer

Hot	• I explored the problem or task quite a lot and thought deeply about it. I didn't decide too early how I was going to approach it. Instead I kept a really open mind. I found a pretty interesting way to think about the task that I don't think others did, but which I also thought would work quite well. • I came up with lots of ideas that were all quite different from each other. As I developed my ideas I could pull the problem apart and think about it in different ways. I combined ideas or made interesting connections in my thinking about how to approach the task. I tried to bring in ideas from lots of different places. • My final idea/best solution was pretty different; one that not many other learners in my class would think of. It also works really well. I was able to explain clearly exactly how it addressed the original problem, or what about it makes it a clever idea.
Warm	• I explored the task in some detail. I thought about a few ways I could approach it as I did some thinking about it. I came up with a way of thinking about the task I was pretty sure was going to work quite well. • I came up with quite a few ideas or solutions that were mostly quite different from each other. I tried to think about the problem from different angles and use any material I had given to help me. I considered ways of combining ideas and tried to think of unique possibilities. • My final idea/best solution had some aspects to it that were quite different: things not many learners in my class would think of. It works quite well, and I could explain how I came up with the idea and why they would work.
Lukewarm	• I tried to explore the task and could see there were a few ways to go with it, but I decided pretty quickly what my approach to solving/the problem/approaching the task was going to be. • I came up with a few ideas, and tried to think of things that were different, but my ideas were mostly quite similar to each other. I experimented a bit with my ideas but not very much. • My final idea/best solution was fairly similar to other learners' ideas, with perhaps something slightly different about it. I am not sure whether my best solution works completely or addresses all parts of the problem or task, but I was able to explain how I thought it would work.
Cool	• I very quickly decided how I would approach the problem or task. It seemed pretty straightforward. • I came up with only a few ideas, and these ideas were very similar to each other. I didn't 'play' with ideas very much at all, or try to change my approach. • My final idea/best solution is very similar to other learners' ideas. It might be a bit too simple to meet all parts of the problem or task. I found it hard to explain why it was a good solution.

CREATIVITY: DEVELOPMENT LEVELS

While this framework describes creativity as a result of solving ill-defined problems, there is obviously much more to creativity. Aspects of personality, one's disposition, experience and environment will play a part. However one part of being creative involves associated skills of divergent thinking developed in this framework. It also requires evaluative convergent thinking skills to identify for oneself an idea that is novel, that will work, and why. Documenting evidence of these skills during a creative problem solving task, and matching them to level descriptions, helps teachers to identify the extent to which learners have the essential skills to enact the creative thinking process.

In the following tables, hypothetical descriptions of growth in each of the sub-dimensions of the framework structure are given. Generally, there are four levels, but in some cases four levels of description could not be supported on the basis of current evidence. It is expected that these learning progressions will evolve as new evidence becomes available to inform them.

Some learners may demonstrate high levels of creative inclination – being very divergent in their thinking – but may lack the convergent thinking skills necessary to identify and develop a creative idea through. Other learners may be the opposite: they may be very convergent in their thinking and need assistance to remain open to experimentation and possibility thinking. Identifying which levels of skill they demonstrate in each of the sub-dimensions supports understanding what they still need to learn.

The following considerations should be taken when using these levels:

1. As these have been written as generic behaviours of learners in response to a generic creative task or problem, the descriptors at each level will not all – or always – necessarily apply. Teachers should therefore treat these as indicative behaviours when trying to consider how creative a learner has been. Learners would typically demonstrate many, but not necessarily all behaviours at a level to be judged at that level.

2. Though many of the descriptors are described as "live" behaviours, it is acknowledged that this may make it difficult to capture such evidence. Consideration should be given to how teachers might record – or ask learners to record – evidence of their skills, knowledge and effective use of attributes, e.g. asking learners to write down all the questions they have, or to complete a reflection task.
3. A reflective question teachers should ask themselves is: Given how creativity is being described at the upper levels
   a) Will my lesson content or the topic elicit these responses and skills in learners? Is the problem or task I am giving them ill-defined enough? Can it be?
   b) Can I present the lesson content/topic in such a way as to elicit greater creative thought and problem solving?
   c) How much opportunity (time, resources, technologies) will the learners have to demonstrate those skills and attributes described at the upper levels? Can I improve that opportunity?

Responses to these questions will help teachers to moderate their expectations both of their learners and themselves; not every lesson, unit or topic will offer the same potential for creativity.

DIMENSION 1: PROBLEM DEFINITION

1.1 DISCOVERY-ORIENTED BEHAVIOUR: WHEN PRESENTED WITH AN ILL-DEFINED PROBLEM/TASK, LEARNERS…

Extensive	• sustain a ranging exploration of the problem/task • approach the ill-defined problem/task with very few preconceived constraints • engage with and explore a diverse range of information, material and ideas deemed to be important in the construction of a more defined and interesting problem to solve in completing the task • demonstrate unconventional consideration of connections between, and possibilities with, the ideas they encounter.
Significant	• open and detailed exploration of the problem/task • approach the ill-defined problem/task with an open mind as to the range of possible directions and interpretations that could be taken • analyse information, material and ideas, and the possibilities they suggest or afford are explored and articulated • explore the problem in thoughtful but relatively conventional ways, leading to an interpretation of the problem or task that is very appropriate, and potentially fruitful, but not highly unique.
Moderate	• explore the problem/task in a routine and superficial manner • understand the ill-defined problem/task does not necessarily entail an obvious approach and needs further development • make plausible efforts to consider the problem from a range of possibilities or perspectives or pursue a small range of alternative material, ideas or directions • explore genuine possibilities but in a relatively shallow way • demonstrates a favoured approach, and 'exploration' of alternatives is limited so as not to complicate original intended approach
Very limited	• explore the problem in a limited way • quickly arrive at interpretations of the problem and settle on these (which may therefore be obvious and predictable) • narrowly explore the complexity of the problem • demonstrates limited exploration of potential range of approaches • focuses on a simple or singular interpretation of the task

DIMENSION 1: PROBLEM DEFINITION

1.2 FORMULATING A PROBLEM: WHEN RE-PRESENTING THE PROBLEM OR EXPLAINING HOW THEY HAVE SOUGHT TO ADDRESS THE TASK, LEARNERS…

Extensive	• interpret the possibilities and nature of the problem/task in a relatively sophisticated and unusual way • can identify how the ill-defined nature of the presented problem/task led to their conceptually unique framing of it
Significant	• interpret the possibilities and nature of the problem/task in a considered and detailed way • can identify how the ill-defined nature of the problem/task enabled a personally interesting and challenging framing of it
Moderate	• interpret the possibilities and nature of the problem/task in a conventional but adequate way • can describe how the presentation of the ill-defined problem/task led to their consideration of it from within a fairly conventional frame of reference only
Very limited	• interpret the possibilities and nature of the problem/task in a superficial and limited way • can describe how the presentation of the ill-defined problem/task led to their consideration of immediately obvious and predictable interpretations of it

DIMENSION 2: GENERATING IDEAS

2.1 FLUENCY: WHEN GENERATING IDEAS, LEARNERS…

Extensive	
Significant	• provide many ideas (relative to peers or to teacher expectations) • demonstrate a willingness and significant ability to consider multiple possibilities
Moderate	• provide a reasonable number of ideas (relative to peers or to teacher expectations) • demonstrate willingness to consider multiple possibilities • demonstrate an ability to 'push past' some immediately obvious ideas
Very limited	• provide a very limited number of ideas (relative to peers or to teacher expectations) • demonstrate significant difficulty considering multiple possibilities beyond the most immediately obvious

DIMENSION 2: GENERATING IDEAS

2.2 FLEXIBILITY: WHEN GENERATING A NUMBER OF IDEAS, LEARNERS…

Extensive	• provide a broad range of ideas; ideas that are quite distinct from one another • demonstrate a repeated ability to shift perspective to achieve a diverse range of ideas • think about the problem/task in several different ways and from a range of conventional and unconventional perspectives/approaches
Significant	• provide a reasonable range of ideas; ideas that are somewhat distinct from one another • demonstrate that they can shift perspective, thinking about the problem/task in some different but mostly conventional perspectives/approaches
Moderate	• provide a limited range of ideas; ideas that are not very distinct from one another • demonstrate that they have difficulty shifting perspective, thinking about the problem/task mostly from conventional perspectives/approaches
Very limited	• provide ideas that are all very similar in type; ideas are variations on a theme rather than categorically different • demonstrate very little capacity to shift perspective, thinking entirely from conventional perspectives/approaches

DIMENSION 2: GENERATING IDEAS

2.3 EXPERIMENTATION: WHEN DEVELOPING IDEAS, LEARNERS…

Extensive	• manipulate elements of the task or solutions effectively • combine elements of different ideas elegantly or cleverly to allow new possibilities or a different way of thinking about the task • shift beyond disciplinary constraints or conventional approaches or perspectives leading to new possibilities • question and renegotiate the boundaries of the task to navigate around possible constraints
Significant	• manipulate some elements of the task or solutions • synthesise existing ideas in ways that are functionally effective but perhaps not elegant • consider less obvious ideas or aspects of the task • generate some promising possibilities
Moderate	• manipulate elements of the task or of solutions in predominantly routine ways • limit exploration to obvious elements of the task • revisit or reapply the same ideas, rather than generating new ones
Very limited	• manipulates little about the task or solution • demonstrate that they struggle to accept variation from the norm or an established solution (perhaps by expressing doubt or negativity about adaptations to it)

DIMENSION 3: QUALITY OF IDEAS

3.1 ORIGINALITY: IN RELATION TO THEIR IDEA OR SOLUTION PRODUCED, LEARNERS…

Extensive	• compose ideas that are quite unique for their peer group • provide ideas that contain or reflect elements and concepts that are unusual and unexpected • provide ideas that may indicate significant transfer and blending of concepts/elements most other learners do not access or consider
Significant	• compose ideas that are somewhat distinctive for their peer group • Provide an idea that aligns with conventional expectations for the task, and appears as a usual type of response, but a significant element of it is quite distinct and memorable when compared to conventional peer responses
Moderate	• compose ideas that are mostly conventional for their peer group • provide ideas that contain or reflect elements that are reasonably obvious and already familiar to them and their peers • demonstrate some minor personalisation or variation to their idea that makes their particular idea somewhat distinct but not significantly so
Very limited	• compose very obvious or conventional ideas, as expected for their peer group • provide ideas that contain or reflect elements and concepts that are already familiar to them and their peers, with minimal evidence of personalisation or variation from a usual response

DIMENSION 3: QUALITY OF IDEAS

3.2 FITNESS FOR PURPOSE: IN RELATION TO THE IDEAS, PRODUCT OR SOLUTION, LEARNERS…

Extensive	• provide a clever solution or response (relative to peers or to teacher expectations) • address the requirements of the problem/task in clever or sophisticated ways
Significant	• provide a considered and effective response • express a solution that fully addresses the requirements of the problem/task
Moderate	• provide an adequate, or insufficiently developed, response • address certain or key aspects of the problem/task but the solution may not completely 'work' or fulfil the requirements
Very limited	• provide an ineffectual or incongruous response • express a solution that does not adequately fulfil the most important requirements of the problem/task and so does not 'work' as a response or a solution

DIMENSION 3: QUALITY OF IDEAS

3.3 ELABORATION: WHEN EXPLAINING THEIR RESPONSE TO A PROBLEM/TASK, LEARNERS…

Extensive	
Significant	• present a complete and coherent elaboration of their idea, product or solution • explain their idea in a substantive way, addressing and justifying all aspects of the effectiveness, originality and fitness for purpose • explain in detail the inspiration for the response, or how the idea came together
Moderate	• present an adequate elaboration of their idea, product or solution • demonstrate a reasonable if not comprehensive understanding of why their response is effective, original or fit for purpose • explain in simple terms the inspiration for the response
Very limited	• presents a basic or limited elaboration of their idea, product or solution • demonstrate limited ability to adequately evaluate their idea for its effectiveness, originality or fitness for purpose • struggle to articulate their inspiration for the response

Table 1: Factors affecting opportunities to be creative in a school context

	Foundational knowledge: extent of prior knowledge taught/established	Valuing creativity: valuing the process, recognising, rewarding and encouraging creativity	Task opportunities: nature & focus of task	Support: extent of guidance, feedback, opportunities to reflect	Access to resources: relevant, readable for learner, available, sufficient
Comprehensive	Learners have been provided with the opportunity to develop a diverse, well-connected, knowledge base from which many possible questions or ideas arise	There is a genuine valuing of the process of being creative, exploring and possibly not finding answers, rewarding time invested, reflections and connections that show greater depth of understanding	Learners are given open tasks with clear guidelines that focus on promoting creativity; sufficient time is allowed for problem solving and reflections; and creativity is not compromised by other task purposes	Extensive support is provided to learners in customising individual creative problem-solving plans with ongoing iterative advice, constructive feedback & structured reflections that challenge thinking	Sufficient appropriate, accessible, engaging resources are available to learners to support creative problem solving
Adequate	Learners have been provided with the opportunity to develop a basic, connected knowledge base prompting some clear questions or ideas, but with limited diversity	Learners are encouraged to pose & investigate a diversity of ideas, and reflection on a range of outcomes is valued	Learners are given open tasks with an intended major focus on pursuing creative ideas and solutions, but are provided with limited guidelines or support and there is limited time allowed	Generic support and advice is regularly provided to learners, including feedback and encouragement of reflections with limited customisation	A range of appropriate, and engaging resources are accessible to learners but tend to constrain the extent of their experimentation
Limited	Learners have been provided with the opportunity to develop a limited knowledge base that is narrow, or largely fragmented	Creativity is interpreted as generating 'curriculum-relevant' ideas and 'successful' findings tend to be valued more than others	Creativity is mainly used as a limited 'add-on' to a task with other foci and the scope of any activities designed to facilitate creativity are heavily constrained	Minimal support is provided to learners at the start, with limited feedback or support as the process unfolds	Either limited appropriate, accessible resources, or an overwhelming array of resources are accessible to learners, with minimal support to filter them
Minimal	Learners have been provided with little opportunity to develop a knowledge base beyond superficial coverage	Any valuing of creativity is largely token – creativity is assumed to align with the curriculum content	Any opportunities to demonstrate creativity are largely prescribed or predictable, or may be missing entirely	Little constructive support is provided to learners at any point	Minimal appropriate resources are available or accessible to learners and there is no support to filter them

APPENDIX 4: CURIOSITY FRAMEWORK

CURIOSITY FRAMEWORK AND EVIDENCING

Australian Council for Educational Research, 2021

INTRODUCTION

This curiosity-driven inquiry framework sets out to provide a practical definition of curiosity as a key component of intrinsically motivated inquiry-based learning that is useful to educators within the International Baccalaureate (IB). Whether curiosity exists as an enduring personality trait, or a temporary cognitive state, it is regarded as a "need for knowledge and exploration of the unknown"[42] that motivates learning.

The framework development was informed by an extensive review of the academic literature, much of it from the field of psychology. This literature was first analysed to identify the most common elements in definitions of curiosity. The literature was further analysed to identify what, specifically, curiosity correlates with that is – or might be expressed by – observable behaviour including cognitive skills and attributes that typically characterise curiosity. These were organised into two dimensions of focusing curiosity (initiation) and resolving knowledge gaps (satiation). Each dimension can be considered a conceptually distinct phase of curiosity.

Defining and capturing curiosity in the abstract as an independent, and often fleeting variable (as one might attempt to do in controlled psychology research) simply would not work in schools. Rather, to be able to capture evidence of curiosity in a classroom context – and a sufficient amount from which to draw meaningful conclusions – it was felt curiosity needed to be contextualised within and framed by an extended inquiry process.

Allowing learners time to pursue a curiosity-driven set of questions as an in-depth pursuit where extensive value is placed on the process of investigation, gives plenty of scope for learners to follow curiosity-driven inclinations and therefore to demonstrate curiosity-driven behaviours as well as demonstrating increasing mastery of a broad set of additional skills required for an effective inquiry.

A practical definition of curiosity is given within a framework that describes how curiosity supports inquiry learning. A curiosity thermometer allows learners and teachers to reflect on and collect evidence of learners' curiosity in the context of the progressive development of their inquiry skills. The framework will help to inform the IB's curriculum, enabling teachers in IB schools to observe evidence of curiosity in learners and potentially to comment on how learners are developing as curious learners, as well as effective inquirers.

It was also critical that teachers could relate to the framework to encourage its adoption. Making curiosity a less-abstract and more-recognisable construct by linking it broadly to an inquiry process that reflects an instructional method teachers in schools often use, was also considered important.

This framework represents not so much a recapitulation of the curiosity research as an innovation upon it. We found that much of the psychology research into curiosity as an independent variable, while fascinating, had limited practical application to support rich learning in schools and classrooms.

Nor did it entail an identified set of skills that could be taught to foster it, nor any clear evidence of how (if at all) it develops in learners. As such, the current framework for the IB is largely a hypothetical extension of the existing research to a classroom teaching and learning context, and in that sense, places the IB at the cutting edge of curiosity and education.

OVERVIEW – HOW TO USE THIS DOCUMENT

International Baccalaureate (IB) schools want their learners to be curious. The first attribute in the IB Learner Profile is that learners strive to be inquirers who nurture curiosity, developing skills for inquiry and research, learning independently, with enthusiasm and sustaining a love of learning throughout life.

This framework describes curiosity in the context of inquiry learning, but it is not intended as a comprehensive inquiry learning model. Rather, it can be considered an 'overlay' teachers and learners can bring to an inquiry or investigation task to understand how – or how much – the learning has been curiosity-driven, as well as identifying the extent to which learners have sufficient inquiry skills and appropriate personal attributes to support effective curiosity-driven learning

The first part of this document defines curiosity as a driver in an inquiry process and describes the two dimensions of focusing curiosity and resolving knowledge gaps along with their sub-dimensions. These align broadly to stages of inquiry or investigation. Each sub-dimension also identifies associated inquiry and reflection skills, knowledge and attributes as these will also need to be nurtured and taught. For each sub-dimension, three examples are offered to illustrate what these sub-dimensions of curiosity-driven inquiry look like in hypothetical school-based inquiry situations.

The second part of this document considers evidence of curiosity that may be collected through learners' use of the curiosity thermometer, as well as levels of evidence of learners' inquiry and reflection skills, knowledge and personal attributes all of which are integral to effective learning in a curiosity-driven inquiry. The separate purposes and uses of the curiosity thermometer and the curiosity-driven inquiry skills levels are explained.

The third part of this document identifies issues IB schools need to consider if they are to provide effective opportunities to learners for curiosity-driven inquiry and how this might fit within the IB curriculum. The kind of school culture and classroom factors that are essential to enable curiosity-driven learning are described with implications for possible changes that may be required in some schools. Some evaluation questions and a rubric are provided to support schools and teachers in developing a school context that effectively supports and encourages curiosity-driven inquiry.

PART 1 CURIOSITY FRAMEWORK

DEFINITION OF CURIOSITY

Curiosity is innate. All children are curious about their world, being motivated to explore it in order to understand it and learn how to function within it. However, a distinction made in the research literature is between 'trait' curiosity (curiosity as an enduring disposition) and 'state' curiosity (curiosity aroused by novel, surprising, complex or ambiguous stimuli[43].

Some children are more overtly curious than others, being clearly adventurous in their exploration of the world and demanding in the questions they ask. This may be indicative of having a more curious disposition. For schools keen to develop curious learners, defining curiosity as a trait is problematic as it risks supposing it is a fixed and immutable quality: something they would like their learners to have but can do nothing to foster.

However, every learner's innate capacity for curiosity can be activated to foster deep learning, given the right stimulus. Therefore, a definition of curiosity as something that is susceptible to influence, and which can be nurtured to train learners in being disposed to a lifelong pursuit of knowledge, is more useful.

Thus, the following is presented as a definition of curiosity:

> *Curiosity is a cognitive state that involves the recognition of a meaningful gap in one's knowledge or understanding, the desire to fill that gap and the motivation and intrinsic satisfaction of doing so.*

Curiosity is an intrinsic part of a process of self-motivated development of knowledge and understanding. This process includes inquiry and investigation skills, critical thinking, open-mindedness, risk taking, self-efficacy and reflection. Curiosity provides the incentive and reward for seeking new knowledge and understanding, requiring other skills to ensure that this learning is rich, sustained and productive.

> What is meant by a 'gap'?
> In the curiosity research literature, a gap refers to something that is currently unknown. This may be an experience, knowledge or understanding. In the definition above, a 'meaningful gap' is one where closing it is a substantive task that is likely to lead to richer, deeper or broader conceptual understanding. In this sense, a gap in understanding is not a negative thing; it is the impetus for inquiry, exploration and investigation. 'Filling' or 'closing' a gap can be seen as both the process or attempt to learn something unknown, or the successful result of doing so. Both the process and the result can elicit satisfaction and are the result of curiosity-driven inquiry.

For learners, a simplified definition of curiosity might be:

> *Curiosity is the motivation and desire to explore the unknown, to ask questions and seek experiences and answers that help to develop a deep understanding.*

KEY SKILLS, KNOWLEDGE AND ATTRIBUTES

Curiosity motivates learning, but learners need to develop a broad range of skills, knowledge and attributes to ensure that curiosity plays an effective role in their learning. These include:

- Inquiry skills
- Knowledge
- Personal learning attributes
- Reflection skills

Inquiry skills

Learners need to know how to:

- ask good questions that are worth pursuing
- find and use resources effectively to learn more
- be organised and plan time well
- explore and consider different perspectives; and
- think critically and explain or justify conclusions.

These are complex skills that learners will slowly develop and need to build on year after year.

Knowledge

Sustained curiosity requires a sound knowledge base. While curiosity implies a gap in knowledge or information, learners need to know enough about the context to be able to ask good questions and understand what they find out. If learners are curious about something they know almost nothing about, then the first step will be building their knowledge.

Learners need opportunities to be curious across different learning areas. Learners might surprise themselves finding interests they did not realise they had. The broader the spread of learners' knowledge across different learning areas the greater the possibilities for wonder and curiosity to flourish.

Personal attributes

Key attributes of a curious learner pursuing a sustained inquiry include:

- persistence
- confidence
- self-efficacy
- open-mindedness
- willingness to make mistakes (risk taking)

These attributes are likely to enhance earning in many different ways that are not necessarily related to curiosity or an inquiry. They should be developed in learners whenever possible.

Reflection skills

Supporting learners to develop an understanding of their own curiosity requires skills in reflection, or metacognition. Learners need to know how to describe:

- the kinds of things that make them curious
- strategies that work for to excite their curiosity and
- blockers that stop them from being curious.

What makes one person curious may not make others curious at all. However, the more learners understand themselves and what makes them curious, and the more open-minded they are, the more likely they are to be curious about a very wide range of things.

Reflection skills are not just about curiosity. Self-awareness and the ability to reflect upon oneself and think about the way you behave and why are important learning skills in many contexts.

THE FRAMEWORK

This framework describes curiosity within the context of inquiry- or investigation-based learning to ensure that essential skills needed to support a curiosity-driven inquiry are included. It provides a curiosity 'lens' or 'overlay' through which to consider how much the inquiry is being driven by learners' curiosity as well as the extent to which learners have the necessary additional inquiry and reflection skills, knowledge and attributes to support effective learning.

DIMENSIONS

The two dimensions are:

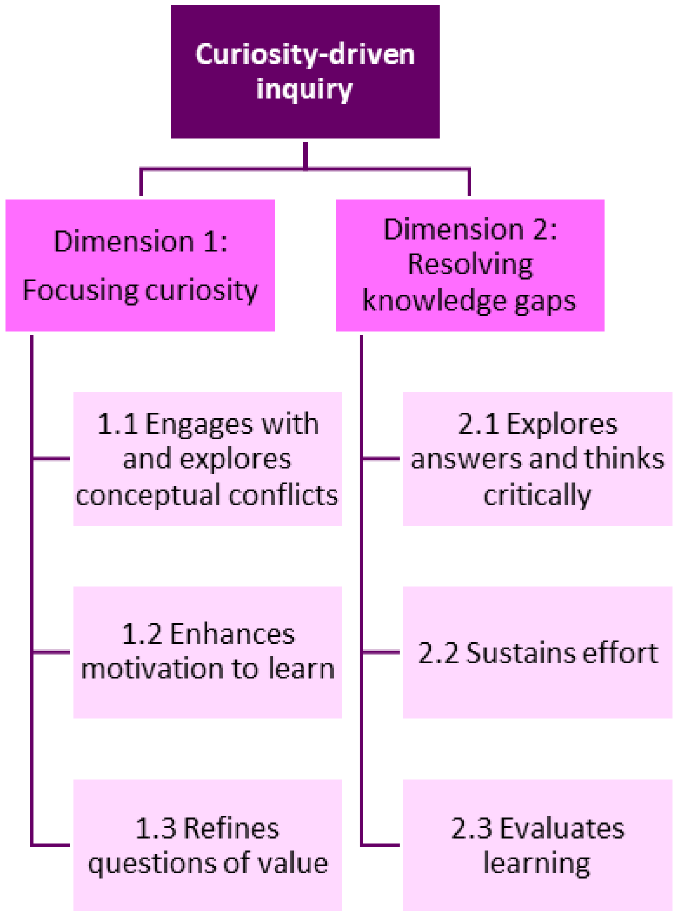
- **Focusing curiosity**: concerns the initial stages of an inquiry when learners are exploring stimulus material, asking questions, identifying what makes them curious, reflecting on this and refining questions of value.

- **Resolving knowledge gaps**: concerns the subsequent stages of an inquiry when learners are pursing questions, experimenting, considering ideas, revising their approach, developing strategies to maintain persistence and finally reflecting on their learning, in particular in relation to the role of their curiosity.

SUB-DIMENSIONS

Each dimension has three sub-dimensions as shown in **Figure 1**.

Figure 1: Curiosity Framework



DIMENSION 1: FOCUSING CURIOSITY

Arousal of curiosity may be involuntary: a spontaneous "*co-occurrence of interest and confusion*"[44] may be triggered when presented with information or stimuli that are novel, complex or ambiguous[45] that seem incongruous or provokes uncertainty[46]. However, when experiencing a sense of interest and confusion, an individual may choose to focus their curiosity through certain active responses to this arousal that prepares them for resolving gaps in knowledge.

SUB-DIMENSION 1.1: ENGAGES WITH AND EXPLORES CONCEPTUAL CONFLICTS

Engaging with and exploring 'conceptual conflicts' refers to those behaviours that suggest curiosity has been aroused. This is demonstrated when one's attention is drawn to a gap in knowledge or misfit of information that one feels compelled to resolve or reconcile[47]. Appraising a situation as puzzling or complex, expressing a desire to know more and asking questions[48] indicate recognition of, and a willingness to create and maintain, these conceptual conflicts[49].

Individuals may voice the contradictions they observe, query unusual or unexpected results or patterns, or identify a confusion and seek clarification to ensure they are not mistaken. Questions may range from shallow fact-based questions to deeper explanation-seeking questions[50].

Examples

- A history teacher shows her class photographs of Easter Island and says, "In 1722, European explorers discovered thousands of people living on this island. Less than 100 years later, almost the entire population of the island had died, leaving 900 statues. Why?" Learners begin to examine the photographs for clues, asking clarifying fact-based questions and posing hypothetical questions.
- A maths teacher covering exponents asks his learners, "If 2 to the power of 2 is 4, and 2 to the power of 1 is 2... what is 2 to the power of 0?" Learners begin to conjecture, justifying their thinking and offering clarifying explanations. When it is revealed the answer is 1, learner ask: Why it isn't 0? How could it be 1? Does the zero halve the base number? What about 3 to the power of 0?
- A primary teacher runs a Predict, Observe, Explain demonstration at the front of the class. A clear container full of water is presented along with a range of different objects of different size, mass and density (a piece of wood, a golf ball, an egg, a rock, an apple, some socks, a paperclip...). The objects are handed around and learners need to predict if they will float or sink. After they observe each object in the water they ask 'explaining questions' or offer some theories as to why some object float and not others.

SUB-DIMENSION 1.2: ENHANCES MOTIVATION TO LEARN

Managing feelings of confusion or cognitive dissonance in order to maintain curiosity enables individuals to enhance their motivation to inquire further. Curiosity may be felt both as a pleasant feeling of interest[51] or a negative feeling of deprivation, and the ability to resolve a balance between these feelings provides the drive to resolve gaps in information[52].

Using metacognitive strategies such as reflecting on what makes one curious, self-setting of learning goals[53], aligning existing interests with new content to develop curiosity[54], acknowledging task value[55] and maintaining an openness to learning and experience[56] all help to enhance motivation to learn.

Examples

- As part of an intercultural understanding unit, learners need to choose a culture different from their own and research some traditions, practices and beliefs of that culture. One learner whose family is planning a holiday to Morocco decides to investigate Moroccan culture, as it may be useful and interesting to see how much of what he learns about he will observe when he arrives there.
- A learner learning about sound and sound waves is also an avid guitarist. She finds the topic of sound waves somewhat boring and wonders why it is important. However she sees a connection between the frequency of waves and the vibration of strings of a guitar. She wonders whether changing a low note to a high note on her guitar by sliding her finger up the fretboard makes the string vibrate faster, creating a higher frequency sound wave. She decides to try to film it using the slow-motion setting on her smartphone to see if she can tell if the string moves faster.
- A primary teacher notices a learner experiencing some frustration during a unit of work on the solar system because they can't understand why objects in space "don't just fall down". To help the learner to enhance their motivation to investigate this, he asks questions like, "How would you feel if you suddenly knew the answer to this question?" and "Where do you think you might be able to find this information out?"

SUB-DIMENSION 1.3: REFINES QUESTIONS OF VALUE

Exposure to ambiguity, novelty and complexity can activate significant curiosity. Multiple questions may be initiated and formulated out of curiosity, but for the purpose of future investigation they must also be evaluated for their worth[57]. Questions that arise are not necessarily equally significant, crucial to understanding, inherently related to each other, or emerge in a coherent order. They may be both open-ended understanding questions that seek in-depth knowledge and identification questions necessary to fill smaller, specific, categorical gaps in knowledge[58].

Refining questions of value, therefore, refers to the process of articulating for oneself the goal of one's inquiry: determining what larger questions of consequence lie 'at the heart' of one's curiosity and have the potential to add significant value to one's existing understanding. These need to be distinguished from those which may be supplementary, secondary to or foundational for developing this understanding, and those that are less useful or unrelated.

Examples

- A senior learner with a keen interest in the law is conflicted by arguments about the role of jails – punishment or rehabilitation? – and the benefits versus costs of imprisonment, and recidivism rates, and so on. He writes down all the questions he has and then tries to organise them into a structure. He thinks his main 'big' question is 'Do prisons create justice or injustice?' but realises this is a moral question and too big to ask by itself. He realises smaller questions such as 'What are the rates of recidivism in different countries?' are empirical questions that are easier to answer, but might also help him answer his big question.
- An art teacher shows his class images of German Expressionist paintings and runs a See, Think, Wonder routine to get the learners to observe the paintings more closely: What do you see? What do you think? What do you wonder? At the end he asks learners to do a final round of reflection: What *did* you see? What *did* you think? What *do you now* wonder? He asks the learners to share one 'wondering' each and writes these on the board. The class are then asked to identify which questions relate to other questions, which questions are open and which are closed, which seem less important and which seem more important.
- A health teacher sets a task for her learners to investigate a question of public health awareness they find interesting by designing a survey to ask members of the public. Using a different health issue as an example, she asks learners to list all the survey questions they might want to ask about it. She then asks them to consider questions like: Do these questions tell us everything we'd want to find out? Would any of these questions be inappropriate to ask? Are any of these questions likely to give us irrelevant information? Would any of these questions be confusing to answer?

DIMENSION 2: RESOLVING KNOWLEDGE GAPS

Either after having deliberately formulated what it is one wants to know, or perhaps more immediately after the initial arousal of curiosity with a given stimuli or environment, resolving knowledge gaps involves the behaviours and abilities that support the exploratory and information-seeking behaviours[59] individuals undertake to resolve questions and confusions and to reduce uncertainty[60].

SUB-DIMENSION 2.1 EXPLORES ANSWERS AND THINKS CRITICALLY

Curiosity involves a search for information to fill a knowledge gap so as to reduce the uncertainty it creates[61]. Therefore, when undertaking an inquiry or investigation, a curious learner is driven to think carefully about what they uncover. Inquisitiveness disposes one to being a critical thinker[62]. Having an open and intellectually curious character correlates strongly with an ability to critically assess sources of information and to use sources with conflicting perspectives[63].

Examples

- A pair of learners run a science experiment dropping objects of different masses from a height to test if they really fall at the same speed. They find their results are not always consistent: sometimes they do but sometimes they don't. They start wondering about whether they can improve the accuracy of their measurement by using a stopwatch and finding a higher drop point. They also wonder if the shape or "floppiness" of objects like handkerchiefs, sheets of paper or foam packaging might be making a difference.
- A learner researches a topical issue in order to write an expository essay about it. The issue is contentious and deeply interesting to the learner, who finds it difficult to establish her own moral position. Because of this, she carefully checks the reliability of websites she reads on both sides to make sure her argument will be sound. Some of the statistics she reads from sources on both sides don't seem to match, so she tries to find other sources that are more objective on the issue.
- A geography teacher takes his learners on a fieldtrip to a local town to gather data that might tell them something about whether the town is a sustainable urban environment. Learners take photos of the built environment, sketch wildlife they see, do traffic counts, undertake litter audits, take river water samples, map locations like green spaces, and so on. Upon returning to class, the learners in small groups begin to collate their data. The teacher asks them three questions: What evidence do you have that the town is a sustainable urban environment? What evidence do you have that it is not? What else would you need to know, to know what your evidence tells you?

SUB-DIMENSION 2.2: SUSTAINS EFFORT

Curiosity is frequently identified by an associated perseverance and persistence in information-seeking behaviour[64]. While a deprivation of knowledge can be experienced as an un-motivating feeling of frustration and helplessness[65], it can also be closely correlated with intense state-curiosity and the persistence of efforts to fill the information gap[66].

This implies that certain observable behaviours such as iterative reformulation of one's inquiry focus, transition of the inquiry into one's own time, and taking certain risk-reward gambles in the process of finding out – including possible social risks – are indicative of an individual's willingness to make efforts to sustain the inquiry[67].

Examples

- A learner has asked an investigation question about an event of local history that they find really puzzling. They also find it more difficult to answer than they expected. They realise the question requires knowledge not easily found on the internet. The teacher suggests visiting the local library. The learner does this but needs help finding resources so they ask the librarian for assistance. This takes a while but soon some books are located, and the learner reads them to find out more.
- After a mathematics class on the golden ratio, or Phi, a learner stays back to ask the teacher some questions: How do we know shapes that have the golden ratio are more beautiful? Is Phi actually an important number for anything useful? And are all the pictures of golden spirals on seashells and buildings and sunflowers just a coincidence? The next lesson the learner tells the maths teacher they watched a YouTube video to try to find out the answers to these questions. He asks the teacher if she could help him to understand whether the ratios in all number sequences will tend towards Phi or is it just the Fibonacci sequence that does this.
- A senior art learner wonders whether fear – being such a strong emotion – has been the subject of much art over time. She decides to make this the topic of her extended research project. However, "Fear in art" does not return very many useful search results. She tries using different search terms (anxiety, terror) and gets a few results. She then considers contexts for art in which fear might feature (war, religion, and migration) and these prove more fruitful. While doing this, she also considers whether creating art as a therapy for trauma might also be an interesting avenue to pursue.

SUB-DIMENSION 2.3: EVALUATES LEARNING

Evaluating learning involves the capacity to reflect on the effectiveness of how one sought to resolve knowledge gaps, to consider whether one's investigations have satisfactorily achieved these aims, and if not, what questions have been left unexplained[68]. Epistemic curiosity has been found to correlate more strongly with deep study approaches than with surface level approaches to learning[69] and with greater knowledge acquisition attributable to a greater propensity to reflect on learning[70].

Examples

- A learner who researched airplanes for his World War II research project reflects on his learning. Answering a series of questions provided by the teacher, he can identify that he learned a lot about the technical differences between fighter jets like the Spitfire and the Messerschmitt, about the extent of the damaged suffered during Battle of Britain and the Kamikaze fighters of Japan. One question he still didn't quite find an answer to was his 'big' question: Was WWII won and lost in the air? However, he realises this was ambitious, and realises also that researching bombers might have been a good way to try to answer that question, given what he now knows about Hiroshima and Nagasaki.
- A learner who ran an experiment growing seeds and plants under different conditions is able to verbally explain three things they learned. They can also explain that they didn't know seeds grew better in darkness than in light because they thought plants needed light to grow, and they are still curious as to why this is.
- A teacher asks learners to use a KWLH chart at the start and end of their research investigation: to list what they KNOW about a topic and what they WANT to know, and then what they LEARNT and HOW they learnt it.

PART 2: EVIDENCE OF CURIOSITY-DRIVEN INQUIRY SKILLS

This section considers evidence that may be collected about the extent of learners' curiosity, as well as evidence of inquiry skills, knowledge and personal attributes that are essential to effective curiosity-driven learning.

Two resources are provided:

- Curiosity thermometer
- Curiosity-driven inquiry: skill development levels

CURIOSITY THERMOMETER

Curiosity fluctuates. Sometimes learners will be curious, and at other times there will be little to arouse or sustain their curiosity depending on factors relating to the learner, the topic, the teaching, and the environment. Many factors are not under learners' control. The curiosity thermometer is a self-reflection tool for learners to answer the questions: How curious was I? What evidence can I point to, to justify this? Why do I think my curiosity was this way in this context?

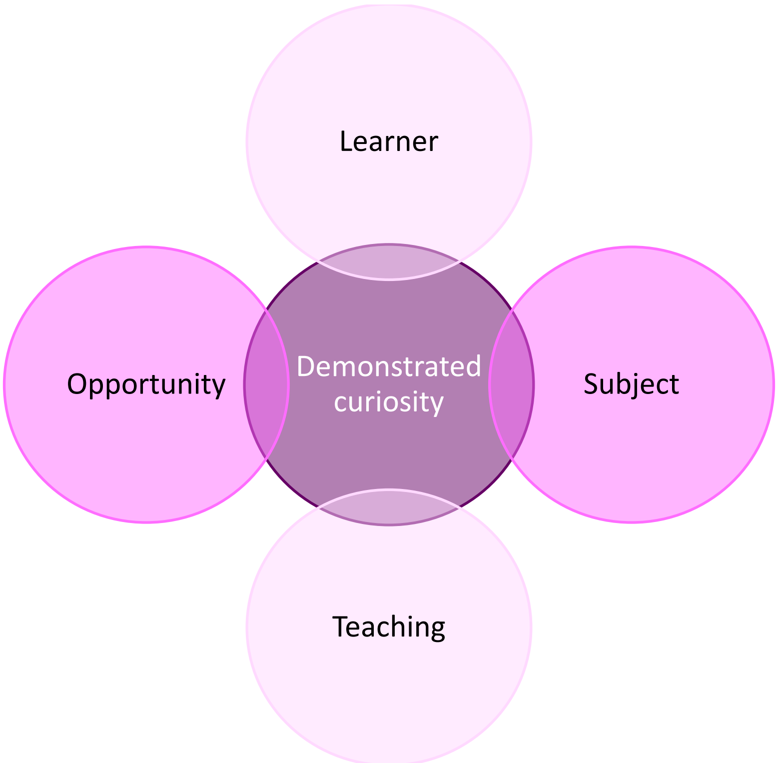
The purpose of the curiosity thermometer is for learners, and teachers, to develop a better understanding of what makes different learners curious in different contexts and how to possibly enhance this.

The curiosity thermometer descriptions range from hot to cool, aiming to make curiosity (an internal cognitive state) more 'visible'. A curiosity thermometer, supported with evidence, allows teachers, and learners to say something meaningful about how curious a learner has been. The aim is not for learners to always be "hot" in terms of their curiosity. Rather, it is to increase learners' self-awareness of what makes them curious, what being curious looks like, and how to foster their own curiosity in a positive and effective way in their own learning.

It is important that learners are provided with opportunities to be curious across different domains and contexts, so that all have opportunities to connect with things that make them curious as well as learning more about themselves in contexts where they struggle to be curious. Even in contexts where some learners are not curious, inquiry skills, knowledge and personal attributes can still be developed that will equip learners to learn more effectively when there is a context that makes them more curious.

The curiosity thermometer is not a learning progression or skill rubric. Progressions and rubrics suggest uni-directional growth in skill or ability. While curiosity-driven inquiry calls upon certain competencies, curiosity itself is not a skill. How much a learner demonstrates curiosity during any given learning task, therefore, is *partly* a function of skills they may or may not have, but much else besides, including:

- **Learner**: their disposition to be curious (trait curiosity), their level of prior knowledge, experience or interest, their skill or ability to pursue their curiosity
- **Subject**: the topic of investigation, and the extent to which it matches a learner's existing interest or experience
- **Teaching**: the way the topic is presented to the learner; how effectively it creates 'conceptual conflicts' and captivates learner curiosity
- **Opportunity**: the time given to allow learners to enquire, and the resources or technology available to the learner to enable them to pursue their curiosity.



Given the range of factors that can affect how much curiosity a learner demonstrates, the curiosity thermometer needs to be understood not as a tool used to assess *the learner*, but as a means of evidencing *their curiosity*, with an understanding that curiosity will fluctuate depending on each of these factors. It is envisaged that the curiosity thermometer will enable teachers to discuss openly with learners how curious they've been in their learning so as to better understand how curiosity affects learning and how it may also be enhanced.

HOW TO USE THE CURIOSITY THERMOMETER

The curiosity thermometer is a means of having learners think about evidence of their own curiosity.

One approach might be to have learners answer a related set of questions and then, based on those answers, place themselves somewhere on this thermometer. The other is the reverse approach: they read the thermometer levels and go with their own intuitive hunch about how curious they know or feel they were, but then need to justify that level with evidence.

Either way, in a conversation with a teacher, the teacher may bring other evidence of what they saw of the learner's curiosity, and the learner may re-adjust their self-assessment.

The metaphor of a thermometer is a deliberate one. It is not describing skills and it is not a learning progression. Rather, it is a tool for learners to use to self-assess a cognitive state they experience that *fluctuates* depending on certain conditions (just like temperature).

When using the thermometer, teachers and learners therefore need to be clear about three things:

1. Curiosity does fluctuate, *and that's okay:* being low in curiosity once does not make one an incurious person. This is also not an assessment, and it contributes nothing directly towards a learner's grades.
2. This fluctuation is not a function simply of the learner's innate (trait) curiosity, but of the learner's own grasp of the topic, their pre-existing skills, knowledge and experience, as well as external factors for which the learner should feel no personal responsibility, such as the subject, the topic, the presentation of material, the learning environment, the time and opportunity to explore and inquire, and potentially many other things.
3. Thus, *knowing why* one was more, or less, curious about something *is the point* of this self-reflection: both for the learner so as to develop a greater metacognitive awareness of their own curiosity, but also for the teacher so they can support the learner to engage with something that makes them curious.

Table 2: Curiosity Thermometer

Hot	I explored the task or topic a lot. I was really interested in one thing in particular or saw lots of interesting things about it. I wanted to know more. I checked my own understanding quite a bit to be clear about what it was I didn't know or understand, but I also asked some really important open questions like "What if?", "Why?" or "How could?" questions. I set myself some ambitious goals to find answers to these questions and I was confident I could find out what I wanted to know. When I was finding out, I used as many sources of information as I could. I made sure these sources were useful and continued to ask questions about what I was learning to make sure it was accurate. I persisted in my inquiry or investigation, even though it might have been difficult or challenging. I may even have used some of my own time. On reflection, I understand better what made me curious in the first place, I know what it is that I learned and how that has answered my questions, and I also know what questions I still have that make me curious.
Warm	I explored the task or topic a fair bit. I could see some things about it that were – or could be – quite interesting to me, or things that I didn't understand but that I did want to know. This made me want to ask some questions to clarify what was confusing, surprising or interesting me and set myself some achievable goals to answer them. When I was finding out, I wanted to use a range of sources of information. I noticed if there were things I was learning that didn't 'add up' or make sense, and tried to fix this. I put a lot of effort into making sure I was on the right track and used my time effectively. On reflection, I know I have learned quite a bit and whether my original questions have been answered.
Lukewarm	I briefly explored the task or topic. I could see something people might find interesting or surprising about it and I could describe what that thing was. I could also see it might be worthwhile finding out more about it. I was somewhat interested in doing this so I set myself a goal to find out some things I didn't know. When I was finding out, I knew I had to use more than one source, and to try to use good sources, so I did. I found a small range of information – some of which might not have really 'added up' or made sense to me but I wasn't too bothered by that. I was happy to find information quickly, even if it didn't quite answer my questions. I made reasonable use of the time I had. On reflection, I can recall some basic information that I learned and whether it more-or-less answered my original question.
Cool	I didn't really explore the task or topic much at all. There *was* something that was surprising, interesting or confusing about it but it didn't interest me to find out very much. I set myself a small goal to answer some simple, closed questions. When I was finding out, I didn't really attempt to use a range of sources of information, or to check what I was learning was accurate – it seemed okay to me. Some of what I came across I didn't understand or wasn't sure if it was useful but I mostly ignored that information. I probably didn't use my time very effectively, or I could have spent more time doing more to find out. On reflection, I can recall some facts I learned about the topic but not much more.

CURIOSITY-DRIVEN INQUIRY: DEVELOPMENT LEVELS

Being curious is not enough for effective learning. The curiosity-driven inquiry development levels describe in generalised terms the development of inquiry, critical thinking and reflection skills and a range of personal attributes that support effective learning in the context of a curiosity-driven inquiry. Documenting evidence of these over the process of an inquiry, and matching them to level descriptions, helps teachers to identify the extent to which learners have the essential additional skills to pursue their curiosity productively.

Many IB schools may already have their own inquiry skills rubrics that they prefer to use. These levels are provided as a potentially useful overlay when the focus is on an inquiry that is driven by the learners' own curiosity.

The two dimensions of Focusing Curiosity and Resolving Knowledge Gaps each have three sub-dimensions. Six tables, one for each sub-dimension, describe levels of evidence of the progressive development of curiosity-driven inquiry and reflection skills, knowledge and attributes from very limited to extensive. Some learners may demonstrate high levels of skills, knowledge and personal attributes during an inquiry without necessarily being that curious.

Their proficiency should be recognised as these skills will be useful, when learners are provided with a different context that does make them curious. Other learners may be passionately curious but lack the essential skills to pursue their curiosity in a way that supports effective learning. Identifying which levels of skill they demonstrate in each of the sub-dimensions supports understanding what they still need to learn.

Effective utilisation of curiosity to support learning is mainly evident in the 'significant' and 'extensive' levels where learners can draw on a well-developed skill set as well as personal attributes of persistence, self-confidence, self-efficacy, open-mindedness and risk taking to support an effective curiosity-driven inquiry.

The following considerations should be taken when using these levels:

1. As these have been written as generic behaviours of learners in response to a generic inquiry, the descriptors at each level will not all – or always – necessarily apply. Teachers should therefore treat these as *indicative* behaviours when trying to consider how effectively learners are learning in a curiosity-driven inquiry context. Learners would typically demonstrate many, but not necessarily all behaviours at a level to be judged at that level.
2. Though many of the descriptors are described as "live" behaviours, it is acknowledged that this may make it difficult to capture such evidence. Consideration should be given to how teachers might record – or ask learners to record – evidence of their skills, knowledge and effective use of attributes, e.g. asking learners to write down all the questions they have, or to complete a reflection task.

3. A reflective question teachers should ask themselves is: Given how curiosity-driven inquiry is being described at the upper levels
    a. Will my lesson content or the topic elicit these responses and skills in learners? Is the content/topic rich and stimulating enough? Can it be?
    b. Can I present the lesson content/topic in such a way as to elicit greater curiosity-driven behaviour and skills?
    c. How much opportunity (time, resources, and technologies) will the learners have to demonstrate those skills and attributes described at the upper levels? Can I improve that opportunity?

Responses to these questions will help teachers to moderate their expectations both of their learners and themselves; not every lesson, unit or topic will offer the same potential for curiosity.

DIMENSION 1: FOCUSING CURIOSITY

1.1 ENGAGES WITH AND EXPLORES CONCEPTUAL CONFLICTS: WHEN PRESENTED WITH RICH, NOVEL, COMPLEX OR AMBIGUOUS STIMULI, LEARNERS…

Extensive	• engage in a thorough, deep exploration of multiple aspects • sustain a detailed, or specific, sense of wonder or intrigue, voluntarily explaining what they specifically find curious • thoughtfully consider multiple aspects of interest e.g. inconsistencies, surprises, unusual patterns • consider a range of possibilities e.g. different perspectives, and implications • identify any confusion promptly and use effective strategies to check base knowledge is correct • extend their initial curiosity as they develop open wondering questions • express a strong desire to find out more
Significant	• focus exploration on a few aspects • show a detailed, or specific sense of wonder or intrigue at some stages (may fluctuate considerably) • thoughtfully consider some aspects of interest e.g. inconsistencies, surprises, unusual patterns • consider a few possibilities e.g. different perspectives, and implications • identify any confusion and use partially effective strategies to check base knowledge is correct • mainly restate their initial curiosity or surprise • express some interest in finding out more
Moderate	• briefly explore most aspects, but not deeply • express a general sense of surprise, interest or confusion that is clearly related to the stimulus • identify major or obvious aspects of interest e.g. inconsistencies, surprises, unusual patterns • thoughtfully consider a single possibility, or briefly consider other perspectives or implications • identify any confusion where base knowledge may be limited but generally require support to correct this • mainly develop closed, fact-checking questions based on initial curiosity
Very limited	• demonstrate limited exploration of a few aspects • possibly express a vague sense of surprise, interest or confusion • describe aspects of interest that are already understood • show satisfaction with current levels of knowledge

DIMENSION 1: FOCUSING CURIOSITY

1.2 ENHANCES MOTIVATION FOR LEARNING: WHEN PROMPTED TO REFLECT ON WHAT MAKES THEM CURIOUS, LEARNERS…

Extensive	• identify a specific and authentic point of curiosity in given material or topic, even if it is not obviously or immediately related to personal interests. • strongly value finding out more • are positive and confident • set achievable learning goals with reasonable challenge • provide insightful reflections that show good self-understanding e.g. how to actively expand curiosity.
Significant	• identify how given material or topic is generally interesting and holds the potential to stimulate curiosity for people, and potentially for themselves. • value finding out more and wish to do so • are generally positive and try to be confident (may lapse at times) • attempt to set achievable learning goals (may be overly, or insufficiently challenging) • provide considered reflections that show some self-understanding e.g. how to stimulate curiosity.
Moderate	• identify how given material or topic has some potential to be interesting for other people and stimulate curiosity in them, or where the topic or material has some tenuous link to their own interest that might be motivating • generally value finding out but limited desire to do so • set task goals that mainly aim to showcase current knowledge, or goals may be vague • provide simple reflections that tend to describe the task rather than self-understanding
Very limited	• identify only in vague ways that a given topic or material might be interesting for other people. Can only identify where their curiosity relates to personal interests, and reject any potential for becoming curious outside of those interests • express little value in finding out more • demonstrate negative attitudes possibly related to limited knowledge, confidence or skill • set perfunctory goals • provide a brief description of what they did with no reflection

DIMENSION 1: FOCUSING CURIOSITY

1.3 REFINES QUESTIONS OF VALUE: WHEN PREPARING TO UNDERTAKE AN INQUIRY, EXPLORATION OR INVESTIGATION, LEARNERS…

Extensive	• develop high quality open questions with supporting closed questions which are likely to lead to significant learning or insight • order questions effectively as 'most important', and supporting questions, or otherwise organise questions into a logical relationship or pathway for inquiry. • show good awareness of their current state of knowledge and what new understanding is realistic • show ambition for the scope of their inquiry but with a realistic pathway/plan for how to achieve it
Significant	• develop worthwhile open questions that are likely to lead to some learning or insight • order questions coherently, mainly separating the 'most important' from supporting questions • show reasonable understanding of their current state of knowledge, but most questions consolidate and extend, rather than challenge their understanding • scope of inquiry is sufficiently broad but constrained; not overly ambitious
Moderate	• develop relevant closed questions and attempt open questions but these are often vague • provide a set of related questions but require support to order them • understands the intention to extend their current state of knowledge, but shows limited skill or interest in doing this e.g. selects questions for which answers are known, or are far too difficult, or do not cohere • shows either very little, or highly unrealistic, ambition with little interest in receiving support
Very limited	• develop a few closed, mainly superficial questions • provide mainly unfocused and unrelated questions that do not cohere • shows little understanding of how questions relate to current state of knowledge • has limited interest in being ambitious or taking risks with their inquiry

DIMENSION 2: RESOLVING KNOWLEDGE GAPS

2.1 EXPLORES ANSWERS AND THINKS CRITICALLY: WHEN UNDERTAKING AN INQUIRY OR INVESTIGATION, LEARNERS…

Extensive	• systematically use a range of relevant sources or observations, or make thorough use of given material to explore answers • progressively evaluate outcomes of their inquiry to inform the next steps e.g. act to resolve inconsistencies • demonstrate excellent critical thinking skills e.g. recognise flaws or inconsistencies, draw logical conclusions, generate new hypotheses • demonstrate highly effective search skills locating sufficient relevant, reputable information that they can understand, consistently discarding inappropriate material
Significant	• attempt to systematically use a range of relevant sources or observations, or given material to explore answers, but this may become fragmented • progressively evaluate key ideas to inform next steps but may overlook, or lack skills to resolve some inconsistencies • demonstrate good critical thinking skills e.g. recognise obvious flaws, generally logical conclusions • demonstrate reasonable search skills locating a limited range of relevant, reputable information that they can understand, mainly discarding inappropriate material
Moderate	• adopt a generally unsystematic approach to accessing relevant sources, or engaging with given material, making observations that quickly narrow, or becomes haphazard • show limited ability to build on findings e.g. next steps tend to follow initial plans or preconceived notions rather than respond to what they've found • show some evidence of critical thinking e.g. makes simple comparisons, identifies obvious inconsistencies, or dubious findings but cursory efforts to resolve. • demonstrate basic search skills to locate a few pieces of broadly accessible information using minimal criteria to establish reliability
Very limited	• show basic search skills locating a few pieces of information that are broadly accessible to them, or make little use of give material • take a narrow approach often based on a single source of information or one-off observation accepting an easily accessible "answer" • show little evidence of critical thinking e.g. obvious contradictions are largely overlooked • require support to search for resources

DIMENSION 2: RESOLVING KNOWLEDGE GAPS

2.2 SUSTAINS EFFORT: WHILE UNDERTAKING AN INQUIRY OR INVESTIGATION, LEARNERS…

Extensive	• consider significant breadth and detail in the inquiry and are open to pursuing new and emergent ideas • persist when faced with unexpected challenges and uncertainty; may even appear comfortable with it by not losing focus • substantially refine search criteria and/or goals as needed • take some quite large risks e.g. pursuing difficult information, asking unusual questions, exposing ignorance
Significant	• comprehensively consider the focus of the inquiry • persist when faced with minor disappointments and inconveniences • refine search criteria and/or goals as needed risking minor uncertainties • take minor risks e.g. modifying goals in light of new information
Moderate	• adopt strategies to make an inquiry simple and brief • are satisfied with quickly-obtained, relevant information • make superficial refinements to search criteria and/or goals • plan to minimise any risks
Very limited	• pursue questions where answers are largely known • are satisfied with minimal new information (may not be relevant to question) • retain original search criteria and/or goals with no refinement • avoid risks

DIMENSION 2: RESOLVING KNOWLEDGE GAPS

2.3 EVALUATES LEARNING: AFTER HAVING INQUIRED OR INVESTIGATED, LEARNERS …

Extensive	• thoughtfully evaluate how questions were answered and the learning process e.g. recognise the impact of misconceptions on their thinking • remain curious identifying specific questions or implications to pursue • critically consider learning strategies used and how these might be improved. • provide insightful reflections that show good self-understanding about their curiosity and inquiry skills
Significant	• mainly focus on evaluating how questions were answered rather than the learning process • remain broadly curious identifying general areas of further interest • identify some useful strategies used to support their learning • provide considered reflections that show some self-understanding about their curiosity and inquiry skills
Moderate	• mainly describe how questions were answered • minimal or vague ongoing curiosity • require support to identify and describe learning strategies they use • provide simple reflections that tend to describe the task rather than show self-understanding
Very limited	• provide some perfunctory answers to questions • provide a brief description of the task rather than a reflection

PART 3 IMPLICATIONS FOR IB SCHOOLS

ENABLING ENVIRONMENTS

CURIOSITY NEEDS TO BE VALUED AND SUPPORTED

Learners need the opportunity to be curious. Schools need to actively support and value the role of curiosity in learning. This has significant implications for schools and may challenge existing practices.

LEARNERS BECOME ACTIVE AGENTS IN THEIR OWN LEARNING

In order to learn how to manage their curiosity learners need to take an active role in leading their own learning. The curriculum and lesson plans need to be sufficiently flexible to allow learners to find what makes them curious and is likely to lead to worthwhile learning. Learners also need to be comfortable with these revised roles that put the responsibility for asking the questions and finding the answers back on them, rather than being passive recipients. Some learners may find this transition challenging.

TEACHERS PROVOKE UNCERTAINTY AND WONDER AND SUPPORT INVESTIGATIONS

When curiosity is being fostered, uncertainties and doubts about what is being studied need to be encouraged. Learners need a basic knowledge base. Some information must be provided or taught, as well as presenting ideas that are, in fact, unresolved or questions for which the answers are genuinely unclear, or various different theories or explanations may be plausible.

Teachers need to be comfortable with allowing learners to experiment and conjecture as they seek to understand the unknown and provide time and space for this within the curriculum. Teachers must know how to be facilitators and provide useful support to learners in these contexts, rather than being the source of all knowledge and provider of answers.

Some teachers may resist, especially where this undermines their notions of what a teacher is and what a teacher should be. Broader cultural assumptions may be challenged and this change may be very uncomfortable for various reasons.

THE LEARNING JOURNEY IS WHAT MATTERS

Curiosity is internally motivated with the rewards coming from intrinsic satisfaction of the learning journey. This may not have provided answers, rather, it might have opened up more questions, or identified that this approach was ineffective, and a different approach is required. A focus on scoring final outcomes will be counterproductive. Not only is it likely to override internal motivation, but it is also likely to overlook the value of the learning journey and discourage experimentation or risk taking.

Demonstrably valuing the process of exploring the unknown and providing useful feedback support and encouragement to learners about how to further enhance their learning through being curious is more likely to be constructive. Sharing stories and celebrating the different ways of learning and how to constructively reflect on these are some useful alternatives to scores or grades.

CURIOSITY IS VALUED BY THE WHOLE SCHOOL COMMUNITY

Curiosity must be valued by the whole school community if learners are to take opportunities to manage their curiosity seriously. All the school leaders, teachers and parents need to clearly recognise the importance of supporting and encouraging curiosity in learning. They also need to support any changes that might need to be made to the way the curriculum is organised, how learners are taught and learn and how learners' efforts are recognised and reported when curiosity is a key part of the learning.

CURIOSITY-DRIVEN INQUIRY IS EMBEDDED IN THE IB CURRICULUM

One of the challenges of providing curiosity-driven learning opportunities is how these might be embedded in the IB curriculum as they clearly require an extended period of time to implement. There are some obvious alignments with the current PYP exhibition, MYP personal project, the CP reflective project, and DP extended essay as these are all interest-based major pieces of work, however, there are high-stakes extrinsic rewards in the project scores. This undermines the notion of life-long learning driven by curiosity and intrinsic motivation.

One suggestion is that a few practice opportunities could be provided over the course of a year for these major projects where there is no scoring, only constructive feedback and support for learners to experiment with developing their skills in a curiosity-driven inquiry where intrinsic satisfaction in improvement is a primary source of motivation.

From a practical perspective, it makes more sense for teachers to apply some constraints to the scope of these practice opportunities by providing a contextual focus in the form of a rich set of stimulus material around a given topic that suggests a diversity of conundrums or opportunities for learners to wonder. Nominating a broad, rich topic allows teachers to provide foundational knowledge to the class, ensure a range of suitable accessible resources are available and will likely allow teachers to efficiently group learners based on similar support needs as they develop their curiosity-driven inquiry learning skills.

If several different practice opportunities are offered over the course of a year, the topics can focus on different domains such as humanities and social sciences; science and mathematics; the arts and technology. This would support learners to develop cross-domain skills in curiosity-driven inquiry learning and directly support the interdisciplinary and transdisciplinary nature of IB programmes. Alternatively, opportunities could be centred on the dimensions or sub-dimensions of curiosity to allow learners to develop and refine their skills in focusing curiosity and resolving knowledge gaps, thereby encouraging transferable skills for future projects.

EVIDENCE OF OPPORTUNITIES FOR CURIOSITY-DRIVEN INQUIRY

SCHOOL LEVEL EVIDENCE OF OPPORTUNITY

The evidencing of curiosity in IB schools must begin with an evaluation of the extent to which the school culture, the curriculum and the teachers both value and provide reasonable opportunities for learners to demonstrate curiosity-driven learning.

Questions that the school leadership need to consider are:

- Has the leadership team established a culture that actively values the role of curiosity in learning and is supported by the school community?
- What kinds of opportunities do learners have to be curious learners, to act on their curiosity and use this to pursue the answers to their own questions?
- How prepared and willing are teachers to facilitate, and model, curiosity-driven learning?
- What supports, resources and accountability measures are in place to guarantee, encourage and improve teaching that facilitates curiosity-driven learning?
- What kind of processes have been developed to recognise and value learners' endeavours in curiosity-driven learning contexts without becoming an extrinsic reward system?

TEACHER LEVEL EVIDENCE OF OPPORTUNITY

Supporting curiosity-driven inquiries requires commitment, preparation and ongoing support from teachers. It is not enough to provide a multifaceted set of stimulus materials and simply leave learners to their own devices. Learners need inquiry skills that can be taught through guided discovery, by modelling and scaffolding these skills, providing feedback and eliciting (and correcting) explanations or misconceptions as learners move through the stages of an inquiry.

By contrast, unguided discovery, in which learners are left to freely explore a topic unassisted and follow where their curiosity leads them is roundly seen as ineffective pedagogy. This is particularly so for learners who are novice both with the subject content and with deploying inquiry skills.

Classroom practices that support curiosity-driven learning should be reviewed in a collaborative spirit with the intention of sharing learning, improving teaching skills and providing useful support. Key factors in classroom practices that support curiosity-driven learning can be identified, discussed and agreed with by teachers. Teachers can then share evidence of how they attempted to incorporate these factors into their teaching and how effective it was.

Teachers need to consider how they:

- actively value being curious, providing diverse examples of the benefits of curiosity from the famous to the personal
- identify and value examples of learners effectively managing curiosity to improve their learning
- ensure learners have sufficient basic knowledge about a context to support a constructive inquiry
- provide a rich, stimulating environment or context that is likely to stimulate curiosity (focussing on different learning areas across the year)
- find an appropriate balance between challenge and support so learners are stimulated without being overwhelmed
- support learners to explore, formulate and then refine questions of value
- ensure learners have or are taught sufficient inquiry skills, or provide support, to ensure effective learning is possible
- ensure a sufficient range of resources that learners know how to use and understand are available
- encourage experimentation, risk-taking and learning from mistakes
- ensure a sufficient range of resources that learners know how to use and understand are available

- encourage experimentation, risk-taking and learning from mistakes.

Factors that affect opportunities to be curious in a classroom context are outlined in **Table 2** as a starting point for teachers to review their practices and identify any desired improvements.

LEARNER LEVEL EVIDENCE OF OPPORTUNITY

The curiosity thermometer helps learners to identify the extent of the opportunities that were provided to them to be curious. It is useful for teachers to understand what learners consider to be enabling factors and what factors they identify as limiting their opportunities to be curious.

Table 3: Factors affecting opportunities to be curious in a school context

	Foundational knowledge: extent of prior knowledge taught/established	Valuing curiosity: valuing the process, recognising, rewarding and encouraging curiosity	Task opportunities: nature & focus of task	Support: extent of guidance, feedback, opportunities to reflect	Access to resources: relevant, readable for learner, available, sufficient
Comprehensive	Learners have been provided with the opportunity to develop a diverse, well-connected, knowledge base from which many possible questions arise	There is a genuine valuing of the process of being curious, exploring and possibly not finding answers, rewarding time invested, reflections and connections that show greater depth of understanding	Learners are given open tasks with clear guidelines that focus on promoting curiosity-driven learning; sufficient time is allowed for investigations and reflections; and curiosity is not compromised by other task purposes	Extensive support is provided to learners in customising individual investigative plans with ongoing iterative advice, constructive feedback & structured reflections that challenge thinking	Sufficient appropriate, accessible, reputable resources (filtered where appropriate) are available to learners to support wide ranging investigations
Adequate	Learners have been provided with the opportunity to develop a basic, connected knowledge base prompting some clear questions, but with limited diversity	Learners are encouraged to pose & investigate a diversity of curious questions, and reflection on a range of outcomes is valued	Learners are given open tasks with an intended major focus on pursuing curious investigations, but are provided with limited guidelines or support and there is limited time allowed	Generic support and advice is regularly provided to learners, including feedback and encouragement of reflections with limited customisation	A range of appropriate, reputable resources (filtered where appropriate) are accessible to learners but tend to constrain the extent of divergent investigations
Limited	Learners have been provided with the opportunity to develop a limited knowledge base that is narrow, or largely fragmented	Curiosity is interpreted as posing 'curriculum-relevant' questions and 'successful' findings tend to be valued more than others	Curiosity is mainly used as a limited 'add-on' to a task with other foci and the scope of any curiosity-driven investigations are heavily constrained	Minimal support is provided to learners at the start, with limited feedback or support as the process unfolds	Either limited appropriate, accessible resources, or an overwhelming array of resources are accessible to learners, with minimal support to filter them
Minimal	Learners have been provided with little opportunity to develop a knowledge base beyond superficial coverage	Any valuing of curiosity is largely token – curiosity is assumed to align with the curriculum content	Any opportunities to demonstrate curiosity are largely prescribed or predictable, or may be missing entirely	Little constructive support is provided to learners at any point	Minimal appropriate resources are available or accessible to learners and there is no support to filter them

APPENDIX 5: CREATIVITY THERMOMETERS

I explored the problem or task quite a lot and thought deeply about it. I didn't decide too early how I was going to approach it. Instead I kept a really open mind. I found a pretty interesting way to think about the task that I don't think others did, but which I also thought would work quite well.

I came up with lots of ideas that were all quite different from each other. As I developed my ideas I could pull the problem apart and think about it in different ways. I combined ideas or made interesting connections in my thinking about how to approach the task. I tried to bring in ideas from lots of different places.

My final idea/best solution was pretty different; one that not many other students in my class would think of. It also works really well. I was able to explain clearly exactly how it addressed the original problem, or what about it makes it a clever idea.

I explored the task in some detail. I thought about a few ways I could approach it as I did some thinking about it. I came up with a way of thinking about the task I was pretty sure was going to work quite well.

I came up with quite a few ideas or solutions that were mostly quite different from each other. I tried to think about the problem from different angles and use any material I had given to help me. I considered ways of combining ideas and tried to think of unique possibilities.

My final idea/best solution had some aspects to it that were quite different: things not many students in my class would think of. It works quite well, and I could explain how I came up with the idea and why they would work.

I tried to explore the task and could see there were a few ways to go with it, but I decided pretty quickly what my approach to solving/the problem/approaching the task was going to be.

I came up with a few ideas, and tried to think of things that were different, but my ideas were mostly quite similar to each other. I experimented a bit with my ideas but not very much.

My final idea/best solution was fairly similar to other students' ideas, with perhaps something slightly different about it. I am not sure whether my best solution works completely or addresses all parts of the problem or task, but I was able to explain how I thought it would work.

I very quickly decided how I would approach the problem or task. It seemed pretty straightforward.

I came up with only a few ideas, and these ideas were very similar to each other. I didn't 'play' with ideas very much at all, or try to change my approach.

My final idea/best solution is very similar to other students' ideas. It might be a bit too simple to meet all parts of the problem or task. I found it hard to explain why it was a good solution.

- I explored the problem or task quite a lot and thought deeply about it.
- I didn't decide too early how I was going to approach it. Instead I kept a really open mind.
- I found a pretty interesting way to think about the task that I don't think others did, which I also thought would work quite well.
- I came up with lots of ideas that were all quite different from each other.
- As I developed my ideas I could pull the problem apart and think about it in different ways.
- I combined ideas or made interesting connections in my thinking about how to approach the task.
- I tried to bring in ideas from lots of different places.
- My final idea/best solution was pretty different; one that not many other students in my class would think of, and it works well.
- I was able to explain clearly exactly how it addressed the original problem, or what about it makes it a clever idea.

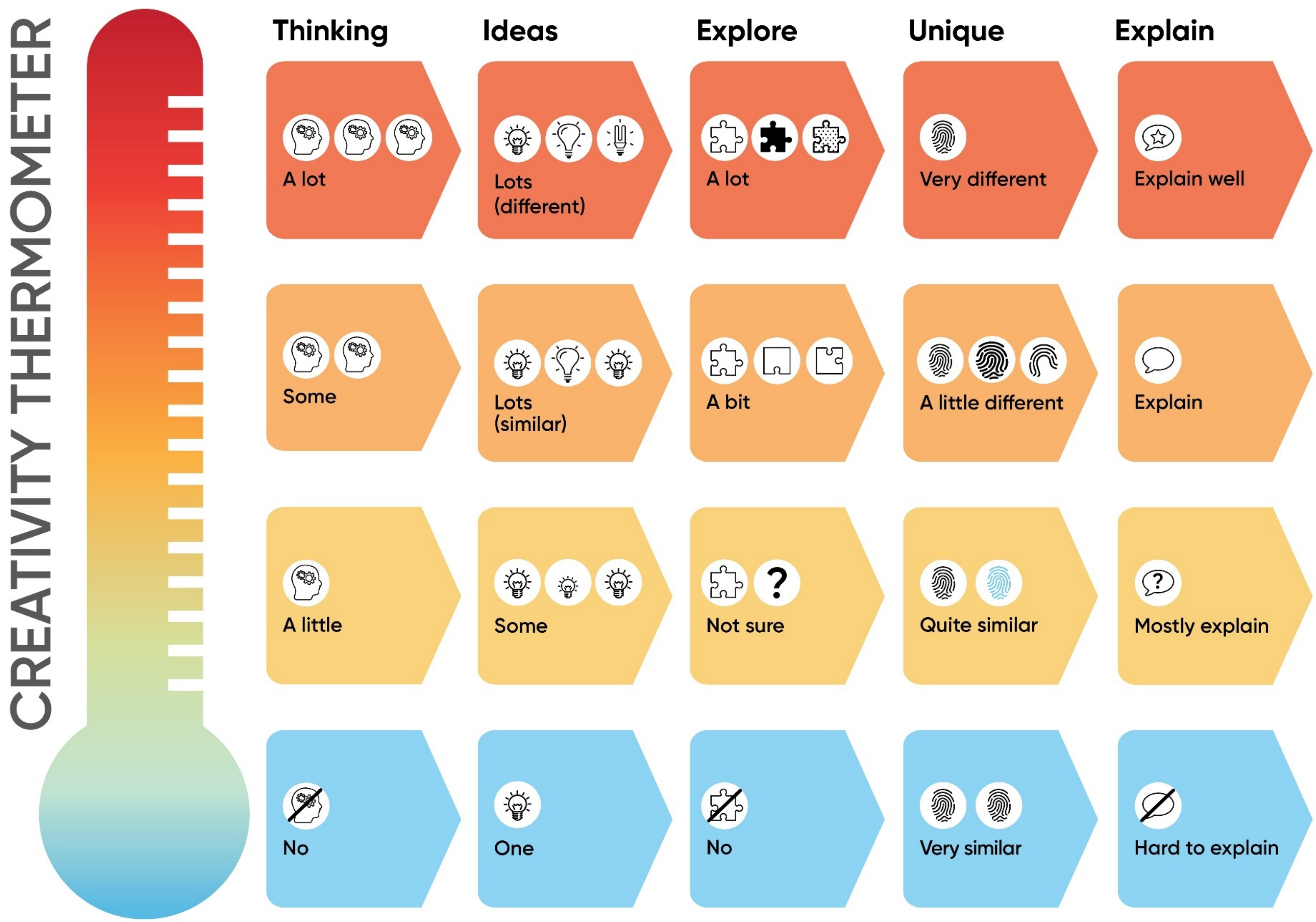
- I explored the task in some detail.
- I thought about a few ways I could approach it as I did some thinking about it.
- I came up with a way of thinking about the task I was pretty sure was going to work quite well.
- I came up with quite a few ideas or solutions that were mostly quite different from each other.
- I tried to think about the problem from different angles and use any material I had given to help me.
- I considered ways of combining ideas and tried to think of unique possibilities.
- My final idea/best solution had some aspects to it that were quite different: things not many students in my class would think of.
- It works quite well, and I could explain how I came up with the idea and why they would work.

- I tried to explore the task and could see there were a few ways to go with it.
- I decided pretty quickly what my approach to solving/the problem/approaching the task was going to be.
- I came up with a few ideas, and tried to think of things that were different, but my ideas were mostly quite similar to each other.
- I experimented a bit with my ideas but not very much.
- My final idea/best solution was fairly similar to other students' ideas, with perhaps something slightly different about it.
- I am not sure whether my best solution works completely or addresses all parts of the problem or task,
- I was able to explain how I thought it would work.

- I very quickly decided how I would approach the problem or task.
- It seemed pretty straightforward.
- I came up with only a few ideas, and these ideas were very similar to each other.
- I didn't 'play' with ideas very much at all, or try to change my approach.
- My final idea/best solution is very similar to other students' ideas.
- It might be a bit too simple to meet all parts of the problem or task.
- I found it hard to explain why it was a good solution.

CREATIVITY THERMOMETER

Thinking	Ideas	Explore	Unique	Explain
I thought hard about different things I could do for this challenge	I had lots of different ideas	I explored my ideas and thought about different ways to use them	My best idea(s) were different from others I have seen	I can explain how or why my ideas work well.
I thought about different things I could do for this challenge	I had lots of ideas, though some were similar	I explored my ideas	My best idea(s) were a little different from others I have seen	I can explain how or why my ideas work.
I thought a little bit about different things I could do for this challenge	I had some ideas; my ideas were mostly similar	I wasn't sure how to explore my ideas but I tried	My best idea(s) were fairly similar to others' ideas	I can mostly explain how or why my ideas work
I didn't have to think very much, there was an easy answer to the challenge	I had one idea	I didn't need to explore my idea or change things around	My idea is similar to others'	It is hard to explain how or why my idea works


CREATIVITY THERMOMETER
Thinking
Ideas
Explore
Unique
Explain
A lot
Lots (different)
A lot
Very different
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Very similar
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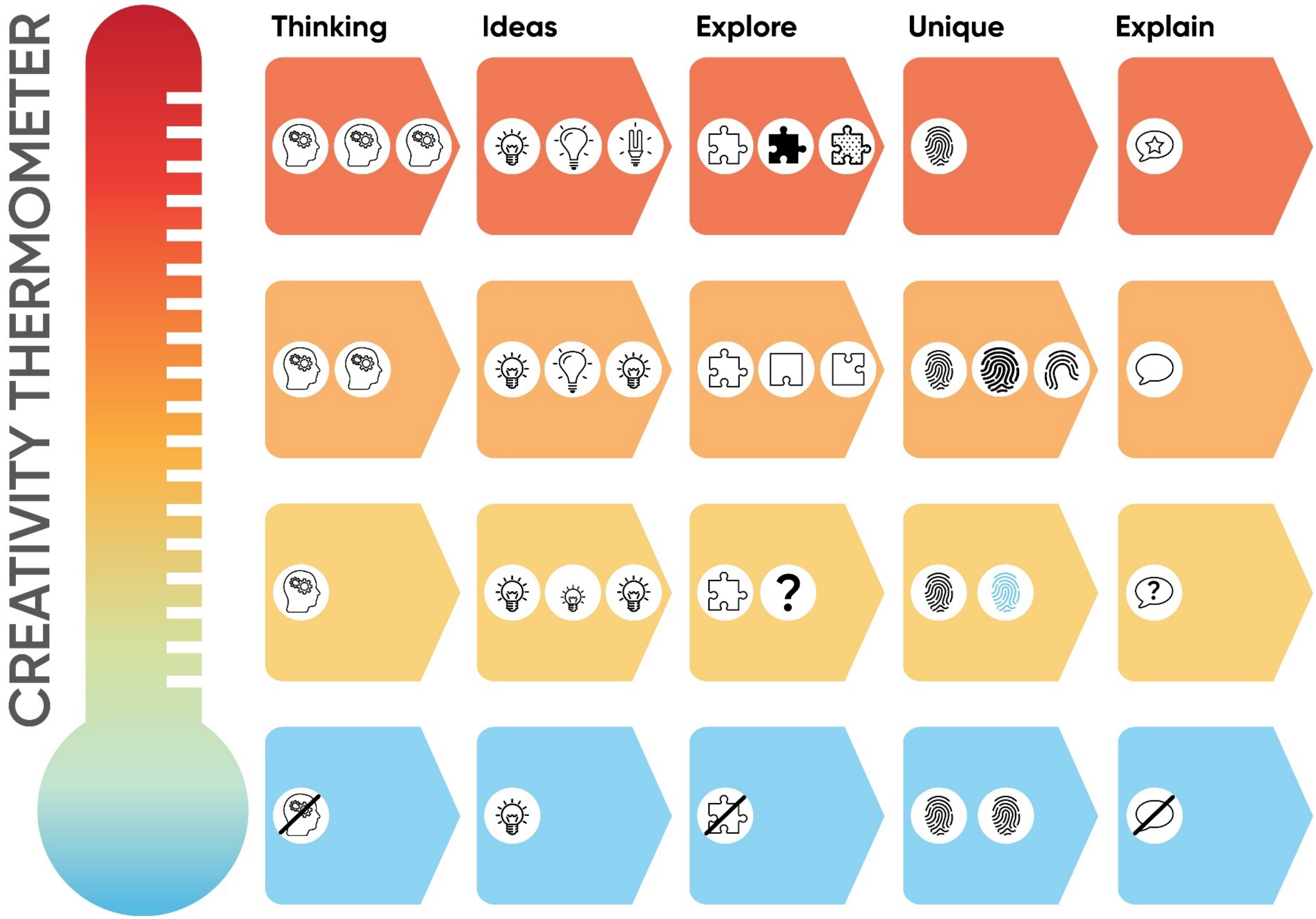

CREATIVITY THERMOMETER
Thinking
Ideas
Explore
Unique
Explain

APPENDIX 6: CURIOSITY THERMOMETERS

CURIOSITY THERMOMETER

I explored the task or topic a lot. I was really interested in one thing in particular, or saw lots of interesting things about it. I wanted to know more. I checked my own understanding quite a bit to be clear about what it was I didn't know or understand, but I also asked some really important open questions like "What if?", "Why?" or "How could?" questions. I set myself some ambitious goals to find answers to these questions and I was confident I could find out what I wanted to know.

When I was finding out, I used as many sources of information as I could. I made sure these sources were useful and continued to ask questions about what I was learning to make sure it was accurate. I persisted in my inquiry or investigation, even though it might have been difficult or challenging. I may even have used some of my own time. On reflection, I understand better what made me curious in the first place, I know what it is that I learned and how that has answered my questions, and I also know what questions I still have that make me curious.

I explored the task or topic quite a bit. I could see some things about it that were – or could be – quite interesting to me, or things that I didn't understand but that I did want to know. This made me want to ask some questions to clarify what was confusing, surprising or interesting me and set myself some achievable goals to answer them.

When I was finding out, I wanted to use a range of sources of information. I noticed if there were things I was learning that didn't 'add up' or make sense, and tried to fix this. I put a lot of effort into making sure I was on the right track and used my time effectively. On reflection, I know I have learned quite a bit and whether my original questions have been answered.

I briefly explored the task or topic. I could see something people might find interesting or surprising about it and I could describe what that thing was. I could also see it might be worthwhile finding out more about it. I was somewhat interested in doing this so I set myself a goal to find out some things I didn't know.

When I was finding out, I knew I had to use more than one source, and to try to use good sources, so I did. I found a small range of information – some of which might not have really 'added up' or made sense to me but I wasn't too bothered by that. I was happy to find information quickly, even if it didn't quite answer my questions. I made reasonable use of the time I had. On reflection, I can recall some basic information that I learned and whether it more-or-less answered my original question.

I didn't really explore the task or topic much at all. There was something that was surprising, interesting or confusing about it but it didn't interest me to find out very much. I set myself a small goal to answer some simple, closed questions.

When I was finding out, I didn't really attempt to use a range of sources of information, or to check what I was learning was accurate – it seemed okay to me. Some of what I came across I didn't understand, or wasn't sure if it was useful but I mostly ignored that information. I probably didn't use my time very effectively, or I could have spent more time doing more to find out. On reflection, I can recall some facts I learned about the topic but not much more.

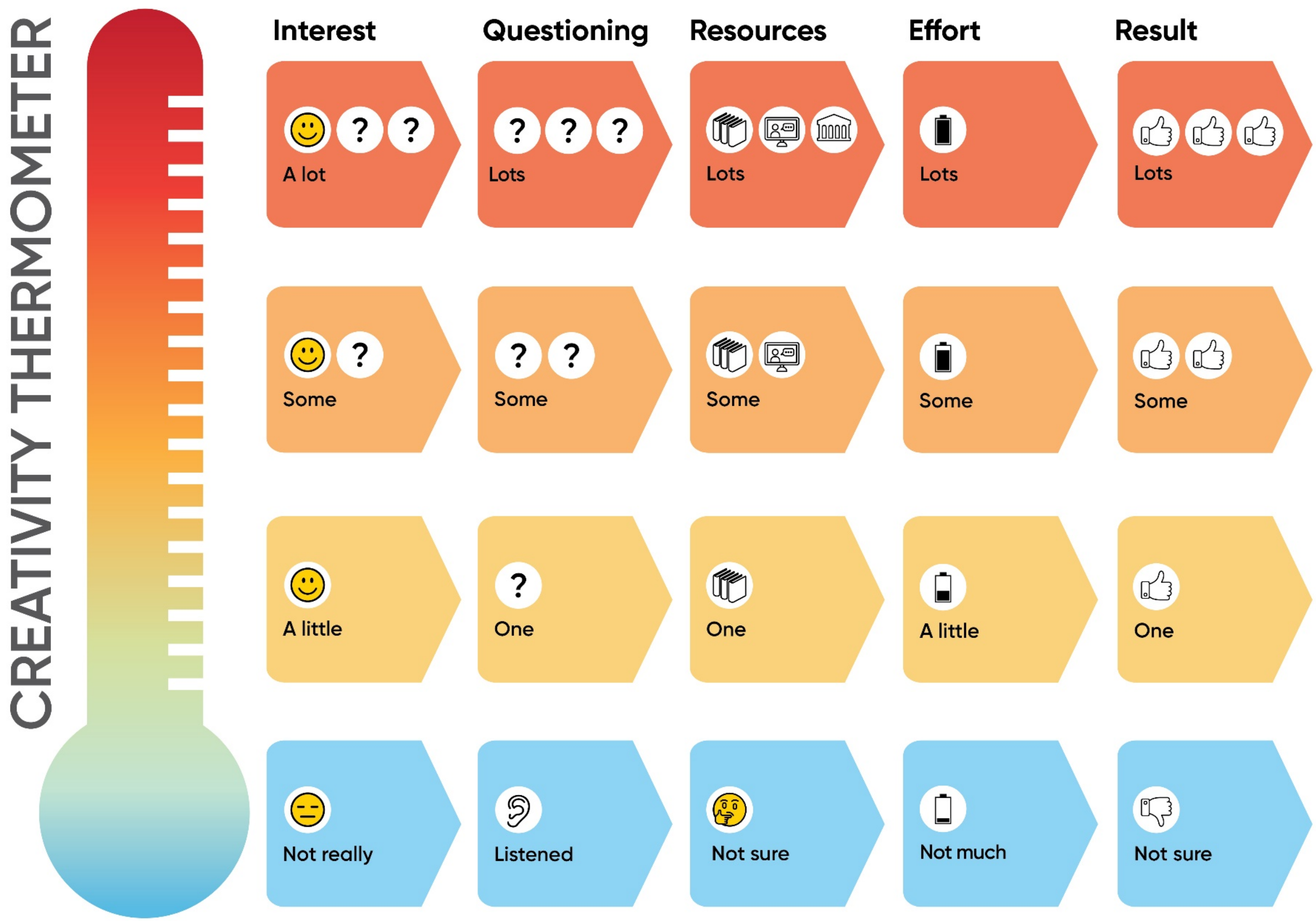
- I explored the task or topic a lot.
- I was really interested in one thing in particular, or saw lots of interesting things about it, and wanted to know more.
- I checked my own understanding quite a bit to be clear about what it was I didn't know or understand.
- I asked some really important open questions like "What if?", "Why?" or "How could?" questions.
- I set myself some ambitious goals to find answers to these questions and I was confident I could find out what I wanted to know.
- I used as many sources of information as I could and made sure these sources were useful.
- I asked questions about what I was learning to make sure it was accurate.
- I persisted in my inquiry or investigation, even though it might have been difficult or challenging, and may even have used my own time.
- On reflection, I understand better what made me curious in the first place, I know what it is that I learned and how that has answered my questions, and I also know what questions I still have that make me curious.

- I explored the task or topic quite a bit.
- I could see some things about it that were quite interesting to me, or things that I didn't understand but that I did want to know.
- This made me want to ask some questions to clarify what was confusing, surprising or interesting me.
- I set myself some achievable goals to answer them.
- I wanted to use a range of sources of information.
- I noticed if there were things I was learning that didn't 'add up' or make sense, and tried to fix this.
- I put a lot of effort into making sure I was on the right track and used my time effectively.
- On reflection, I know I have learned quite a bit and whether my original questions have been answered.

- I briefly explored the task or topic.
- I could see something people might find interesting or surprising about it and I could describe what that thing was.
- I could also see it might be worthwhile finding out more about it.
- I was somewhat interested in doing this so I set myself a goal to find out some things I didn't know.
- When I was finding out, I knew I had to use more than one source, and to try to use good sources, so I did.
- I found a small range of information – some of which might not have really 'added up' or made sense to me but I wasn't too bothered by that.
- I was happy to find information quickly, even if it didn't quite answer my questions.
- I made reasonable use of the time I had.
- On reflection, I can recall some basic information that I learned and whether it more-or-less answered my original question.

- I didn't really explore the task or topic much at all.
- There was something that was surprising, interesting or confusing about it but it didn't interest me to find out very much.
- I set myself a small goal to answer some simple, closed questions.
- When I was finding out, I didn't really attempt to use a range of sources of information, or to check what I was learning was accurate – it seemed okay to me.
- Some of what I came across I didn't understand, or wasn't sure if it was useful but I mostly ignored that information.
- I probably didn't use my time very effectively, or I could have spent more time doing more to find out.
- On reflection, I can recall some facts I learned about the topic but not much more.

Interest	Questioning	Resources	Effort	Result
I really wanted to know more	I asked "What if?" "Why?" or "How?" questions	I tried many different ways of finding out	I kept trying, even when my investigation was difficult	I found out many things and can tell you about them
I wanted to know more	I asked some "Why?" questions	I tried one or two ways to find answers	I mostly kept trying to find answers	I found out some answers
I wanted to know a little bit more	I asked some yes-no questions	I tried one way to find answers	I tried but stopped when it got difficult	I found at least one answer
I was not really interested	I only listened to others' questions	I was not sure how to look for answers	I tried some easy things	I'm not sure if I found any new answers


CREATIVITY THERMOMETER
Interest
Questioning
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A lot
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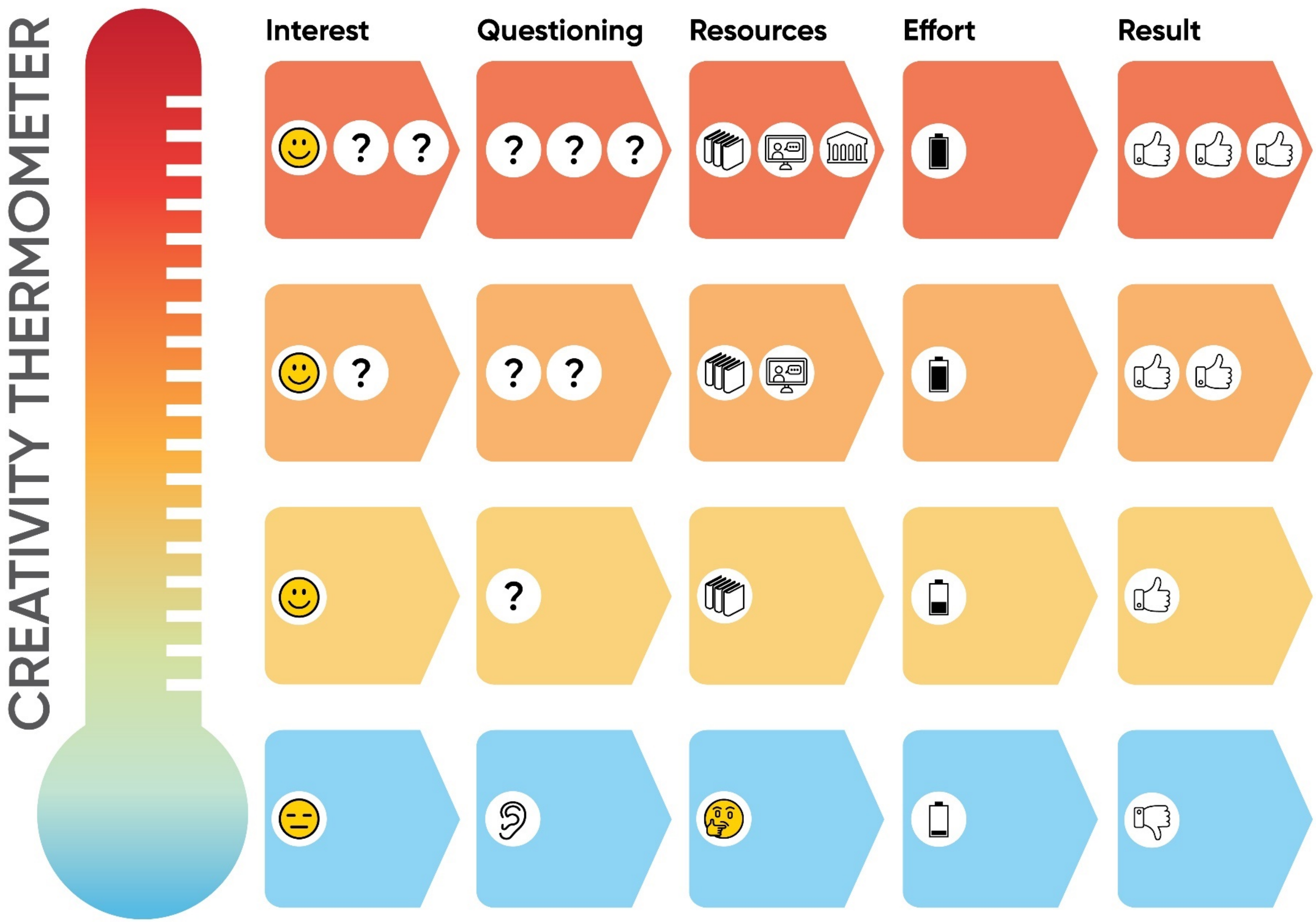
Not much
Not sure


CREATIVITY THERMOMETER
Interest
Questioning
Resources
Effort
Result

APPENDIX 7: ENABLING ENVIRONMENT FOR CREATIVITY

CREATIVITY

- Learners have been provided with the opportunity to develop a diverse, well-connected, knowledge base from which many possible questions or ideas arise
- There is a genuine valuing of the process of being creative, exploring and possibly not finding answers, rewarding time invested, reflections and connections that show greater depth of understanding
- Learners are given open tasks with clear guidelines that focus on promoting creativity; sufficient time is allowed for problem solving and reflection; and creativity is not compromised by other task purposes
- Extensive support is provided to learners in customising individual creative problem-solving plans with ongoing iterative advice, constructive feedback & structured reflections that challenge thinking
- Sufficient appropriate, accessible, reputable resources (filtered where appropriate) are available to learners to support creative problem solving

- Learners have been provided with the opportunity to develop a basic, connected knowledge base prompting some clear questions, but with limited diversity
- Learners are encouraged to pose & investigate a diversity of ideas, and reflection on a range of outcomes is valued
- Learners are given open tasks with an intended major focus on pursuing creative ideas and solutions, but are provided with limited guidelines or support and there is limited time allowed
- Generic support and advice is regularly provided to learners, including feedback and encouragement of reflections with limited customisation
- A range of appropriate, reputable resources (filtered where appropriate) are accessible to learners but tend to constrain the extent their experimentation

- Learners have been provided with the opportunity to develop a limited knowledge base that is narrow, or largely fragmented
- Creativity is interpreted as posing 'curriculum-relevant' questions and 'successful' findings tend to be valued more than others
- Creativity is mainly used as a limited 'add-on' to a task with other foci and the scope of any activities designed to facilitate creativity are heavily constrained
- Minimal support is provided to learners at the start, with limited feedback or support as the process unfolds
- Either limited appropriate, accessible resources, or an overwhelming array of resources are accessible to learners, with minimal support to filter them

- Learners have been provided with little opportunity to develop a knowledge base beyond superficial coverage
- Any valuing of creativity is largely token – creativity is assumed to align with the curriculum content
- Any opportunities to demonstrate creativity are largely prescribed or predictable, or may be missing entirely
- Little constructive support is provided to learners at any point
- Minimal appropriate resources are available or accessible to learners and there is no support to filter them

APPENDIX 8: ENABLING ENVIRONMENT FOR CURIOSITY

CURIOSITY

- Learners have been provided with the opportunity to develop a diverse, well-connected, knowledge base from which many possible questions arise
- There is a genuine valuing of the process of being curious, exploring and possibly not finding answers, rewarding time invested, reflections and connections that show greater depth of understanding
- Learners are given open tasks with clear guidelines that focus on promoting curiosity-driven learning; sufficient time is allowed for investigations and reflections; and curiosity is not compromised by other task purposes
- Extensive support is provided to learners in customising individual investigative plans with ongoing iterative advice, constructive feedback & structured reflections that challenge thinking
- Sufficient appropriate, accessible, reputable resources (filtered where appropriate) are available to learners to support wide ranging investigations

- Learners have been provided with the opportunity to develop a basic, connected knowledge base prompting some clear questions, but with limited diversity
- Learners are encouraged to pose & investigate a diversity of curious questions, and reflection on a range of outcomes is valued
- Learners are given open tasks with an intended major focus on pursuing curious investigations, but are provided with limited guidelines or support and there is limited time allowed
- Generic support and advice is regularly provided to learners, including feedback and encouragement of reflections with limited customisation
- A range of appropriate, reputable resources (filtered where appropriate) are accessible to learners but tend to constrain the extent of divergent investigations

- Learners have been provided with the opportunity to develop a limited knowledge base that is narrow, or largely fragmented
- Curiosity is interpreted as posing 'curriculum-relevant' questions and 'successful' findings tend to be valued more than others
- Curiosity is mainly used as a limited 'add-on' to a task with other foci and the scope of any curiosity-driven investigations are heavily constrained
- Minimal support is provided to learners at the start, with limited feedback or support as the process unfolds
- Either limited appropriate, accessible resources, or an overwhelming array of resources are accessible to learners, with minimal support to filter them

- Learners have been provided with little opportunity to develop a knowledge base beyond superficial coverage
- Any valuing of curiosity is largely token – curiosity is assumed to align with the curriculum content
- Any opportunities to demonstrate curiosity are largely prescribed or predictable, or may be missing entirely
- Little constructive support is provided to learners at any point
- Minimal appropriate resources are available or accessible to learners and there is no support to filter them

APPENDIX 9: TRANSCRIPT FOR CREATIVITY

Creativity Transcript

Student name: ______________________________ Date: ______________________________

Teacher name: ______________________________

Name of task: ______________________________

Length of time taken to complete task: ______________________________

My level of creativity during this task [tick box]:

Cold ☐ Cool ☐ Warm ☐ Hot ☐

In completing this task, I have demonstrated the following elements of creativity [*refer to the creativity thermometer to support your response*]:

____

____

____

____

____

____

____

I still need to work on:

____

____

____

I found these parts difficult when trying to be creative:

____

____

Teacher validation:

______________________ [*student name*]'s level of creativity during this task was [*tick box*].

Cold ☐ Cool ☐ Warm ☐ Hot ☐

☐ Agree – has demonstrated the elements mentioned above
☐ Partly Agree – has partly demonstrated the elements mentioned above
☐ Disagree – has not demonstrated the elements mentioned above

Teacher comments:

____

____

____

Reflection On My Creativity

Student name: ____________________ Date: ____________________

Teacher name: ____________________

Hot

Warm

When my creativity is hot or warm, this helps me to learn because:

Hot

Warm

When my creativity is hot or warm, these are the elements of creativity that I am best at: [*refer to the creativity thermometer and previous transcripts to support your response*]

What do my transcripts tell me about my creativity? What could help to warm it up?

I can take the strategies I use when my creativity is hot and apply them to times when my creativity is cold. I plan to do this by:

My school and teachers can help to support my creativity by:

Creativity Transcript – Early Years version

(Teachers may need to scribe for students)

Student name: ______________________________ Date: ______________________________

Teacher name: ______________________________

Name of task: ______________________________

Length of time taken to complete task: ______________________________

Student statement
I think creativity means:
My level of creativity about this task [tick box]: Cold ☐ Cool ☐ Warm ☐ Hot ☐
In doing this task, I have shown the following elements of creativity: (Some questions to help: What did I have to do? Do any pictures on the thermometer help?)
Did anything stop me from being creative?
What could I practice more?
Teacher Validation
______________ [*student name*]'s level of creativity about this task was [*tick box*]: Cold ☐ Cool ☐ Warm ☐ Hot ☐
☐ Agree – has demonstrated the elements mentioned above
☐ Partly Agree – has partly demonstrated the elements mentioned above
☐ Disagree – has not demonstrated the elements mentioned above

Creativity Transcript – Early Years Formative Activity

Student name: ______________________ Date: ______________________

Teacher name: ______________________

I learn best when my creativity is: Cold ☐ Cool ☐ Warm ☐ Hot ☐

This is because:

When my creativity is hot or warm, I'm best at: Thinking Ideas Uniqueness Explanation

This is because:

What do I need to do to warm up my creativity? Thinking Ideas Uniqueness Explanation

What would make me more creative?

What can my teachers do to help warm up my creativity? Thinking Ideas Uniqueness Explanation

How could we do this?

APPENDIX 10: TRANSCRIPT FOR CURIOSITY

Curiosity Transcript

Student name: ______________________ Date: ______________________

Teacher name: ______________________

Name of task: ______________________

Length of time taken to complete task: ______________________

My level of curiosity during this task [tick box]:

Cold ☐ Cool ☐ Warm ☐ Hot ☐

In completing this task, I have demonstrated the following elements of curiosity [*refer to the curiosity thermometer to support your response*]:

I still need to work on:

I found these parts difficult when trying to be curious:

Teacher validation:

______________________ [*student name*]'s level of curiosity during this task was [*tick box*].

Cold ☐ Cool ☐ Warm ☐ Hot ☐

- ☐ Agree – has demonstrated the elements mentioned above
- ☐ Partly Agree – has partly demonstrated the elements mentioned above
- ☐ Disagree – has not demonstrated the elements mentioned above

Teacher comments:

Reflection On My Curiosity

Student name: ______________________________ Date: ______________________________

Teacher name: ______________________________

Hot

Warm

When my curiosity is hot or warm, this helps me to learn because:

Hot

Warm

When my curiosity is hot or warm, these are the elements of curiosity that I am best at: [*refer to the curiosity thermometer and previous transcripts to support your response*]

What do my transcripts tell me about my curiosity? What could help to warm it up?

I can take the strategies I use when my curiosity is hot and apply them to times when my curiosity is cold. I plan to do this by:

My school and teachers can help to support my curiosity by:

Curiosity Transcript – Early Years version

(Teachers may need to scribe for students)

Student name: ______________________________ Date: ______________________________

Teacher name: ______________________________

Name of task: ______________________________

Length of time taken to complete task: ______________________________

Student statement
I think curiosity means:
My level of curiosity about this task [tick box]:  Cold ☐ Cool ☐ Warm ☐ Hot ☐
In doing this task, I have shown the following elements of curiosity: (Some questions to help: What did I have to do? Do any pictures on the thermometer help?)
Did anything stop me from being curious?
What could I practice more?

Teacher Validation
______________________ [*student name*]'s level of curiosity about this task was [*tick box*]:  Cold ☐ Cool ☐ Warm ☐ Hot ☐
☐ Agree – has demonstrated the elements mentioned above
☐ Partly Agree – has partly demonstrated the elements mentioned above
☐ Disagree – has not demonstrated the elements mentioned above
Teacher comments:

Reflection On My Curiosity – Early Years Formative Activity

Student name: ______________________ Date: ______________________

Teacher name: ______________________

I learn best when my curiosity is:	Cold ☐	Cool ☐	Warm ☐	Hot ☐

This is because:

When my curiosity is hot or warm, I'm best at:	Interest	Questions	Resources	Effort	Result

This is because:

What do I need to do to warm up my curiosity?	Interest	Questions	Resources	Effort	Result

What would make me more curious?

What can my teachers do to help warm up my curiosity?	Interest	Questions	Resources	Effort	Result

How could we do this?

APPENDIX 11: EDUCATOR CREATIVITY QUIZ

CREATIVITY REFLECTIVE QUIZ

Australian Council for Educational Research, 2021

This quiz provides the opportunity for you (either as an individual or as a group of teachers) to reflect on the extent to which you provide an enabling environment for learners to use their creativity. It is not a test! It is designed to spark reflection and discussion.

For each pair of statements, please identify which is **MORE** true and tick the relevant box ✔.

A	I / we believe that creativity requires learners to come up with workable ideas. I / we believe that creativity allows learners to come up with any ideas they like.	1 ☐ 2 ☐
B	I / we encourage learners to exchange ideas between subjects. I / we encourage learners to use ideas within subjects.	1 ☐ 2 ☐
C	I / we tell learners to solve subject-focused problems with any ideas they want. I / we tell learners to solve subject-focused problems with subject-relevant ideas.	1 ☐ 2 ☐
D	I / we encourage learners to brainstorm ideas without filtering. I / we encourage learners to filter ideas during brainstorming.	1 ☐ 2 ☐
E	I / we tell learners to define constraints that will determine if a solution is useful. I / we tell learners to ignore constraints that will limit their creation of a solution.	1 ☐ 2 ☐
F	I / we suggest learners do background research before they design an object. I / we suggest learners avoid background research before they design an object.	1 ☐ 2 ☐
G	I / we provide learners with an open definition of a problem they need to solve. I / we provide learners with a clear definition of a problem they need to solve.	1 ☐ 2 ☐
H	I / we expect learners to detail the practical ways in which an idea can work. I / we expect learners to detail the originality of their ideas.	1 ☐ 2 ☐
I	I / we believe that clever ideas with a clear purpose are the goal of creativity. I / we believe that brilliant ideas without clear purpose are the goal of creativity.	1 ☐ 2 ☐
J	I / we expect learners to think of ideas that are unusual compared to their peers. I / we expect learners to think of ideas that are similar compared to their peers.	1 ☐ 2 ☐
K	I / we encourage learners to generate a new hypothesis. I / we encourage learners to use the hypothesis they are taught.	1 ☐ 2 ☐
L	I / we expect learners to say why a problem is interesting before they solve it. I / we expect learners to rely on their instincts before they solve a problem.	1 ☐ 2 ☐
M	I / we reward learners for the quantity of their ideas. I / we reward learners for the quality of their ideas.	1 ☐ 2 ☐
N	I / we believe that broad understanding of a wide range of subjects is valuable. I / we believe that deep understanding of important subjects is valuable.	1 ☐ 2 ☐
O	I / we value learners who build relationships between diverse topics. I / we value learners who build relationships between complementary topics.	1 ☐ 2 ☐
P	I / we ask learners to justify the pragmatism of their ideas. I / we ask learners to justify the originality of their ideas	1 ☐ 2 ☐
Q	I / we value ideas that need to have their application to the real world explained. I / we value ideas that have an obvious application to the real world.	1 ☐ 2 ☐
R	I / we want learners to be creative even if unrelated to what they are learning. I / we want learners to be creative within the subjects they are learning.	1 ☐ 2 ☐
S	I / we expect learners to break agreed rules in defining their explorations. I / we expect learners to follow agreed rules in defining their explorations.	1 ☐ 2 ☐
T	I / we encourage learners to focus attention on subjects they are interested in. I / we encourage learners to focus attention on subjects they are studying.	1 ☐ 2 ☐
U	I / we want learners to generate lots of ideas that are unfit for implementation. I / we want learners to only generate ideas that are fit for implementation.	1 ☐ 2 ☐
V	I / we ask learners to decide their desired outcomes before starting an experiment. I / we ask learners to read instructions carefully before starting an experiment.	1 ☐ 2 ☐
W	I / we reward learners who come up with unlikely and original solutions. I / we reward learners who come up with logical and realistic solutions.	1 ☐ 2 ☐
X	I / we encourage learners to focus on ideas that have practical value. I / we encourage learners to focus on ideas even if they are impractical.	1 ☐ 2 ☐

Interpretation and guidance can be found on the following page.

Mostly 2s

You are making an effort to enable learners to be creative. Your approach to doing so, however, places limits on how creative learners can be. You view your role as providing the structure, expectations, hypotheses and approaches that learners should use in order to ensure that they are successful in the application of their creativity. But going against all of these parameters is in fact a necessary requirement for learners to be truly creative. In fact, breaking rules and generating novel approaches is important for learners in practicing their creativity. At the same time, however, allowing learners to begin generating ideas before time spent thinking about, and conducting background research on the topic is not helpful. Instead, time spent identifying what is interesting or challenging will yield dividends in the creative outputs that learners generate.

You encourage learners to focus on the subjects that they are studying, hoping that this will aid their academic success. Subject parameters, however, are yet another set of constraints and learners need to be free to make conceptual connections between topics that may seem to bear little relationship to each other, and to draw on a wide range of domains. While education has traditionally focused on solving problems by drawing on resources within that topic, this limits the possibilities of where creativity may lie. Allowing learners to go 'off topic' and to draw on seemingly irrelevant insights expands the possibility of the ideas that they may come up with.

A common approach to the generation of ideas is to set expectations around the types of ideas that are generated. Learners are often instructed to come up with 'good' ideas. This actually inhibits their natural creativity, however. Learners will spend time and effort trying to evaluate and filter the quality of their ideas too early. To counteract this, providing learners with the freedom to brainstorm, to generate lots of impractical ideas and to think entirely outside the box is a vital first step in being creative. Learners whose ideas might seem weird, and that are wildly different to those of their peers, are to be rewarded for giving their creativity free rein.

Once ideas have been generated, however, an important aspect of creativity is to focus on the utility of ideas. Their relevance to solving problems in the real world is extremely important and coming up with solutions is the point at which constraints become essential. Learners need to be able to justify not only the originality of their ideas but also their pragmatism. Their explanations may be lengthy, and the solutions not immediately obvious, but creative learners need to ensure that they can explain the purpose of their suggested solutions and the problems that they will solve.

Mostly 1s

You are nurturing and enabling a learning environment in which learners are able to fully practice their creativity. Although it may seem that this requires giving them too much freedom, you understand that the freedom and lack of constraints is an essential component of a creative learning environment. Rather than giving learners instructions, rules, hypotheses and procedures, you expect learners to work these out for themselves. You realise that when they have to do so, they will become more engaged in the topic and take greater ownership over the approaches they choose to follow.

While you value learner freedom to establish routes to a solution, you equally understand the importance of learners engaging in a topic at a conceptual level before they try to generate ideas. You encourage them to think about the conceptual challenges, to identify what they think is interesting and to undertake background research to find out more about the subject matter. You know that this will ensure more valuable creative outputs than if this stage does not occur.

When learners are generating ideas you encourage them to draw on any subject areas, interests or perspectives that they like. You don't feel the need to constrain them to the topic of study but understand that drawing connections between distinct ideas can help generate novel concepts. You instruct them to avoid filtering their ideas as they are being generated, or trying to only come up with 'good' ideas. You explain that all ideas are valued and understand that learners who can generate many different approaches, including those that may seem weird or eccentric, are exhibiting their unleashed creativity in full.

At the same time, you understand that once ideas have been generated, an important component of creativity is to identify the usefulness or pragmatism of solutions. You expect learners to be able to justify not only the originality of their ideas but also the issues that they will help solve, the benefits that they will generate or the real-world issues that they will tackle. You realise that some of these explanations will require a deal of patience but understand that the ability to explain notions that at first seem unworkable is a valuable skill in itself. You fundamentally realise if learners are to build the skills that underlie creativity, you need to model and nurture a learning environment in which learners can develop and reinforce the skills.

More Information

Many of the statements in the quiz refer to more than one category in the Framework. Nevertheless, they have been grouped together here as coherently as possible to provide further insights into how teachers can help support learners' creativity.

Statements F, L and V - Discovery Oriented behaviour – An important element of learners' creativity is the exploration that they put into a problem before they try to find a solution for it. Getting started on trying to solve it without first identifying what or why is interesting is likely to narrow learner's scope for, and reduce the quality of, they solutions they arrive at. It is therefore valuable for learners to first undertake some background research that identifies interesting factors that they might not otherwise have considered. It is also valuable for learners to define the outcomes they wish to achieve before they get started. While teachers may be tempted to give careful instructions to learners, having learners determine objectives and steps to achieve them will enhance the creativity they use.

Statements E, G and K - Formulating a problem – It is common for teachers to provide learners with a hypothesis, or a clear definition of a problem that needs to be solved, but this can suppress their creativity. Instead, it is better if learners are expected to generate their own hypothesis and to work out their own interpretation of a problem. This will engage them in thinking deeply about a topic and will help them identify what is valuable to focus on, hence stimulating creative ideas. Completely free exploration of ideas is not as helpful to creativity as it may at first seem. Instead, getting learners to set constraints and limitations around how they will judge the success of an outcome focuses their minds on what an appropriate solution may be.

Statements D, M and U - Fluency – While setting limits on solutions is useful to creativity, setting limits on ideas is not. The more ideas that learners come up with, the more likely they are to think of something really creative. Unfiltered brainstorming is a first and vital step in creativity. At this initial stage, filtering and judgement of idea quality impedes creativity. Learners should be encouraged to let their imaginations run wild. Those who come up with an abundance of ideas, no matter how far-fetched, are showing true creativity. Once the initial phase is over, however, it is important that learners are able to evaluate their ideas for their suitability in solving the problem that was identified at the start. Continuing to pursue impracticable solutions is not advisable as novelty has limited value when it is has no practical use.

Statements C, N and T – Flexibility – Creative learners not only come up with lots of ideas, but also think of a range of different types of ideas. This demonstrates their ability to think from different perspectives and to consider a wide range of possibilities. It is particularly important that they think beyond the subject area of the topic they are focusing on. Bringing in insights from a wide range of completely different domains can overcome the fixedness that often limits creativity. A breadth of approach opens up the possibility of novel and unique solutions to problems. This does require teachers to allow learners' ideas to come from areas that may have little to do with the focus of their study, and to devote time to being 'off-topic'. Rather than detracting from their learning, however, this only reinforces the creativity that they can bring to any topic of study.

Statements B, O and S – Experimentation - Creativity requires the willingness to engage in experimentation. This requires learners to transcend boundaries – both those in their minds and also those set by the structures that they study in. Boundaries can include rules and expectations about the 'right' way to do something. Allowing learners to break these can be challenging for teachers. It is important, however, that learners have the freedom to engage in conceptual play – merging different concepts from different domains, pushing boundaries, identifying commonalities between what at first appear distinct topics and coming up with new ways of looking at things. All of these will help nurture their creativity.

Statements J, R and W – Originality – Having learners come up with lots of ideas is an important part of creativity. But when all the learners in a class come up with similar ideas, this is a sign that creativity is not being fully realised. Instead, teachers should encourage learners to think of things that are totally different to those of their peers, approaching ideas from different points of view and identifying what may at first seem like very surprising or unconventional approaches. Learners that go out of their way to link together what may seem two or more unrelated concepts may be regarded as eccentric by their peers but eccentricity should be interpreted as an indication that creativity is being put to good use, and thus nurtured.

Statements A, P and X - Fitness for Purpose - However wild and wonderful learners' ideas are, successful creativity requires finding the balance between novelty and utility. Ideas need to have a practical value. This does not need to be immediately apparent, however. Notions that require explanation for their pragmatism to become clear are likely indications of greater creativity than those that are immediately obvious. The important emphasis should be on learners being able to justify how they think that something will work in practice, and what benefits this will yield. In allowing this, teachers need to be careful to silence any initial scepticism and to give learners the opportunity to persuade others of the functionality of their idea.

Statements H, I and Q – Elaboration – Elaborating ideas for their application to the real world requires more than simple justification. In addition, learners need to be encouraged to think very specifically about how something might work. This means going through the implementation in detail, considering its dynamics and the requirements it will impose. It is also important that learners can elaborate on how they think their concept is different or original, and what benefit they see as inherent in this originality.

APPENDIX 12: EDUCATOR CURIOSITY QUIZ

CURIOSITY REFLECTIVE QUIZ

Australian Council for Educational Research, 2021

This quiz provides the opportunity for you (either as an individual or as a group of teachers) to reflect on the extent to which you provide an enabling environment for learners to use their curiosity. This is not a test! It is designed to spark reflection and discussion.

For each pair of statements, please identify which is **MORE** true and tick the relevant box ✔.

A	I / we expect teachers to set goals for learners. I / we expect learners to set their own goals.	1 ☐ 2 ☐
B	I / we encourage learners to focus on concepts that are clear cut. I / we encourage learners to grapple with conceptual conflicts.	1 ☐ 2 ☐
C	I / we expect learners to follow an agreed formula in arriving at answers. I / we expect learners to take risks in the process of arriving at answers.	1 ☐ 2 ☐
D	I / we expect learners to accept information from trusted sources. I / we expect learners to question any information they are given.	1 ☐ 2 ☐
E	I / we expect learners to understand how to avoid making mistakes. I / we expect learners to understand why they have made mistakes.	1 ☐ 2 ☐
F	I / we expect learners to value the satisfaction of succeeding at tasks. I / we expect learners to value the satisfaction of engaging in tasks.	1 ☐ 2 ☐
G	I / we encourage learners to find out more about any topics. I / we encourage learners to find out more about topics in the curriculum.	1 ☐ 2 ☐
H	I / we reward learners who find an efficient way of finding the correct answer. I / we reward learners who explore different ways of finding the correct answer.	1 ☐ 2 ☐
I	I / we expect learners to explore all topics with equal intensity. I / we expect learners to explore some topics more intensively than others.	1 ☐ 2 ☐
J	I / we value learners' efforts to justify their approaches to inquiry. I / we value learners' efforts to critically reflect on their approaches to inquiry.	1 ☐ 2 ☐
K	I / we regard successful learners as those who avoid making mistakes. I / we regard successful learners as those who try, even with lots of mistakes.	1 ☐ 2 ☐
L	I / we encourage learners to reflect on elements that they need to learn. I / we encourage learners to reflect on elements that excite them.	1 ☐ 2 ☐
M	I / we expect learners to celebrate finding the answers to their questions. I / we expect learners to celebrate thinking of more questions to ask.	1 ☐ 2 ☐
N	I / we expect learners to accept any unexpected results that arise. I / we expect learners to highlight, and seek to clarify, any unexpected results.	1 ☐ 2 ☐
O	I / we tell learners to ask teachers to explain things they are confused about. I / we tell learners to accept that confusion is a normal part of learning.	1 ☐ 2 ☐
P	I / we ask learners to focus on asking all the questions they have. I / we ask learners to focus on evaluating which questions are worth asking.	1 ☐ 2 ☐
Q	I / we reward learners who define an area of inquiry and then stick to it. I / we reward learners who repeatedly redefine and expand an area of inquiry.	1 ☐ 2 ☐
R	I / we expect learners to answer all their questions during an activity. I / we expect learners to have unanswered questions at the end of an activity.	1 ☐ 2 ☐
S	I / we expect learners to seek sources with a similar viewpoint on an issue. I / we expect learners to seek sources with opposing viewpoints on an issue.	1 ☐ 2 ☐
T	I / we value learners who manage to finish their inquiry-tasks within school time. I / we value learners who use some of their free time to finish their inquiry-tasks.	1 ☐ 2 ☐
U	I / we want learners to have clearly defined investigation questions but not goals. I / we want learners to have clearly defined investigation goals but not questions.	1 ☐ 2 ☐
V	I / we introduce content by identifying what learners already know about it. I / we introduce content by identifying how it relates to learners' interests.	1 ☐ 2 ☐
W	I / we believe learners should trust what their teachers tell them. I / we believe learners should question contradictions in what they are taught.	1 ☐ 2 ☐

Interpretation and guidance can be found on the following page.

Mostly 1s

You are creating a learning environment that is conducive to successful learners but that may constrain their curiosity. A preference for clear-cut concepts, a desire to stay within the curriculum and an implicit trust in what teachers say are often regarded as positive learner characteristics. What they also represent, however, are learners who wish to play it safe and who are not prepared to deal with the uncertainties that they will encounter in their lives. This can inhibit the motivation to learn that arises when learners engage with uncertainties.

Teachers often like to establish clear parameters for learners to aid their learning. This means identifying what they need to learn, setting clear goals and rewarding successes. It can also mean providing resources and curating them for learners. It is understandable that teachers feel the need to do this. But by taking responsibility for directing learners, teachers can encourage learners to rely on others. Instead, the opportunity to figure out things for themselves, to see value in the act of engaging in an activity – regardless of the outcome – and to take responsibility for their own learning can help learners thrive.

Another set of characteristics that teachers often encourage learners to exhibit are efficiency and accuracy. Learners are told to focus on the most straightforward approach to a task, the avoidance of errors, and to make sure that they finish on time. They are asked to justify why their method was the best one and to make sure they find answers to all their questions. These are certainly skills that can help learners when they are faced with examinations. But making mistakes, exploring different approaches, going off topic, changing their minds and needing extensions are all elements that are vital in learning. They help build traits of grit and perseverance and are often under-valued in school environments.

There is a perception that every learner can be encouraged to be interested in every subject if teachers could only make it engaging. This does not reflect the reality of our lives, however. All of us are naturally more interested in some things than others. We can gain a great deal from being allowed to focus intensely on the aspects of a topic that fascinate us. When learners can decide what they are interested in learning and are given the freedom to experiment with different paths towards achieving their goals, they will practice important skills that can be applied when content areas are of less intrinsic interest.

Mostly 2s

You are creating a learning environment that is highly conducive to curious learners. You understand that frustration, confusion and contradictions are important in driving learning and that it is not the job of teachers to make learners feel completely safe. You allow learners to follow their passions, even if they deviate from the curriculum, as you understand that the process of doing so will help learners gain skills to apply to topics they like less.

You are also helping nurture curiosity by expecting learners to take responsibility for their own learning. You expect them to set their own goals and to figure out how to achieve them. You accept that false starts, errors, risk-taking and reversals are not only an essential part of learning but are the aspects of any activity that hold the most value for learners. You understand that learners may have incoherent questions, may refine their areas of focus and may need to ask for more time, and that these should be regarded as positive signs of growth rather than setbacks.

You encourage learners to unpack the factors that stimulate their curiosity and to use this information to find ways to engage in content that is not naturally appealing. You expect learners to gain satisfaction from engaging in tasks and learning from mistakes, perhaps even more so than from being right the first time.

When you give learners information and provide them with resources you are not offended when they doubt their authenticity, but instead actively encourage learners to question everything, and to seek out opinions that contrast with their own. You reward innovative approaches and persistence, encourage learners to put in extra time and expect them to critically evaluate the choices that they make. You always expect learners to have unanswered questions and ongoing doubts and understand that these will drive further learning in the future.

More Information

Many of the statements in the quiz refer to more than one category in the Framework. Nevertheless, they have been grouped together here as coherently as possible to provide further insights into how teachers can help support learners' curiosity.

Statements B, G, N, W - Engages with and explores conceptual conflicts - Learners' curiosity is sparked when they identify things that they do not understand. Frustration is positive if it stimulates a desire for resolution. Teachers may be tempted to help, but it is often better to let learners find their own solutions. Channelling negative emotions into positive actions is a habit that will equip learners to thrive in the future. Curiosity may also lead learners away from the core subjects in the curriculum. While teachers can find this challenging, it is valuable for learners to engage in topics of personal interest. The skills and knowledge they learn from doing so can be applied to help encourage their curiosity in other topics too.

Statements A, O, L, V, F - Enhances motivation to learn - Metacognition is essential in nurturing curiosity. It is important that learners reflect on what makes them curious. By identifying underlying patterns, learners gain insights into how they can approach content that does not excite them. Teachers can also help by asking learners how new content relates to aspects they are naturally curious about. It can help 'hook' learners into content areas that they may otherwise struggle to value. It is also important for learners to set their own learning goals. This involves them taking responsibility for their own learning and evaluating progress towards objectives. When learners focus on tasks, it is important that they are encouraged to see the inherent value in engaging in an activity, regardless of the outcome.

Statements I, P, U – Refines questions of value - Curious learners ask questions, but rather than a constant stream of minor ones, should be encouraged to filter these by value and focus only on those that they regard as the most significant. This will help to channel their curiosity in beneficial ways. The act of evaluation itself will also build useful skills for application to other topics. Curiosity often leads to inquiry. Although inquiry requires a sense of purpose, changing direction half-way through, and evolving through a series of incoherent questions, should not be taken as signs of failure but instead as phases that will ultimately enhance the quality of the inquiry. These will enable learners to reap the greatest rewards from their curiosity.

Statements D, M, S – Explores answers and thinks critically - Finding answers to questions can be satisfying but may not be the best outcome of curiosity. Instead, coming up with more and more questions, and identifying increasing amounts of complexity and conflict, can be even more valuable. It is important that learners are encouraged to question everything, even resources or sources of information that at first seem reliable. This can include their teachers! It may be reassuring to seek out perspectives and views that are similar to our own, but curious learners will instead seek out conflicting opinions and diametrically opposed stances.

Statements C, H, K, Q, T – Sustains effort - Curious learners do not necessarily take the easiest route to finding answers to their questions but may instead prefer to try out lots of different approaches so that they can evaluate the relative merits of each one. Some of these approaches may seem foolish, but experimentation and risk taking are important aspects of curiosity. If learners are engaged, they may decide to use up some of their free time to explore further and this is something that is ideally encouraged.

Statements E, J, R – Evaluates learning - Curious learners may not reach a place at which all of their questions and uncertainties are resolved. Instead, they may have many unexplained areas of inquiry remaining. The ability to identify these, and to critically evaluate their approach to inquiry, is an important element of curiosity. Mistakes made along the way are opportunities to learn more. If teachers can resist the urge to step in and provide answers, learners will gain insights into how to apply their curiosity in other situations. Evaluating the reasons for mistakes can help learners to identify alternative approaches for exploration in the future.

APPENDIX 13: REPORT FROM FIRST ROUND OF CONSULTATIONS (FRAMEWORKS)

PARTICIPANT FEEDBACK ON DRAFT FRAMEWORKS

Australian Council for Educational Research, 2021

SUMMARY

The International Baccalaureate Organisation (IB) and the Jacobs Foundation (JF) have generously funded The Australian Council for Educational Research (ACER) and the Oxford University Centre for Educational Assessment (OUCEA) to undertake parallel studies on creativity and curiosity. The purpose of the ACER study is to develop a method for teachers to capture insights into learners' achievement in these 21st century skills.

Since IB programmes are taught in 159 countries around the world, the way teachers identify evidenced behaviours needs to be relevant and practicable in many different contexts. At the same time, since IB programmes are delivered to learners between the ages of 3 and 19, it was also important to consider the relevance to learners of a wide range of different age groups.

A virtual symposium with educators and experts on creativity and curiosity was held in October 2020 to inform the working definitions of creativity and curiosity and initial development of frameworks for each construct. Evidence from a literature review helped support the development of those draft frameworks, which also included definitions and progressions for tracking learner development.

The draft frameworks were sent to teachers and programme coordinators of IB programmes across the world. Included was a link to a survey asking for feedback on either or both frameworks, as well as feedback on the design of a 'Mastery Transcript' for recording learners' evidence of creativity and curiosity. Twenty-two responses were received for the creativity draft framework, and seventeen for the curiosity draft framework.

CREATIVITY

Almost all feedback gathered via the surveys on the creativity framework indicated it was easy to follow, although some respondents felt that was not the right length and could be shorter. The working definition of creativity was generally well received as well as being regarded as comprehensive and relevant across cultures.

Some respondents however, felt that the definition did not make sense and may not be relevant for learners within their schools. Open-ended questions showed that some terms within the definition, such as 'divergent' and 'experimental', confusing and wordy.

The creativity framework had three dimensions: 'problem finding', 'generating ideas', and 'quality of ideas'. All three dimensions were generally well received by respondents although 'problem finding' was found to be less comprehensive than the other two dimensions. Overall, respondents generally agreed the dimensions were easy to understand and relevant to the context in which they were working in.

'Problem finding' was further broken down into two sub-dimensions which were both well received by respondents. There were indications, however, that they were not written in plain English. To address this, respondents suggested getting rid of citations and references within the framework text in order to make the text more to the point. Furthermore, some teachers of creative arts subjects did not find those sub-dimensions very relevant to their disciplinary areas.

'Generating ideas' had three sub-dimensions which were well received. The only statement about those sub-dimensions that were questioned by respondents were whether or not they were equally applicable to the youngest and oldest learners. Respondents noted that these sub-dimensions could be made clearer and more distinct. Respondents also asked to see practical examples to help understand the sub-dimensions; a request echoed throughout the feedback.

'Quality of Ideas' had three sub-dimensions and was the most well received of all the dimensions. One sub-dimension, 'originality', however, was something some respondents struggled to grapple with, and they reflected that evaluating originality could be difficult, and the sub-dimension could be misinterpreted in its current form.

The creativity framework also included a table which defined different levels of competence for all of the sub-dimensions. These were very well received; all but two respondents agreed with every statement about the progressions. Respondents felt the progressions were written in plain English, were easy to understand, and were relevant for using with their learners. Nevertheless, some respondents indicated the language used to describe the progressions could be clearer.

CURIOSITY

The curiosity framework was found to be easy to follow, with only a few respondents indicating it was not the right length. The definition of curiosity was very well received, with all but one respondent agreeing with every positive statement about the definition. The use of the word "gap" within the definition was, however, cited by many respondents as potentially problematic, and other respondents suggested adding more elements to the definition.

Curiosity had two dimensions, called 'focusing curiosity' and 'resolving knowledge gaps'. Almost every respondent agreed the dimensions made sense, were comprehensive and written in plain English, were relevant for use with their learners, and that cultural factors did not prevent them from being applicable in their schools.

'Focusing curiosity' contained three sub-dimensions which were all extremely well received. Furthermore, every respondent agreed the sub-dimensions within focusing curiosity had comprehensive definitions. Respondents noted that practical examples, for different subjects, would help give a clear picture to respondents regarding how the sub-dimensions would look in practice.

'Resolving knowledge gaps' had three sub-dimensions which were also extremely well received; every respondent agreed with every statement about those sub-dimensions. Respondents felt that the sub-dimensions were comprehensive and well written. Respondents had few suggestions for improvement, with one being differentiating between usage with learners of different age groups, and the other being to incorporate the term "feedforward" into the sub-dimensions.

Similar to the creativity framework, the curiosity framework also included a table that indicated different levels of competence for all of the sub-dimensions. The curiosity progressions were well received by respondents. The least supported statement about the curiosity progressions was that they are equally applicable to the youngest and oldest learners in their school, although the majority of respondents agreed that they were.

While most of the feedback was positive, some respondents suggested the progressions may be too complex and could benefit from being streamlined or summarised. While both frameworks received mostly positive feedback, slightly more respondents found the creativity draft framework the clearer of the two.

It was suggested for both frameworks more integration and references with existing IB materials and philosophy could make an improvement. Approaches to Learning and learner profiles were commonly mentioned as examples of how these could be integrated with existing IB systems.

MASTERY TRANSCRIPT

An important part of this work has been to design a way of recording learner achievement in creativity and curiosity, and to enable this to be tracked over time. Respondents for asked for their ideas on how to develop this and what features it should include.

Respondents were uncertain about how a Mastery Transcript, should appear. The most popular suggestions were online portfolios or similar, and some suggested it could form part of an IB Transcript. Some suggested a transcript could be a useful way of communicating 21st century skills to universities or employers, and could potentially be annotated with comments explaining how the behaviours were evidenced.

Whatever form the Mastery Transcript takes, respondents emphasised that it needs to be easy to read and follow, otherwise universities and employers would not engage with it. The design of the Mastery Transcript is still ongoing and this report contains suggestions for its development.

ACKNOWLEDGEMENTS

ACER would like to thank all IB support staff, subject coordinators and teachers for making this research possible. Without the assistance of all those who reviewed the draft frameworks and responded to our questionnaire, we would have been unable to improve the frameworks to the same extent.

We are also very grateful for the time and feedback provided by IB staff in support of this research.

INTRODUCTION

In September 2020, the study on creativity and curiosity referred to in this report began. With generous funding from the Jacobs Foundation (JF) and the International Baccalaureate (IB), the Australian Council for Educational Research (ACER) and the Oxford University Centre for Educational Assessment (OUCEA) have been able to undertake parallel studies on creativity and curiosity. The purpose of the ACER study is to develop a method for respondents to capture insights into learners' achievement in these 21st century skills.

A virtual symposium with educators and experts on creativity and curiosity from across the globe was held soon after the project commenced and delivered valuable insights. Key questions posed during the symposium focused on defining creativity and curiosity, what it may look like across different age ranges, what teaching approaches show promise for creativity and curiosity, cultural factors to be considered, and what a Mastery Transcript would need to include.

The symposium helped define creativity and curiosity and understand the challenges of measuring those learner behaviours in classrooms. Combined with evidence from our literature review, we developed two draft frameworks: the Creativity Skill Development Framework and the, Curiosity Skill Development Framework. Each document included a preamble, practical definition, framework, and a progression with different levels.

The frameworks follow the structure of those that underpin assessment in key curriculum areas such as mathematics and reading. The significant difference in this study, however, is that assessment is not an outcome of the work that has been done. Instead, this study will inform the IB's Mastery Transcript, enabling respondents in IB schools to observe evidence of curiosity and creativity in learners and potentially to comment on how students are developing these 21st century skills.

After the draft frameworks were developed, they were sent to teachers and subject coordinators of IB programmes in schools all over the world. All of these schools had responded to a request for expressions of interest in participating in consultation on the study. Since synchronous consultation was not possible with all schools, the survey was a way of involving schools in consultation in a way that allowed for greater flexibility.

Those respondents were asked to provide feedback via a survey created by ACER. At the time of surveying, supporting materials for the frameworks, such as Evidence Exemplars and practical advice for respondents, were under development and therefore not provided to the participants of this study.

Note on nomenclature: At the time of the consultations the key elements in each framework were collectively referred to as 'strands' and the sub-elements as 'aspects'. To enhance clarity (and because these are terms already used – in different ways in IB documents), these were revised to become 'dimensions' and 'sub-dimensions'. For consistency across all of the appendices included here, the terms strands and aspects have been replaced with dimensions and sub-dimensions here.

METHODOLOGY

To glean the feedback of the two draft frameworks, a survey[4] was developed and shared with teachers of IB programmes. For each component of each framework, respondents were asked to provide feedback by responding to both closed and open questions. There were over 40 questions in total, seeking input about each draft framework, their tables indicating different levels of proficiency, comparing the frameworks, and the Mastery Transcript itself.

Respondents could opt to give feedback on either the creativity draft framework or curiosity draft framework, or both frameworks. Those who opted to give feedback on both frameworks were also asked some questions comparing the frameworks. Everyone was asked to give feedback on the development of a Mastery Transcript.

The survey was sent to 100 respondents of IB programmes across the world who previously expressed interest in being involved in consultations. At face value, the response rate was 27%, however, responses indicated, in some cases, groups of respondents in a single school discussed the questions together and agreed a response; sometimes one survey response represented multiple respondents.

Two respondents taught in government or public schools, and the rest in independent or private schools, within: Australia, Canada, Colombia, India, Jordan, Latvia, Oman, South Korea, Sweden, Turkey, the United Arab Emirates, and Vietnam.

All respondents were teachers, many of whom were experienced; feedback was given by respondents who, on average, had over 15 years' experience. The table below shows the programmes taught by our sample (note: many respondents taught multiple programmes).

Table 4. Programmes taught by respondents

I teach the...		
Answer	Count	%
Primary Years Programme (PYP)	17	68%
Middle Years Programme (MYP)	10	40%
Diploma Programme (DP)	8	32%
Career-related Programme (CP)	2	8%

[4] This survey was created using the tool LimeSurvey (https://www.limesurvey.org/).

In order to minimise the response burden on participants, answers were not mandatory for every question; thus some questions have fewer responses than expected.

CREATIVITY

Twenty-two respondents gave feedback on the creativity draft framework. Almost everyone agreed (19, with nine of those strongly agreeing) the framework was easy to follow. There was less agreement on whether the framework was the right length (not too long and not too short).

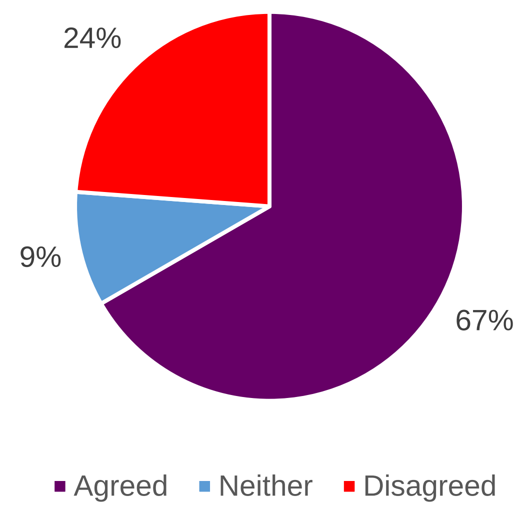


Figure 4. Responses to "the framework is about the right length" (n=21).Five respondents disagreed that the framework was about the right length while two neither agreed nor disagreed.

DEFINITION OF 'CREATIVITY'

Respondents were provided the draft definition of 'creativity' and asked the extent to which they agreed or disagreed with the following six statements:

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for using with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

On the definition of creativity, the vast majority of respondents felt it was comprehensive, written in plain English, and that cultural factors do not prevent the definition from being applicable in their schools (note: nobody disagreed with this last statement).

When asked if they agreed the definition made sense to them, was relevant for use with learners in their school, and was equally applicable to the youngest and oldest learners, the majority of respondents still agreed with each statement, but there was more disagreement.

Table 5. Agreement with statements about the definition of creativity.

Statement	Agreement (%)
It makes sense to me.	82
It is a comprehensive definition.	91
It is written in plain English.	91
It is relevant for using with learners in my school.	73
It is equally applicable to the youngest and oldest learners in my school.	76
Cultural factors do not prevent this definition from being applicable in my school.	95

The four respondents who disagreed that the definition was equally applicable to the youngest and oldest learners in their schools taught the MYP and the DP; none of the 15 PYP respondents disagreed with this statement.

A few respondents did not appear to like much about the definition of creativity, disagreeing with many statements; one MYP and DP respondent disagreed with all statements about the definition (except on cultural factors preventing its use in their school, which they did not answer). Furthermore, one of those respondents (who taught MYP and DP) disagreed with almost every statement in the entire survey (note: they opted to only give feedback on the creativity framework).

IMPROVING THE DEFINITION

When asked how the definition could be improved, two responses were complimentary without adding any suggestions,

> *"We think that the definition is comprehensive and it includes the key features of creativity and the definition is directed toward the process of purposeful learning in real world situations."*
>
> *"We thought that it was informative, clear and we could all understand your definition."*

Most other responses were purely critical or offered suggestions. In particular, 'divergent' and 'convergent' thinking were highlighted as challenging,

> *"Use of terms "divergent, experimental (and convergent)" ends up making the definition confusing."*
>
> *"The last part of the definition "made possible through divergent, experimental (and convergent) thinking" is too confusing and makes the definition too long."*
> *""Divergent, experimental (and convergent) thinking" is easy to explain to older learners, younger learners will require examples [to help them understand what it means]."*
>
> *"I am not sure that (convergent) needs to be included in the way it is in the document. It seems redundant."*
>
> *"It is better if we could simplify using simple terms with the meaning of Divergent and convergent thinking."*

There was a sense the definition is too long or "wordy"; one respondent suggested using

> *"...a lighter one like this: 'Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others.'"*

Another common theme was a request that the definition came with examples, scenarios, or case studies, to help both respondents and students understand the definition. Other comments included an issue with linking creativity with "problem solving/problem finding. Instead, perhaps creativity is born from inquiring into a question or area of interest".

DIMENSIONS

All three dimensions were well received, with the vast majority of respondents typically agreeing with the following statements: 'It makes sense to me', 'It is a comprehensive definition', 'It is written in plain English', 'It is relevant for use with learners in my school', 'It is equally applicable to the youngest and oldest learners in my school', and 'Cultural factors do not prevent this definition from being applicable in my school.' However, out of the three dimensions, 'problem finding' had the lowest rates of agreement.

Table 6. Agreement with statements about 'problem finding'.

Statement	Agreement (%)
It makes sense to me.	77
It is a comprehensive definition.	67
It is written in plain English.	76
It is relevant for using with learners in my school.	73
It is equally applicable to the youngest and oldest learners in my school.	73
Cultural factors do not prevent this definition from being applicable in my school.	86

Respondents had similarly lower agreement with statements about the definition making sense to them, being comprehensive, and being relevant for use with learners in their schools. 'Generating ideas' had the highest rates of agreement across all statements and was the most well received dimension in the creativity draft framework.

Table 7. Agreement with statements about 'generating ideas'.

Statement	Agreement (%)
It makes sense to me.	95
It is a comprehensive definition.	86
It is written in plain English.	91
It is relevant for using with learners in my school.	86
It is equally applicable to the youngest and oldest learners in my school.	86
Cultural factors do not prevent this definition from being applicable in my school.	95

The same three respondents (with differing years of experience and programmes taught) disagreed with three statements (with no respondents neither agreeing nor disagreeing) making those statements ('It is a comprehensive definition', 'It is relevant for use with learners in my school', and 'It is equally applicable to the youngest and oldest learners in my school') the least agreeable statements in the dimension. The vast majority of respondents agreed with the statements about this dimension.

'Quality of ideas' was also well received; all but two respondents (and half of those, strongly) agreed it was written in plain English, and cultural factors would not prevent this dimension being used in their schools.

Table 8. Agreement with statements about 'quality of ideas'.

Statement	Agreement (%)
It makes sense to me.	82
It is a comprehensive definition.	82
It is written in plain English.	91
It is relevant for using with learners in my school.	82
It is equally applicable to the youngest and oldest learners in my school.	82
Cultural factors do not prevent this definition from being applicable in my school.	90

Four respondents disagreed with quality of ideas having a comprehensive definition, which was the statement with most disagreement. 'It makes sense to me', 'It is relevant for use with learners in my school', and 'It is equally applicable to the youngest and oldest learners in my school' each had three disagreeing and one neither agreeing nor disagreeing. The vast majority of respondents agreed with the statements about this dimension.

SUB-DIMENSIONS

The sub-dimensions were generally quite well received, although there was slightly more disagreement with the statements than when questioned about the dimensions. The statements were the same as those used for the dimensions.

Four respondents, all from the same school, disagreed with almost all statements about the sub-dimensions. Those four respondents taught MYP and three of them also taught DP.

PROBLEM FINDING

'Discovery-oriented behaviour' and 'Formulating a problem' are the two sub-dimensions within problem finding. The majority of respondents agreed with all statements about these two sub-dimensions. Only three respondents did not agree that cultural factors would prevent these definitions being applicable in their school.

Table 9. Agreement with statements about 'discovery-oriented behaviour' and 'formulating a problem'.

Statement	Agreement (%)
They make sense to me.	82
They are comprehensive definitions.	73
They are written in plain English.	73
They are relevant for using with learners in my school.	81
They are equally applicable to the youngest and oldest learners in my school.	82
Cultural factors do not prevent these definitions from being applicable in my school.	86

Three or four respondents disagreed with the rest of the statements about 'Discovery-oriented behaviour' and 'Formulating a problem', except the statement asking if they were written in plain English. Five respondents disagreed and one did not agree nor disagree, making it the least agreed upon statement regarding problem finding sub-dimensions.

IMPROVING 'DISCOVERY-ORIENTED BEHAVIOUR' AND 'FORMULATING A PROBLEM'

Respondents of arts subjects did not find these sub-dimensions very relevant for them,

> *"As a music and theatre respondent. I struggle with the notion of problem finding in creativity. I don't always agree that it is a problem . . . I would argue that music composition and devised theatre have as much if not more of "Discovery Oriented Behaviour" [than "Formulating a problem"] . . . There are no arts examples for ["Formulating a problem"] which is unfortunate."*
>
> *"I don't agree with the first dimension being called 'problem solving' as quite regularly there isn't a problem that needs solving in any performing arts dimension. - There isn't always an ill-defined problem. Especially in performing arts. Sometimes it's just a task to create a performance and it isn't ill defined."*
>
> *"Further clarity required for problem statements in Languages & Arts."*
> *"The word 'problem'- could there be a more neutral word instead- not every creative activity is motivated by a problem."*

The sub-dimensions being written in plain English was the least agreed upon statement, and some of the feedback explained this. Suggestions included stripping the definitions of all citations and just give respondents what they need to know, and making them more concise,

> *"Get rid of citations and references in the definitions and just create a one-sentence simplified definition. For this to be relevant and useable, all we need is your final conclusion."*
>
> *"The definitions for each dimension are not clear. Each dimension has multiple paragraphs written in the framework and it is not clear where the definition starts and ends. Additionally, definitions should not have citations included."*
>
> *"Discovery-oriented behaviour definition is almost a little bit 'wordy'. Could it be made more succinct?"*

Including practical examples and connection to assessment was also suggested,

> *"Supporting examples from classrooms will help the learning community to see sub-dimensions in context and make deeper connections for effective implementation."*
>
> *"Will creativity be assessed summatively using a rubric or, like with curiosity, be used solely as feedback/formative assessment? Is the evaluation of creativity desirable? Connection to assessment would be useful here."*

GENERATING IDEAS

'Fluency', 'Flexibility', and 'Experimentation' are the three sub-dimensions within 'generating ideas'. The majority of respondents agreed with all statements about these three sub-dimensions.

Table 10. Agreement with statements about 'fluency', 'flexibility', and 'experimentation'.

Statement	Agreement (%)
They make sense to me.	86
They are comprehensive definitions.	86
They are written in plain English.	86
They are relevant for using with learners in my school.	82
They are equally applicable to the youngest and oldest learners in my school.	77
Cultural factors do not prevent these definitions from being applicable in my school.	90

Only two respondents did not agree that cultural factors would not prevent those sub-dimensions' definitions being applicable in their school, making it the most agreed upon statement. All other statements had just three or four respondents disagreeing – with nobody neither agreeing nor disagreeing on any statements.

The statement with the fewest respondents agreeing was '[the sub-dimensions' definitions] are equally applicable to the youngest and oldest learners in my school'.

The five respondents who disagreed with the above statement taught across all programmes except CP, and had varying years' teaching experience; there was no obvious correlation regarding their context or backgrounds.

IMPROVING 'FLUENCY', 'FLEXIBILITY', AND 'EXPERIMENTATION'

The definitions of the sub-dimensions received praise by some; when asked how the definitions could be improved, one respondent wrote "I'm not sure they can. The definition for 'Flexibility' is incredibly accurate and realistic." However, the most common feedback was that they could be clearer and more concise,

> *"If they are definitions, please just give a short definition rather than explanation / rationale."*
>
> *"Definitions need to be clear. They are not."*
>
> *"Fluency could be elaborated a little more."*
>
> *"The distinction between fluency and flexibility needs to be clearer. It can be confusing due to some overlaps."*

As with the problem finding sub-dimensions, some respondents would like to see practical examples and links to assessments to make the sub-dimensions easier to understand. One respondent added, "*How* a student experiments will have implications for the evaluation rubrics (e.g. Diploma science courses)".

One respondent took issue with these sub-dimensions and perhaps the entire dimension,

> *"Sorry, but even a monkey can generate many ideas from a variety of sources given things to point to. This does not mean it is creative. The notion that the number and breadth of ideas -- without reference to their quality -- is proportional to creativity is a silly one. This is the same problem with creativity tests designed by psychologists. You get points for each use of an object listed, regardless of quality of such uses".*

Other suggestions included the following,

> *"Inquiry based learning might be referred here to explain how IB promotes generating ideas. Also IB learner profile might be good point to discuss here to support your claims."*
>
> *"Fluency considered as the creation of ideas, flexibility as gathering and focusing ideas tightened up to disciplines may combine to creativity."*

QUALITY OF IDEAS

'Originality', 'Fitness for purpose', and 'Elaboration' are the three sub-dimensions within quality of ideas'. Statements about sub-dimensions within this dimension, overall, had slightly more agreement than statements about sub-dimensions in the other two dimensions.

Table 11. Agreement with statements about 'originality', 'fitness for purpose' and 'elaboration'.

Statement	Agreement (%)
They make sense to me.	82
They are comprehensive definitions.	77
They are written in plain English.	86
They are relevant for using with learners in my school.	82
They are equally applicable to the youngest and oldest learners in my school.	86
Cultural factors do not prevent these definitions from being applicable in my school.	90

Only two respondents did not agree that cultural factors would not prevent those sub-dimensions' definitions being applicable in their school, making it the most agreed upon statement.

The least agreed statement was about the sub-dimensions' comprehensiveness.

Three respondents disagreed that the sub-dimensions had comprehensive definitions, with two respondents neither disagreeing nor agreeing. All other statements only had three or four respondents not agreeing with them. The vast majority of respondents agreed with the statements about these sub-dimensions.

IMPROVING 'ORIGINALITY', 'FITNESS FOR PURPOSE', AND 'ELABORATION'

One respondent wrote about the sub-dimensions that they're "perfect. And this is what should be at the heart of things really". However, almost all other feedback was about 'originality'. Comments mentioned how challenging it can be to evaluate, and that it could be improved with rewording,

> *"I struggle with the notion of evaluating originality with the current definition.*
> *"It can be challenging to evaluate the quality of an idea and/or the originality of an idea."*
>
> *"Sub-dimension 3.1 Originality definition is slightly 'wordy'."*
>
> *""Originality" is a good point as IB give importance to Academic Integrity."*
> *"In originality - I think that the final sentences could be improved, "It may be quite challenging or difficult to understand or appreciate as a response to the problem/task, at least initially.""*
>
> *"Originality could be unpacked with more concrete details and suitable examples."*
>
> *"The term originality can be misinterpreted by some. This needs to be defined further."*

Two respondents mentioned 'fitness for purpose', stating that it could be revised with IB's approach to being aware of local and global needs, and that it could be "defined better" (without further explanation).

TABLES INDICATING DIFFERENT LEVELS OF COMPETENCY

Respondents were shown the tables for creativity, and were asked the extent to which they agreed or disagreed with the following five statements:

- The distinctions between each level are easy to understand.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

The tables were very well received by the respondents, with all but two respondents agreeing with every statement.

Table 12. Agreement with statements about the competency tables for creativity.

Statement	Agreement (%)
The distinctions between each level are easy to understand.	91
They are written in plain English.	91
They are relevant for using with learners in my school.	91
They are equally applicable to the youngest and oldest learners in my school.	91
Cultural factors do not prevent these definitions from being applicable in my school.	95

The two respondents who either disagreed with every statement, or neither agreed nor disagreed, both taught MYP and DP in the same school. The pie chart above is typical of the responses to the progressions. About half of the responses which agreed with the statements *strongly* agreed with the statements (by giving the highest rating possible). Therefore, respondents agreed the distinctions between each level were easy to understand, were written in plain English, were relevant and equally applicable to use with all learners in their schools, and cultural factors do not prevent these definitions from being applicable in their schools.

IMPROVING CREATIVITY TABLES

The responses about how the creativity tables of different levels of competency could be improved provided mixed feedback, with some criticisms which were not captured by the statements above. Some positive feedback was that the progressions are straight forward, aligned with the proposed ideas within the framework, with realistic and applicable scales.

The language within progressions was criticised as being unclear,

> *"If we can suggest an area for improvement, we noticed that the language is a bit rigid..."*

> *"Clarifying the meaning and scope of 'fluency' and flexibility, originality."*
> *"The language used in some of these progressions is ambiguous e.g. the difference between 'a reasonable number' and 'many ideas' is unclear."*

Some respondents felt it would find it difficult to give creativity a level, and that the levels need further work or reorganisation,

> *"You need to make sure that the skills development framework is structured in the same was as other IB rubrics. I.e. 1,2,3,4 - not 4,3,2,1 as you look at the table."*

> *"Distinctions between levels could be more explicit. Each descriptor could be levelled across the bands. Tangibility of levels is not evident. Proficiency levels indicate a scale of 0 -4 which is clearly evident here but '0' does not feature in the progression rubric for Creativity."*

> *"Exemplars at each level? Not examples of tasks, but something that 'shows' how this is evident in a piece of work?"*

> *"The flexibility progressions, are not able to show a definitive progress for conventional and unconventional. Like "all are likely to be in their own way to be reasonably conventional" and "range of conventional perspectives or approaches" are both about conventional approach and unconventional flexibly appears only in the fourth progression. It will become difficult for a respondent to contextualize this in his/her classroom as an observable progression. Can we elaborate and split the two further. Convention has different interpretation in different cultures. We must be able to plan a clarification for that."*

One respondent noted that such detailed progressions may have *adverse* effects on creativity in the classroom, and suggested an alternative checklist approach,

> *"Honestly, the idea of having to document and grade on this very detailed level seems like it will destroy the creativity that the framework hopes to analyse. I would MUCH prefer to see something more like a checklist of "aiming for increased creativity" with ways students could do so, rather than a graded scale."*

CURIOSITY

Seventeen respondents gave feedback on the curiosity draft framework.

All but two respondents agreed that the current framework structure is easy to follow; one disagreed, and one neither agreed nor disagreed. There was less agreement on whether or not the framework was the right length (not too long and not too short).

There was slightly less, although still a high level of, agreement when it came to the length of the framework.

Two respondents disagreed the framework was about the right length, and one did not agree nor disagree.

DEFINITION OF 'CURIOSITY'

Respondents were provided the draft definition of 'curiosity' and asked the extent to which they agreed or disagreed with six statements.

Table 13. Agreement with statements about the definition of curiosity.

Statement	Agreement (%)
It makes sense to me.	94
It is a comprehensive definition.	94
It is written in plain English.	94
It is relevant for using with learners in my school.	94
It is equally applicable to the youngest and oldest learners in my school.	94
Cultural factors do not prevent this definition from being applicable in my school.	88

The definition of curiosity was very well received by the respondents. All but one respondent agreed with every statement; one respondent disagreed with every statement, and another respondent disagreed with just one statement.

Therefore, the least agreed statement was the only statement *two* respondents did not agree with, that cultural factors do not prevent this definition from being applicable in their schools.

IMPROVING THE DEFINITION

When asked how the definition could be improved, three responses were complimentary without adding any suggestions,

> *"I think it is perfect."*
>
> *"It is a comprehensive and easy to understand definition."*
>
> *"Simple language is used and the key words in the definition lead to broader understanding."*

The biggest area for improvement within the definition was the term "gap". The issues were twofold, conceptually with the idea of a *gap* being filled, and a suggestion that *gap* is not a positive term to use,

> *"Maybe the term "gap" might require a better unpacking to make it globally transferable. Gap as a term is viewed differently in different cultures and can have positive and negative connotations. Maybe showing it in the Johari Window style of Know, Don't Know, don't know that you don't know kind of definition, might help it become a progressive activity, instead of a definitive*

> *judgement. The current pursuit of "Gap" can come from the "living in the gap" ideology and this means, that the gap is set by bringing a new benchmark to achieve. This way, the provocation might become diluted in schools and respondents might shift to topical approach instead of a conceptual one."*
>
> *"Revise 'fill the gap' with 'explore the gap' as a resolution might not be achieved but this doesn't mean that students won't have exhibited the traits associated with curiosity. The expectation that students be agents of learning is not always valued in all cultures- some cultures expect knowledge to be imparted."*
>
> *"More clarity on- meaningful gap. Could this be rephrased with a more positive phrase?"*
> *"I think the word 'GAP' needs to be looked into. I need not have any gap yet the curiosity can prevail."*

Some respondents suggested adding more elements to the definition, such as play based learning "to give a whole picture for the curiosity-driven learning opportunities in IB", or rephrasing the definition to "capture the idea of wonder or attraction" in the learner. Others suggested rephrasing for the benefit of younger learners,

> *"I think it may be necessary to have an even simpler definition for PYP students. Early years students may be overwhelmed by this current form and feel intimidated."*
> *"Applicability for KG and Lower Primary could be elaborated further."*

Two respondents felt the definition was long and hard to read.

DIMENSIONS

Both dimensions were extremely well received. Regarding both dimensions, the vast majority of respondents agreed they made sense, were comprehensive and written in plain English, they were relevant for use with learners of all ages in their schools, and that cultural factors did not prevent them from being applicable in their schools.

Table 14. Agreement with statements about 'focusing curiosity'.

Statement	Agreement (%)
It makes sense to me.	94
It is a comprehensive definition.	88
It is written in plain English.	88
It is relevant for using with learners in my school.	88
It is equally applicable to the youngest and oldest learners in my school.	88
Cultural factors do not prevent this definition from being applicable in my school.	88

All respondents, except two, agreed with every statement about both dimensions; only two respondents (one taught the PYP and the other the DP) did not agree with some statements.

The PYP respondent did not agree nor disagree with any of the statements about focusing curiosity. When asked how to improve the sub-dimensions within focusing curiosity, their only feedback was that they "could be explained in a simplified manner". The same respondent agreed with all statements about the resolving knowledge gaps dimension.

The DP respondent agreed that the focusing curiosity dimension made sense to them, but they disagreed with the remaining five statements. The DP respondent disagreed focusing curiosity has a comprehensive definition, is written in plain English, is relevant for learners in their school, is equally applicable to the youngest and oldest learners in their school, and that cultural factors would not prevent its definition being applicable in their school.

Table 15. Agreement with statements about 'resolving knowledge gaps'.

Statement	Agreement (%)
It makes sense to me.	100
It is a comprehensive definition.	100
It is written in plain English.	100
It is relevant for using with learners in my school.	100
It is equally applicable to the youngest and oldest learners in my school.	100
Cultural factors do not prevent this definition from being applicable in my school.	94

The same DP respondent did not agree nor disagree with one statement about the resolving knowledge gaps dimension, which was the only time anyone did not *agree* to the statements about this dimension.

SUB-DIMENSIONS

The sub-dimensions, like the dimensions, were very well received. The statements about the sub-dimensions were the same as those used for the dimensions.

FOCUSING CURIOSITY

'Engages with and explores conceptual conflicts', 'Enhances motivation', and 'Refines questions of value' are the three sub-dimensions within focusing curiosity.

Table 16. Agreement with statements about 'engages with and explores conceptual conflicts', 'enhances motivation' and 'refines questions of value'.

Statement	Agreement (%)
They make sense to me.	100
They are comprehensive definitions.	100
They are written in plain English.	94
They are relevant for using with learners in my school.	94
They are equally applicable to the youngest and oldest learners in my school.	94
Cultural factors do not prevent these definitions from being applicable in my school.	94

One respondent, who taught the PYP, agreed the sub-dimensions made sense to them and were comprehensive, but disagreed with the remaining four statements. All other respondents agreed with every statement about the sub-dimensions within focusing curiosity. The DP respondent mentioned above did not respond to statements about the focusing curiosity sub-dimensions, despite disagreeing with most statements about the dimension, although they did provide some feedback on the sub-dimensions (noted below).

IMPROVING 'ENGAGES WITH AND EXPLORES CONCEPTUAL CONFLICTS', 'ENHANCES MOTIVATION', AND 'REFINES QUESTIONS OF VALUE'

The DP respondent who disagreed with most statements on focusing curiosity, but did not respond to statements specifically about its sub-dimensions, gave the following feedback,

> *"These sub-dimensions need to be more tangible and able to be seen. There can be conceptual breakthroughs and learnings without a conflict. 'Enhances' is problematic as a way to measure motivation- it presupposes an initial degree of motivation and it is nebulous about how much change would be need to document that motivation was enhanced. Learner agency would have been better than enhancing motivation. Or place more emphasis on aligning existing interests with new content".*

Respondents suggested providing examples and giving a clear picture of how the sub-dimensions would look in practice, across different subjects,

> *"The definition seems to imply that the respondents will have a key role to play in creating opportunities for this dissonance. How would this look like in a classroom?"*
>
> *"When talking about curiosity we suggest to use learning environment instead of classroom because learning take place anywhere and it could even happen at home. We recommend including examples that the reader can relate to and apply it within their school context".*
>
> *"Specific examples of classroom indicators for certain sub-dimension would be useful, e.g. insightful reflections (as is seen in 2.2 Sustains Effort)".*
> *"Clearer direction for knowledge gaps with suitable examples from different subject domains".*
>
> *"...also sharing examples of how can school/respondents support curiosity in an environment that focuses on structured learning".*

Even though all but one respondent felt the sub-dimensions were written in plain English, a few respondents mentioned they could be written clearer, "by using simpler vocabulary" and that the sub-dimensions "could be explained in a simplified manner". One respondent provided feedback from a Swedish school perspective, noting a problem with the use of the term "gap",

> *"Under Engages with and explores conceptual conflicts, how can we bring in the idea of a 'caramel' to elaborate on the kind of conceptual gap we are talking about. Gap in the Swedish context, for example, is not a good term at all to be associated with learners."*

The term "gap" was also criticised where it was used within the creativity draft framework.

RESOLVING KNOWLEDGE GAPS

'Explores answers and thinks critically', 'Sustains effort', and 'Evaluates learning' are the three sub-dimensions within resolving knowledge gaps. The statements about the sub-dimensions within resolving knowledge gaps were the same as those used before.

Table 17. Agreement with statements about 'explores answers and thinks critically', 'sustains effort' and 'evaluates learning'.

Statement	Agreement (%)
They make sense to me.	100
They are comprehensive definitions.	100
They are written in plain English.	100
They are relevant for using with learners in my school.	100
They are equally applicable to the youngest and oldest learners in my school.	100
Cultural factors do not prevent these definitions from being applicable in my school.	100

All seventeen respondents responded to the statements regarding the sub-dimensions within resolving knowledge gaps, and all seventeen agreed with every statement.

Therefore, the sub-dimension definitions within resolving knowledge gaps were clearly very well received.

Improving 'Explores answers and thinks critically', 'Sustains effort', and 'Evaluates learning'

When asked for feedback on how to improve these three sub-dimensions, six respondents wrote positively,

> *"The three sub-dimensions are correlated and have a sequence".*
>
> *"I thought they were very thorough. Somewhat wordy for the "explores answers and thinks critically" category".*
>
> *"Seems fine and clear".*
>
> *"It is comprehensive and seems to cover all sub-dimensions".*
>
> *"The definitions are comprehensive and [I have] nothing to add".*

> *"These are already clear, they follow a clear process that could be used in the classroom and therefore are more effective. However, we wonder how this process is different from critical thinking and whether labelling this process as being part of curiosity may cause confusion rather than clarify the teaching and learning that we are aiming for".*

Two respondents, who both taught the PYP (in different countries), noted that different ages may affect how they can be applied,

> *"Student development stages affect how it can be applied in school for younger and older learners".*

One respondent suggested incorporating the IB's term "feedforward" within the draft framework,

> *"Apart from feedback – "feedforward" is a term used by IB educators to nurture students' curiosity and set new goals for themselves to self-regulate themselves. How concept-based teaching and learning and scaffolding might be more elaborated".*

DIFFERENT LEVELS OF COMPETENCY

Respondents were shown the tables summarising different levels of competency for curiosity, and were asked the extent to which they agreed or disagreed with five statements.

Table 18. Agreement with statements about the competency tables for curiosity.

Statement	Agreement (%)
The distinctions between each level are easy to understand.	82
They are written in plain English.	82
They are relevant for using with learners in my school.	82
They are equally applicable to the youngest and oldest learners in my school.	76
Cultural factors do not prevent these definitions from being applicable in my school.	88

The competency-levels were quite well received by the respondents, with all but four respondents agreeing with every statement. Three respondents disagreed or neither agreed nor disagreed with almost everything, and between them taught all four programmes. One other respondent neither agreed nor disagreed that competency levels are equally applicable to the youngest and oldest learners in their school.

The least agreed statement about the curiosity competency levels was that they are equally applicable to the youngest and oldest learners in their school, although the majority of respondents agreed with the statement.

IMPROVING CURIOSITY LEVELS

When asked about how the curiosity competency levels could be improved, three main areas were highlighted: their complexity, the need for practical examples for respondents, and their suitability for learners across different age groups.

Some respondents felt the competency levels were complex and may benefit from being streamlined or summarised, not only for their sake but also that of their learners,

> *"We felt these were overly complex and therefore would be hard to place students accurately or confidently at a progression point when she may behaviours and actions are required. We are concerned this would not guide students sufficiently. The descriptions are very prescriptive- for example, searching a wide range of relevant information is not essential in Literature, where close reading of the text is sufficient for developing an insightful understanding".*

> *"The progression attempt to capture many sub-dimensions of curiosity and are incredibly detailed in scope. Perhaps they could be streamlined somewhat as to not appear overwhelming – especially when students are applying these concepts to their own understanding".*

> *"What is written is valuable but need to be summarized to be more teacher and student friendly".*

When trying to understand how the competency-levels could be applied to learners of different ages, respondents called for examples or a simplified version of the progressions for younger learners,

> *"It would be very valuable to see tasks that have been created by teachers to foster curiosity. Table 1 (school context) is helpful, but exemplars of how this can be effectively done at all levels (PYP, MYP, DP) would be particularly useful for implementation. Many of these sub-dimensions are currently assessed indirectly/differently in Diploma IA tasks - our assumption is that the goal here is to go beyond what is required for these tasks. Exemplars would also help Diploma teachers consider how to effectively provide additional opportunities for curiosity (beyond IAs, EEs, etc.) without sacrificing teaching time".*

> *"I am not sure how they would look like in the early years - the ideas seem complex for the early years. Is there going to be a simpler version of this for their use?"*

> *"Would need to discuss with teachers in all year levels to evaluate whether the achievements and expectations could apply for each year level. Would these need to be modified depending on age?"*

> *"We would like to use them if there is a skill continuum with sub skill descriptors for various levels of learners".*

MASTERY TRANSCRIPT

Respondents suggested that both draft frameworks and their competency levels would benefit from having clear and practical examples to help teachers understand how they can be applied in their classrooms, and kick-start their implementation to save teachers time figuring out how to get started. When asked to reflect on both frameworks and how they could be strengthened, this was echoed,

> *"With exemplars/vignettes for teachers. Examples in the progressions. Ensuring that the concepts do not overlaps but may complement each other. Separating the sections on the philosophical underpinnings and the practical user manual would be helpful. A glossary of words to explain what they mean. Defining the role of the teacher".*

> *"Perhaps you can give some examples (teacher/student friendly) in some areas to make it an even more practical guide and ensure consistency and ease of implementation. This might be an additional resource".*

> *"More examples, case studies will surely support effective implementation".*
> *"Maybe we can summarize the curiosity framework and include more real life examples so readers can relate".*

It was also clear from feedback that the frameworks may include too much detail. Sometimes the draft frameworks were regarded as too complex or prescriptive, other times they were too wordy or included details (such as references to literature) teachers did not need. Often teachers asked for simplified or streamlined frameworks in their qualitative feedback, although for both draft frameworks respondents generally agreed they were clear and comprehensive.

Respondents were asked, since each draft framework was written in a slightly different way, did they find one clearer than the other.

Slightly more respondents found the creativity draft framework the clearer of the two, and three respondents felt they were equally clear. This reflects some qualitative feedback on the curiosity framework where respondents pointed out the creativity framework was clearer. When given the opportunity to reflect on both frameworks, some respondents noted how they found the creativity framework easier to follow,

> *"The Creativity Draft was so much easier to read and understand. We were a group of 4 teachers and all found the Curiosity paper hard to read".*

> *"Because curiosity seems even more abstract a concept than creativity, I think that the authors have gone to great effort to capture intangibles - and sometimes it reads this way. It is not as easy to use and understand as the creativity framework".*

> *"It's the first time that I've read about curiosity which I find really interesting and noble whereas the creativity framework is clearer".*

One respondent noted the creativity framework may be clearer as ACER has researched this area in the past. It is assumed they are referring to the creative thinking framework when they say "the original ACER" work, which they said they preferred,

> *"The definition and written text in the creativity framework is clearer, possibly because of the extensive research ACER has already done in this area. However, the decision to change the sub-dimensions and dimensions from the original ACER work was a negative as we felt the original definitions were more tangible and therefore more likely to inform teaching, be used to discuss actions and behaviours with students, and that teachers would have been more confident to assess student progress on the original version, rather than the new creativity dimensions being presented. The curiosity framework is definitely more complex as what was being described sometimes seemed to be critical thinking or creative thinking and it seemed the framework had made these more tangible and well-known skills hidden by new terminology and new clusters of behaviour. The curiosity framework also seemed to describe elements that would not necessarily be observable in the classroom making it less useful as a teaching and learning tool to guide students and learning design".*

Some respondents noted that more integration and references to IB materials or philosophy would strengthen the frameworks,

> *"Creativity: "Reflection and reflective thinking" might be embedded in the framework. Also "approaches to learning" might be used to frame the literature review part. Under the subskills - there are lots of information about the definition, expectations and opportunities to be provided for students in terms of creativity which you may find out in IB - Learning and teaching document. So it will be more efficient to use within the IB school context. Especially student agency can be coined to give the essence of the interdependence between student's agency and problem solving – creativity".*
>
> *"... in the curiosity framework there are more emphasis on IB philosophy regarding approaches to teaching, both documents might be structured in a way to show their relevance to IB programmes".*
>
> *"The explanations need to be balanced between "jargon" and quoting experts and have more about defining them for an educator in perspective to the IB Framework. That flow is missing in the current document. It is abrupt and more chunky as a copy-paste of the ideologies/schools of thoughts. The weave needs to be better".*

Another suggestion to strengthen the frameworks was to adapt them for different subjects.

INTEGRATING A TRANSCRIPT INTO EXISTING IB SYSTEMS

Respondents were asked "How could a transcript be integrated into existing IB systems so that it sits alongside, for example, records of grades in subjects?" Approaches to Learning and learner profiles were commonly mentioned as examples of how the transcript could be integrated,

> *"Approaches to Teaching and Approaches to Learning… Also learner profile attributes should be considered. Rather than grade level, this should be adaptable to student's progression apart from their grade level to make it more useful regarding the inclusive approach".*
>
> *"It could be featured in the same way that Approaches to Learning is".*
>
> *"We already have Learning Outcomes (scope and sequences) and ATLs (sub skills) that are assessed on. It would be best to devise a "Creativity outcomes" and "curiosity outcomes" kind of view for schools to contextualize and build in their own setting".*
>
> *"I think that at the heart of IB framework is the inquiry approach that helps the students to develop all the learner profiles that seemed to align with the transcript. The teachers are already creating their rubrics which help them to assess the learner profiles. However, providing some key characteristics of a curious learner can help in integrating the transcript".*
>
> *"Could it sit amongst the IB scope and sequences? Could it form a component of the Units of Inquiry for PYP?"*
>
> *"Along with certain Learner Profiles and given samples for self-assessment in transdisciplinary units".*

Some respondents there may be problems or conflicts with grading, or that curiosity and creativity should not be 'mastered' or graded,

> *"It would need to sit alongside grades, but this raises a challenge as grades offer a subject specific window into performance. Would this Mastery Transcript be filled in for each subject, or would it be holistic and if it's the latter, how would schools collect and collate this information? If a student demonstrated different levels of mastery in different subjects, might synthesising this into one table and transcript mean that we lose insight into the relative strengths of a student because they are aggregated into an 'average' judgement on the progressions?"*
>
> *"Unclear - this creates the requirement for assessment / determination of a level which the frameworks appear to request. - Perhaps descriptor level (0-4) could be amalgamated across all subjects, and an overall comment for each sub-dimension is recorded. This avoids using levels which are likely to be perceived as assessment rankings".*

"As a progression- I am not sure that there should be mastery- more like continuum to indicate progress. As these skills are fluid and not static at any point".

"I guess creativity and curiosity may not be graded".

Some respondents noted that online records of curiosity and creativity may help with integration with current IB systems and students' future prospects,

"A form/online template could be made accessible for ease/consistency of implementation/practice".

"Online portfolio would be best to fit what University and colleges are looking for".

"I think that a written rubric without visual examples would be hard for parents to understand. If students were to gather examples in an online portfolio they would have ownership, agency and a deep understanding of when they demonstrated creativity or curiosity. It would rely on constant reflection and a clear understanding of the different stands and sub-dimensions required during the process. The dimensions would have to be taught and visible cues would be required in the classroom. The online portfolio could be Transdisciplinary. The portfolio would have to be an easy to follow template. Not like the repetitive documentation require for the PYP programmes. (A keynote might work)".

Other feedback included the following comments,

"Schools use Toddle and Seesaw in the PYP and Managebac in the DP. If the transcript could be integrated into these existing IB systems it would be great. Learner Portfolios which was introduced in 2019 in the DP evidenced the students learning journey over two years.

"Maybe to include it as teacher support material with examples from other IB schools"

"It could be mapped to Action both inside and outside of POI."

WHAT COULD THE MASTERY TRANSCRIPT LOOK LIKE?

Respondents were asked "when you think about such a transcript, what form do you imagine it to take?" Respondents could tick all the suggested forms they thought could be suitable and were given a text box to suggest alternative forms.

Table 19. Ideas regarding the form of a Mastery Transcript

Form of Mastery Transcript	Count
Online portfolio	15
Online form or spreadsheet	14
Video	8
Paper form or spreadsheet	2
No idea	2

Online portfolios were most frequently chosen as the form the respondents imagined a Master Transcript would take, closely followed by another online form or spreadsheet. Only three respondents took the opportunity to suggest alternative forms of the Mastery Transcript, which are as follows:

> *"Similar to the way the individual school shares other information".*
>
> *"Toddle Enabled, so that my teachers could easily weave it into their learning experiences and unit of inquiry, this way they can evidence and assess it (both teachers and students)".*
>
> *"Keynote".*

USES FOR FUTURE EMPLOYERS AND UNIVERSITIES

Respondents were asked "For learners in your school finishing the DP or CP, how could the Mastery Transcript help them to communicate their 21st century skills to potential universities or employers?"

Respondents often felt the Mastery Transcript could be used as a record of development, perhaps as part of an IB Transcript, showing development in 21st century skills. The record could be annotated with comments, for example, on each sub-dimension.

> *"It may be useful when the student has a particularly high degree of creative ability. It will be a great way to displaying talent in the area of creativity. It may also show evidence of growth in the area of creativity".*
>
> *"It will show the universities and employers the skill progression of a person. Perhaps this will be a better window of a person's growth and journey instead of a personality test".*
>
> *"This could be a unique portfolio capturing learning dispositions and thought process celebrating creativity and curiosity. CP supports ATLs especially in their reflective projects which is an extended research work on issues. This will help build their portfolio with such meaningful elements that have relevance and significance in the learning journey and real world".*
>
> *"Overall comments [e.g. for each sub-dimension] could be shared as part of an IB transcript. - Summary list of inquiry activities that the student engaged in that demonstrated learner profile attributes".*
>
> *"It could be included/ given a special section in their mid-year and end of year written reports".*
>
> *"The students could modify and use appropriate evidence collected during their school years".*

A transcript may be a useful way of communicating skills to universities (or employers), although this is dependent on the application system providing the space to submit this information,

> ***"I think a Mastery Transcript could capture skills but it's dependent on whether universities and employers provide opportunity to provide this information. Online recruiting and application systems may not be flexible enough to provide space for new types of documentation such as this***".

If the Mastery Transcript were online rather than a file of some form (such as a Word document), students may be able to provide the link in a text box somewhere in the application rather than relying on a space for additional documents to be uploaded. Of course, a student could possibly append their Mastery Transcript to a file (such as a CV or other record) anyway.

The Mastery Transcript could help the student develop by providing a way for them to reflect on what they have learned and how they have developed, particularly if the transcript has a self-reporting component.

> *"I am a PYP teacher and do not have much idea about how will it look like at DP or CP level. However, mastery of the transcript will help the learners evaluate and analyze any situations thus reflecting their critical thinking skills. By not giving up easily and constantly trying to find alternatives would also reflect students as resilience. By embracing a new environment and attempting to understand an environment, situation or problem will reflect them as open-minded individuals who have growth mindset and creative individuals".*
>
> *"It will help them develop a student profile with persona clearly indicating the descriptors and the continuum of these framework with supporting evidences can help the potential universities or employers understand "Who the applicant is""*.
>
> *"It will prepare them with the skills required to become lifelong learners".*

Other comments from respondents on how the Mastery Transcript could help future employers or universities included the following,

> *"The rubric levels could be charted across the program. An addendum to their transcript could chart these skills".*
>
> *"Having a Mastery transcript will ensure that our curriculum is aligned to future studies and the needs of the industry. While building their own portfolio their focus will be directed".*

KEY CONSIDERATIONS FOR DESIGN

Respondents were asked "What are the key considerations we should bear in mind in designing the Mastery Transcript? Many respondents emphasised the need for the transcript to be easy to read and follow. If the transcript is difficult to engage with, for people not already familiar, it may lose some of its value. One respondent suggested the current framework is too long and complex, and universities and employers would not read pages and tables of a transcript if the Mastery Transcript will be like the frameworks,

> *"Formatting to make it easy to look at and follow. It's a lot of information (important), but it needs to be 'easy' to read and reference".*
>
> *"As user friendly for teachers and students alike. It would be great to have a reflective/ evidential tool for students to keep/ manage".*
>
> *"It should be easy for teachers to understand. - It should not be too prescriptive and no too generic either. The progression should be visible and clear on the quantifiables. This will help teachers design the learning better".*
>
> *"TIME, EFFICIENCY, Both for students and teachers who are already incredibly busy".*
>
> *"It need to be easily read. Currently there are too many words and it's too dense to be an accessible and visual snapshot of a student's skills. It is likely that universities and employers would not read pages and pages of a table like the current drafts represent. There would also need to be assurance that all students are given access to learning opportunities that enable them to demonstrate mastery in these areas- the limitations of teaching might inhibit students from being able to demonstrate their skill".*
>
> *"Readability and access. Students should have access to this growing transcript throughout their time with us. The language used should be clear and accessible to all those who will be reading them in future - apart from the teachers and the students".*
>
> *"It needs to be user friendly for teachers who already have huge amounts of documents to reference so if it can be incorporated into something existing, it will be received and used more successfully. - For PYP, could the MT be used at the end of each year level?"*

Respondents also emphasised there should be space to provide examples of curiosity, creativity, and other work within the Mastery Transcript, such as a portfolio with a summary,

> *"You have made great drafts for progressions for dimensions; I believe examples from school will give an even better understanding of what is expected for both respondents and students.*

> *"That it is clear in what it asks teachers and students to do. Shows real examples of both. Has students explain their thought process behind the product".*
>
> *"Observe, findings, reflection, consideration, demonstration, and recycling".*
>
> *"Should reflect the process and the product. Supported with evidence and work. Interesting and engaging. Build upon a success criteria for effectiveness".*
>
> *"It will be difficult to keep this from becoming another assessment rubric/checklist. - A summary of student initiated activities (portfolio with summary) would be more revealing than generic comments/ descriptors. Unclear how this would be tracked/uploaded to IBIS, etc."*
>
> *"The transcript articulates essential skills, habits and dispositions that can be demonstrated through student work along with the marks transcript".*

In terms of security, one respondent recommended (presumably if the transcript is online) restricted accessibility to universities and potential employees, and only on a verified request.
Some respondents also highlighted that the Mastery Transcript will need to be accessible and understandable across different cultures, including where standardised testing is the focus. Furthermore, the transcript should be relevant to learners within different age groups, as described by one respondent, "…that it is age appropriate and can be interpreted and used upwards".

Creativity and Curiosity: Draft Framework Review
Survey Items

[Note – these items were delivered online using Lime Survey and included dynamic conditions for only showing appropriate or relevant items that cannot be seen in this format]

Introduction

Thank you for your interest in participating in a review of the draft creativity and curiosity frameworks that have been developed for use across International Baccalaureate programmes.

For each component of each framework you will be asked to provide your feedback by responding to both closed and open questions.

About the Survey

21st Century Skills

As you know there is a great deal of interest in helping learners to gain 21st century skills during their schooling, to better equip them to be able to contribute to, and lead, their communities in the future. In this project, we have been asked by the International Baccalaureate Organisation to develop an approach to evidencing 21st century skills that is suitable for implementation in the classroom. The goal is to gather evidence of learner skills and record this evidence in a Learner Profile Mastery Transcript.

There is an important reason why we are using the term 'evidencing' instead of 'assessment'. We are focusing on observable student behaviours that do not necessarily occur in the context of a formal assessment. The intention is that learners will be able to demonstrate their skills – for example through a portfolio or project – and then they, alongside their teachers, will be able to evaluate their achievement in a way that encourages further development.

Although the IB Learner Profile does not explicitly mention creativity and curiosity, these are highly relevant to many of the attributes it includes. They have been chosen as two exemplar 21st century skills to start with, and the intention is that the Mastery Transcript should allow other 21st century skills to be recorded in the future.

Draft Frameworks

Our first activity in this project has been to develop draft frameworks for both creativity and curiosity. We consulted some of the leading global scholars, and reviewed the most important research, to identify the key characteristics of each skill and their relevance to learning.

These frameworks define what we mean by creativity and curiosity and lay the groundwork for the evaluation of student work with the progressions provided at the end of the frameworks.

In this survey we would like your feedback on the draft frameworks. The aim of the survey is to gather feedback from schools to help us ensure that the frameworks are appropriate for IB programmes. They should be easily understandable by teachers, relevant across different IB programmes and in different countries, and provide help to teachers and learners in your school in evaluating learner achievement. Please reflect on the context in your school and country when you respond to the questions.

In this survey you can provide feedback on ONLY the creativity framework, ONLY the curiosity framework or BOTH.

It will take approximately 20 minutes to provide feedback on each framework.
Please select which framework(s) you would like to provide feedback on.
Please choose only one of the following:

- The Draft Creativity Framework
- The Draft Curiosity Framework
- Both the Draft Creativity and the Draft Curiosity Frameworks

Research Ethics

We are conducting this survey according to ACER's research ethics guidelines.
We will not collect any personal information from you, and neither you nor your school will be identified in any reporting that we do.

We would like to encourage you to answer honestly – all constructive criticism is welcomed! Please provide as much or as little feedback as you would like.

I confirm that I am happy to participate in this survey.

- Yes
- No

About Me

We need to collect a little information about you to help us analyse the data.

The name of my school is [open text box]

My school is

- Independent or private
- Government or public

My school is in [name of country chosen from drop down list]

I teach in the (Please choose all that apply):

- PYP
- MYP
- DP
- CP

I am

- Female
- Male
- Prefer not to say

I have been teaching (across all schools) for …. years. [open box for numbers]

Creativity

The creativity framework provides a definition, identifies the different dimensions and sub-dimensions and provides a progression with defined levels. It is designed to help learners and teachers understand what creativity is, and how different sub-dimensions can be recognised.

A dimension is an overarching conceptual category for framing the skills and knowledge associated with either creativity or curiosity. Dimensions are amenable to instruction, provide evidence of creativity or curiosity, and can potentially be assessed.

An sub-dimension refers to a specific content category within a dimension.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- The current framework structure is easy to follow.
- The framework is about the right length (not too long and not too short).
-

Please read our draft definition of creativity in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for using with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

How could this definition be improved? [OPEN]

We have divided creativity into four 'dimensions'. A dimension is an overarching conceptual category for framing the skills and knowledge associated with curiosity. Dimensions are amenable to instruction, provide evidence of creativity or curiosity, and can potentially be assessed

These are the four dimensions that we are using:

- Problem finding
- Generating ideas
- Verifying ideas
- Quality of ideas

Please read our definition of the dimension 'Problem finding' in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

Please read our definition of the dimension 'Generating ideas' in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

Please read our definition of the dimension 'Verifying ideas' in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

Please read our definition of the dimension 'Quality of ideas' in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

We have suggested that 'Problem finding' has two "sub-dimensions" - an sub-dimension is a content category. The two sub-dimensions are:

- Discovery-oriented behaviour
- Formulating a problem

Please read the definition of each sub-dimension in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

How could these definitions be improved? [OPEN]

We have suggested that 'Generating ideas' has three "sub-dimensions" - an sub-dimension is a content category. The three sub-dimensions are:

- Fluency
- Flexibility

- Experimentation

Please read the definition of each sub-dimension in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- They make sense to me.
- They are comprehensive definitions.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

How could these definitions be improved? [OPEN]

We have suggested that 'Verifying ideas' has three "sub-dimensions" - an sub-dimension is a content category. The three sub-dimensions are:

- Evaluating solutions
- Seeking feedback
- Refining ideas

Please read the definition of each sub-dimension in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- They make sense to me.
- They are comprehensive definitions.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

How could these definitions be improved? [OPEN]

We have suggested that 'Quality of ideas' has three "sub-dimensions" - an sub-dimension is a content category. The three sub-dimensions are:

- Originality
- Fitness for purpose
- Elaboration

Please read the definition of each sub-dimension in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

- They make sense to me.
- They are comprehensive definitions.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school

How could these definitions be improved? [OPEN]

Progressions

For each sub-dimension, 'progressions' define five proficiency levels – 0, 1, 2, 3, and 4. For each sub-dimension they provide definitions for what learner achievement at each level might look like. Please read the draft progressions in the framework. Bear in mind that, at this stage, progressions are theoretical and not yet validated - they are currently our best attempt and may change.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- The distinctions between each level are easy to understand.
- They are written in plain English.

- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

How could these progressions be improved for use in your school? [OPEN]

Curiosity

The curiosity framework provides a definition, identifies the different dimensions and sub-dimensions and provide a progression with defined levels. It is designed to help learners and teachers understand what curiosity is, and how different sub-dimensions can be recognised.

A dimension is an overarching conceptual category for framing the skills and knowledge associated with either creativity or curiosity. Dimensions are amenable to instruction, provide evidence of creativity or curiosity, and can potentially be assessed.

An sub-dimension refers to a specific content category within a dimension.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- The current framework structure is easy to follow.
- The framework is about the right length (not too long and not too short).

Please read our draft definition of curiosity in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for using with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.

- Cultural factors do not prevent this definition from being applicable in my school.

How could this definition be improved? [OPEN]

We have divided curiosity into two 'dimensions'. A dimension is an overarching conceptual category for framing the skills and knowledge associated with curiosity. Dimensions are amenable to instruction, provide evidence of creativity or curiosity, and can potentially be assessed

These are the two dimensions that we are using:

- Focusing curiosity
- Resolving knowledge gaps

Please read our definition of the dimension 'Focusing Curiosity' in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.
- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

Please read our definition of the dimension 'Resolving Knowledge Gaps' in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- It makes sense to me.
- It is a comprehensive definition.
- It is written in plain English.
- It is relevant for use with learners in my school.

- It is equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent this definition from being applicable in my school.

We have suggested that 'Focusing Curiosity' has three "sub-dimensions" - an sub-dimension is a content category. The three sub-dimensions are:

- Engages with and explores conceptual conflicts
- Enhances motivation
- Refines questions of value

Please read the definition of each sub-dimension in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- They make sense to me.
- They are comprehensive definitions.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

How could these definitions be improved? [OPEN]

We have suggested that 'Resolving Knowledge Gaps' has three "sub-dimensions" - an sub-dimension is a content category. The three sub-dimensions are:

- Explores answers and thinks critically
- Sustains effort
- Evaluates learning

Please read the definition of each sub-dimension in the framework.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- They make sense to me.
- They are comprehensive definitions.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

How could these definitions be improved? [OPEN]

For each sub-dimension, 'progressions' define five proficiency levels – 0, 1, 2, 3, and 4. For each sub-dimension they provide definitions for what learner achievement at each level might look like. Please read the draft progressions in the framework. Bear in mind that, at this stage, progressions are theoretical and not yet validated - they are currently our best attempt and may change.

Please indicate your level of agreement with the following statements.

Strongly Disagree 1 2 3 4 5 6 7 8 9 10 Strongly Agree

Please choose the appropriate response for each item:

- The distinctions between each level are easy to understand.
- They are written in plain English.
- They are relevant for using with learners in my school.
- They are equally applicable to the youngest and oldest learners in my school.
- Cultural factors do not prevent these definitions from being applicable in my school.

How could these progressions be improved for use in your school? [OPEN]

Creativity and Curiosity

Each framework is written in a slightly different way.

Did you find one clearer than the other?

- The frameworks are equally clear.
- The curiosity framework is clearer than the creativity framework.
- The creativity framework is clearer than the curiosity framework.

How could the frameworks be strengthened? [OPEN]

The Mastery Transcript

We would like to ask for your help in designing the Mastery Transcript. This should be a way for teachers and learners in your school to summarise their current proficiency in a 21st century skill (with creativity and curiosity for example), and also enable progress to be tracked over time.

When you think about such a transcript, what form do you imagine it to take?

Please choose all that apply:

- Paper form or spreadsheet Paper form or spreadsheet
- Online form or spreadsheet Online form or spreadsheet
- Online portfolio Online portfolio
- Video Video
- I have no idea I have no idea
- Other:

How could a transcript be integrated into existing IB systems so that it sits alongside, for example, records of grades in subjects? [OPEN]

For learners in your school finishing the DP or CP, how could the Mastery Transcript help them to communicate their 21st century skills to potential universities or employers? [OPEN]

What are the key considerations we should bear in mind in designing the Mastery Transcript? [OPEN]

Thank you very much for your time - your responses will be very valuable to us as we revise the frameworks.

Thank you for completing this survey.

APPENDIX 14: DATA FROM SECOND ROUND OF CONSULTATIONS (SUPPORT MATERIALS)

PARTICIPANT FEEDBACK ON DRAFT TRANSCRIPTS AND SUPPORT MATERIALS

Australian Council for Educational Research, 2021

INTRODUCTION

Following on from the first round of consultations, ACER returned to the same schools that had indicated willingness to be involved in consultations for further feedback on the draft transcripts and support materials. This was undertaken in November and December 2021.

Despite reminders, it proved difficult to gain responses from schools, and just eleven were received. Due to the small number, we cannot be certain how representative the responses are. Nevertheless, they provided some suggestions that have subsequently been used to revise the materials.

REVISED FRAMEWORKS

Respondents were asked to comment on the revised frameworks, with revised language, development levels and the inclusion of examples. All eleven agreed that they found the development levels to be appropriate and that the factors that affect opportunities for creativity and curiosity are comprehensive and useful. Comments were:

> *"You can also include some specific examples for early years".*
>
> *"For the Foundational Knowledge, is there a way to use the terminology of concept, subject skills and progression? It will help build a stronger connection to the Knowledge component".*
>
> *"Teaching for Creativity is very different to being a creative teacher -this could be addressed in you research".*
>
> *"Does not really address the difference between teaching for creativity and the creative teacher".*
>
> *"Creativity: Everything is very clear and very logically laid out. Well done! I am only slightly confused with "use any material I had given to help me". It seems to appear in one of the levels but not in other. Also should "help me" be replaced by "stimulate my inspiration"?*
>
> *"Curiosity: I like the time efficiently and feel it should be mentioned in all level".*

THERMOMETERS

Respondents were asked to review the different versions of the thermometers for both creativity and curiosity. All eleven agreed that the approaches targeted at different age groups make sense. Ten out of eleven agreed that they found the different levels of heat easy to distinguish and that the language is appropriate for each group. Comments were:

> *"Are the graphics too basic?"*
>
> *"The thermometer has a pictorial representation for Lower PYP, however, I am curious to know how would it look like for the early years. As students are still developing the language".*
>
> *"The middle two read very similar for MYP-DP. Perhaps the quantifies make it very grey by using "quiet and few" and "few". Is there a way around these terms. Students in Lower MYP will find it hard to place themselves on these statements".*
>
> *"I am presuming that a much simpler version of the curiosity thermometer will be developed for early year's students to be able to use for self-reflection".*
>
> *"I feel that for questioning basic direct fact question such that what, where, when should be mentioned at the yes or no level. For resources I would not only have books on different way, I would have an emoji of conversation, museum and computer".*

REFLECTIVE QUIZZES

Respondents were asked for their feedback on the reflective quizzes. All eleven agreed that using quizzes would be useful for them, that the quizzes were clear, and the quizzes were easy to understand. Comments were:

> *"They are very thorough".*
>
> *"I thought they were interesting and appropriate".*
>
> *"They are very comprehensive. I observed that most of the second options were directed towards building curiosity in school. You can change the order".*
>
> *"They are apt and age appropriate".*
>
> *"Excellent tools for self-assessment and self-reflection. Would help in teacher evaluation processes to figure out PD needs of staff".*
>
> *"I found the quizzes interesting. However, a number of questions we felt could really be 'both' -as they depend on scaffolding, student age, time allocation and inquiry process".*
>
> *"They are a good starting point/ provocation for a discussion. I think that it is not that cut and dry, for e.g. Curiosity - L we have to follow the curriculum but can approach the learning using creativity games, creative teaching and the students' interests to develop interest and hopefully excitement in the learning".*
>
> *"My only worry is if people don't like any of the choice. The analysis are long, I wonder if it would not be better to have a table with characteristic and suggestions".*

TRANSCRIPTS

Respondents were asked for their feedback on the transcripts. All agreed that they found the information provided in these materials accessible. Ten out of eleven agreed that the transcripts were suitable for students to complete, that the teacher validation element was suitable, and that the information provided in the materials was easy to digest. Comments were:

> *"I am not sure about the graphics".*
>
> *"Creativity looks good. Can we weave the word "wondering" into the curiosity transcripts?"*
>
> *"A very useful approach with a specific focus on the 21st century skills".*
>
> *"I think the thermometers are great, self-reflection is crucial and knowing the student's process is integral - either digitally, through journaling, discussions and visually".*
>
> *"The transcripts are brilliant and are strongly aligned with student agency where the student takes ownership of their own learning".*
>
> *"I like the way the reflection is spread out. Keen to see how these can be adapted to lower PYP for deep reflections".*
>
> *"The transcripts can be used with upper PYP students only. And these reflection sheets would only work if teachers use them as a part of a routine. I am not too sure if this can be used with Early years".*
>
> *"I would change have at least two type of design format according to MYP cycles e.g. MYP1 to 3 and MYP 4 to 5".*

ADDITIONAL COMMENTS

Finally, respondents were asked to make any additional comments on two key points:

1) Is there anything else that you would like to see that would help you navigate these areas

> *I am also curious to know how we are measuring effort in the thermometer. How are we defining it?*
>
> *Either a "figure" or Model that helps navigate these separate documents. Perhaps a small framework or a planning sheet for teachers to see how to implement these.*

Subsequent to this feedback, ACER has developed a model that helps teachers navigate the separate documents and is working on a planning sheet for teachers to use

2) What steps would you need to follow to integrate the framework into your classroom practice

> *"Explaining and expanding on the framework to the students in practice.*
> *Teachers and students need to engage in the process and just not use it as a tool to measure curiosity. A few steps that I would use is create: open-ended learning spaces, use VTR, unstructured play, engaging students in reflections, focus on social-emotional learning, student-centric learning, teacher and parents PD sessions to name a few".*
>
> *"A workshop must be given to the teachers by the head of the department to make them accessible to the students".*
>
> *"Some training and a lot of unpacking before implementation".*
>
> *"Please bring back the PYP attitudes. Important attitudes like Curiosity and Creativity first need to be explored (seen, felt, touched, even smelt and tasted) individually for them to become an intrinsic part of one's nature. At the PYP level, it is very important to recognize and understand "what positive attitudes are" and "how they lead students to bigger things" e.g. what does Curiosity and Creativity look like in our everyday lives, how can they be defined, how do they help us, etc.? Building a curious and creative mind is so important at this stage, it all depends on how adults can create a learning environment that offers opportunities for students to be curious and creative. Recognizing and understanding curiosity and creativity right from the start helps students to experience different pathways towards becoming Inquirers, Risk-Takers, Knowledgeable, Thinkers, etc., and understand these attributes in their totality. This process can take a year or it can take years for a student but the journey must begin as early as possible with first developing the habits of curious and creative minds".*
>
> *"I am a teacher that teaches for creativity as much as possible. But students need foundation skills to be able to make and create. If you don't have the skills, techniques and knowledge your ideas will just stay as an idea and will not become producers. Open-ended questions and problems is easy. Brain storming and mind-mapping the first step. Then developing/generating their ideas to*

create a product. I would then use you evidence and evaluating thermometer, proficiency rubrics and self -reflection. I believe it would be very easy to implement in my programmes of Inquiry. I find it very exciting!"

"I think we would need have common vocabulary introduced in the strands and the ATL".

FURTHER REVISIONS

Subsequent to this feedback, ACER has had early years experts review the materials and has made further revisions according to their feedback.

Many of the other comments relate to elements that are beyond the scope of the current project but that will have implications for the implementation of the materials in schools.

Creativity and Curiosity: Support materials feedback

Survey Items

[Note – these items were delivered online using Lime Survey]

Introduction

Thank you for your interest in participating in a review of the draft creativity and curiosity frameworks' supporting materials that have been developed for use across International Baccalaureate programmes.

For each component you will be asked to provide your feedback by responding to both closed and open questions.

About This Survey

21st Century Skills

As you know, there is a great deal of interest in helping learners to gain 21st century skills during their schooling, to better equip them to be able to contribute to, and lead, their communities in the future. In this project, we have been asked by the International Baccalaureate Organisation to develop an approach to evidencing 21st century skills that is suitable for implementation in the classroom. The goal is to gather evidence of learner skills and record this evidence in a Learner Profile Mastery Transcript.

There is an important reason why we are using the term 'evidencing' instead of 'assessment'. We are focusing on observable student behaviours that do not necessarily occur in the context of a formal assessment. The intention is that learners will be able to demonstrate their skills – for example through a portfolio or project – and then they, alongside their teachers, will be able to evaluate their achievement in a way that encourages further development.

Although the IB Learner Profile does not explicitly mention creativity and curiosity, these are highly relevant to many of the attributes it includes. They have been chosen as two exemplar 21st century skills to start with, and the intention is that the Mastery Transcript should allow other 21st century skills to be recorded in the future.

Draft Materials

Our first activity in this project has been to develop draft frameworks for both creativity and curiosity. We consulted some of the leading global scholars, and reviewed the most important research, to identify the key characteristics of each skill and their relevance to learning. These frameworks define what we mean by creativity and curiosity and lay the groundwork for the evaluation of student work with the progressions provided at the end of the frameworks.

We have also developed thermometers that define different levels of creativity and curiosity for students of different ages. Creativity and curiosity quizzes have also been developed for schools and teachers to help you identify extent to which you are providing conducive environments for creativity and curiosity. Lastly, we developed draft transcript for learners to use to identify how they think they have demonstrated creativity or curiosity, with space for teachers to validate their claims.

In this survey we would like your feedback on the draft frameworks, thermometers, quizzes, and transcripts. The aim of the survey is to gather feedback from schools to help us ensure these materials are appropriate for IB programmes. They should be easily understandable by teachers, relevant across different IB programmes and in different countries, and provide help to teachers and learners in your school in evaluating learner achievement.

This survey will take approximately 10 minutes to complete.

Ethics

We are from the Australian Council for Educational Research UK. ACER is leading independent, not-for-profit research organisation that has been working with schools, teachers and education leaders around the world since 1930, helping them to enhance learning, teaching and policy making. We are conducting this survey according to ACER's research ethics guidelines.

We will not collect any personal information from you, and neither you nor your school will be identified in any reporting that we do.

We would like to encourage you to answer honestly – all constructive criticism is welcomed! Please provide as much or as little feedback as you would like.

I confirm that I am happy to participate in this survey.

- Yes
- No

Frameworks

Please look at the draft creativity and curiosity frameworks.

In the creativity framework, development levels are on page 17, and factors that affect opportunities are on page 14 & 18.

In the curiosity framework, development levels are on page 16, and factors that affect opportunities are on page 26.

Please indicate your level of agreement with the following statements.

Agree Neutral Disagree

- I find the development levels appropriate
- Factors that affect opportunities for creativity and/or curiosity are comprehensive and useful

Can you think of anything else that was missed? [OPEN]

If you have any other comments or feedback about the frameworks, please note them here. [OPEN]

Thermometers

Please look at the thermometers.

Please indicate your level of agreement with the following statements.

Agree Neutral Disagree

- I find the different levels of heat easy to distinguish
- The approaches targeted at different age groups make sense
- The language used is appropriate for each group

Can you think of anything else that was missed? [OPEN]

If you have any other comments or feedback about the thermometers, please note them here. [OPEN]

Quizzes

Please look at the quizzes.

What do you think of the creativity and curiosity quizzes? [OPEN]

Please indicate your level of agreement with the following statements.

Agree Neutral Disagree

- Using quizzes would be useful for me
- These quizzes are clear
- These quizzes are easy to understand

If you have any other comments or feedback about the quizzes, please note them here. [OPEN]

Transcript

Please look at the transcripts.

What do you think of this approach to recording students' achievements in creativity and curiosity? [OPEN]

Please indicate your level of agreement with the following statements.

Agree Neutral Disagree

- The transcripts are suitable for students to complete
- The teacher validation element is suitable

Please explain your reasons for the above agreement levels. [OPEN]

Please also note any other comments you have regarding the transcript here. [OPEN]

Final Thoughts

Please indicate your level of agreement with the following statement.

Agree Neutral Disagree

- I found the information provided in these materials accessible
- I found the information provided in these materials easy to digest

Is there anything else that you would like to see that would help you navigate these areas? [OPEN]

What steps would you need to follow to integrate the framework into your classroom practice? [OPEN]

If you have any other comments or feedback to provide which hasn't been captured so far, please note it here. [OPEN]

Thank you very much for your time - your responses will be very valuable to us as we revise the materials.

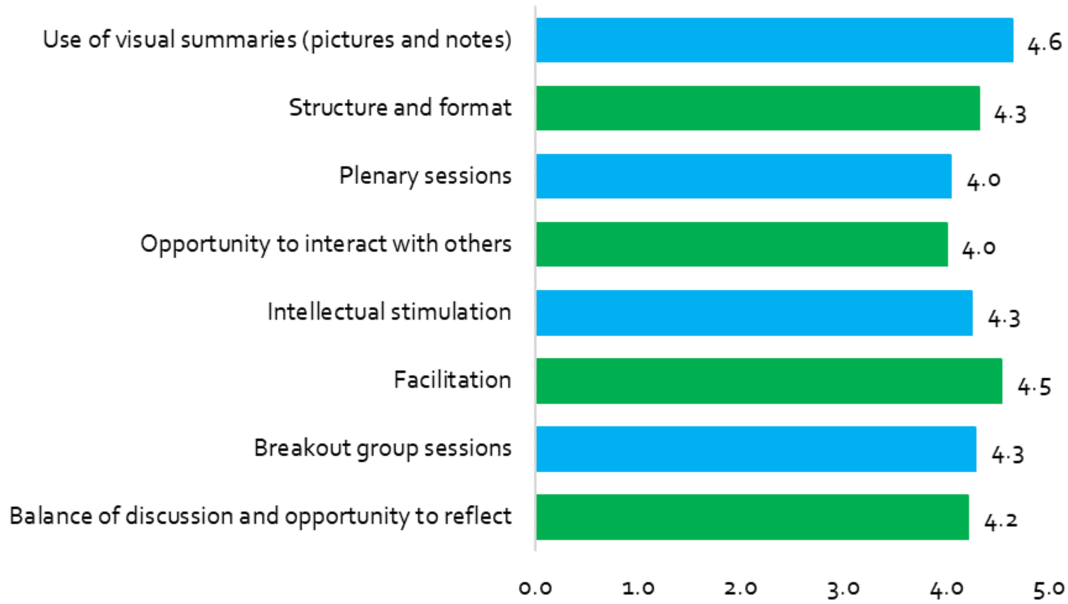
APPENDIX 15: FEEDBACK ON SYMPOSIUM

PARTICIPANT FEEDBACK ON CREATIVITY AND CURIOSITY SYMPOSIUM

Australian Council for Educational Research, 2021

INTRODUCTION

After the initial symposium on creativity and curiosity, all participants were asked to provide feedback. A total of 28 responses were received, and participants were asked to rate the quality of the following aspects of the symposium out of five.



They were further asked how satisfied they were with the symposium overall, out of ten. The overall rating was 8.5, with eight participants rating it 10/10.

Participants were asked what they valued most about the symposium. Their comments identified a number of different aspects:

- The quality and depth of the conversations around a key contemporary issue in education.
- I value the perspectives that were shared and how it varies and helps create a bigger understanding of the concept. I value the way the ideas were presented. It made it easier for us to reflect and see a better view of everyone's ideas.
- Visual real time summary was amazing. The discussion with experts was very good. The general direction for practicality and not just general theoretical discussions.
- Being a guest in other break-outs for a more detailed catch-up
- It was a fantastic opportunity to become familiar with a wide range of views, in particular a combination of research and practice and a variety of disciplines and disciplinary approaches.
- Exchanging ideas with such an interdisciplinary group.
- Opportunities for deep dive discussions with experts from both academia and schools.
- The opportunity to learn from such a diverse range of voices, thinking and opinions; from school educators, scholars, industry and interest groups

- Sharing Ideas and learning from others.
- What I valued most was that the symposium felt like a good use of my time. I thought that it was productive in terms of accomplishing the stated goals while also being worthwhile for participants in broadening our thinking by hearing perspectives from people we don't usually get to interact with. I thought that the facilitation was very well done in terms of having a clear structure and clear goals, with people responsible for keeping everyone on track to make progress toward the goals. The structure of breakout groups to include a mix of backgrounds and perspectives led to richer idea generation and the facilitators did a good job of supporting all participants in getting their ideas heard. The ability to use chat helped to control people dominating the verbal conversation. It was very helpful to have multiple people working on recording the ideas generated in different ways, so that those ideas were not lost.
- I thought the overall facilitation by DPict on Zoom was amazing. I also really appreciated the ability to discuss with both academic experts and on-the-ground educators.
- I was delighted to see the IB philosophy in action during the event. I appreciated the planning, organization and excellent time management. I also highlighted respect for different ideas and perspectives.
- I mostly valued getting to know colleagues from all over the world who are studying and examining the same topics that I am interested in.
- The opportunity to interact with others, exchange ideas and collaboratively build a model that will help others.
- Listening to the IB teachers/heads interact with the curiosity and creativity experts.
- The IB has the skill of connecting committed educators that vibrate in the same frequency. Having a chance to raise our voices, aiming to support our educational communities as they lead society towards the future, is to me, a treasured opportunity.
- Some time to reflect and to think about teaching in a more blue sky manner.
- Hearing from the educators and learning more about issues coming up in schools/practice.
- The opportunity to consider research knowledge within a perspective of the development of educational programs.
- Opportunities for discussion in small groups were great, the "home group" check in was a good opportunity to get to know a small number of people better, the illustrations were a strong addition that I had not seen used before.
- The opportunity to engage and interact around these key issues
- I valued the content. It was a good topic to talk about and I decided to bring it to our pedagogical meetings at school
- Interacting with scholars and educators on topics I care about, in a way that was reflective and sparked my curiosity; I felt my ideas were heard and I learned a lot from others.
- The interaction with other people and the first day with the creativity group. I also enjoyed the last day about something material that would elicit what students had learned and discovered. I also enjoyed how Marga facilitated the sessions - the kind of questions she asked and how she stimulated dialogue. A real role model for me.
- Opportunity to reflect on creativity and curiosity from an educator and policy perspective.

- "Meet different educators. Identify different perspectives. Opportunity to interact and share ideas and proposals"

In addition, 89% of participants reported that they had learnt something from the symposium that they could use in their work. This included:

- Auditing understanding of creativity and curiosity in staff PD session.
- I learned that there are many ways to present ideas. Zoom meetings are usually very plain but this symposium was very interesting, colourful and it showed a different level of creativity through poetry, music, visual arts, etc.
- Reflection of students of their current state and reason for actions is an important aspect of curiosity and creativity assessment and promotion. I'm integrating this concept to the curiosity promoting platforms I develop.
- Definition of curiosity
- The fact that free writing is an amazing tool to get one's creative juices going!
- Looking for evidence of curiosity and creativity in my students work.
- How academia experts and school practitioners can be brought together in a valuable way, even online.
- possible application route for indicators of growth
- Curiosity is there in our schools we just need to make it happen
- I think that the way I distinguish between curiosity and creativity in my measures may be messier than I thought, and I need to go back and rethink whether or not it is possible to differentiate these with our current methods. I am studying how curiosity and creativity are promoted in US public schools, and now am interested in looking at IB schools as potential models.
- 1) More ways to use Miro as a teaching tool in my work. 2) How to better emphasize the differences between curiosity and creativity. 3) How to better emphasize why theoretical interpretations of concepts don't always work when we're trying to create on-the-ground school assessments.
- Become and observer of opportunities to encourage and notice creativity and curiosity outside of the classroom. Promote a creativity and curiosity school culture.
- I expanded my operational definitions of curiosity and creativity; I learned techniques for active engagement via Zoom, and using technology to provide as close to a genuine collaboration as is possible.
- The tools and strategies that facilitated the symposium can be emulated in a school environment during staff meetings. Also, the discussion around how to provide flexibility that allows for more creativity and curiosity in the classroom can be continued at school.
- The role of curiosity and creativity in a school, its importance; how these attributes will help us all face the future in a more down-to-earth innovative way.
- Thinking about dynamics of school/policy challenges as applications of basic science.
- As a retired academic I continue to think about the issues associated with curiosity and interest and the content of the symposium provided a different perspective for this thinking.

- I learned more about the praxis of student evaluation and the difficulties inherent in translating academic definitions into the classroom.
- To be fair this was the use of Miro- v valuable
- I had never before thought about overlaps between curiosity and creativity, but am already planning a new study!
- IB Learner profile clarification

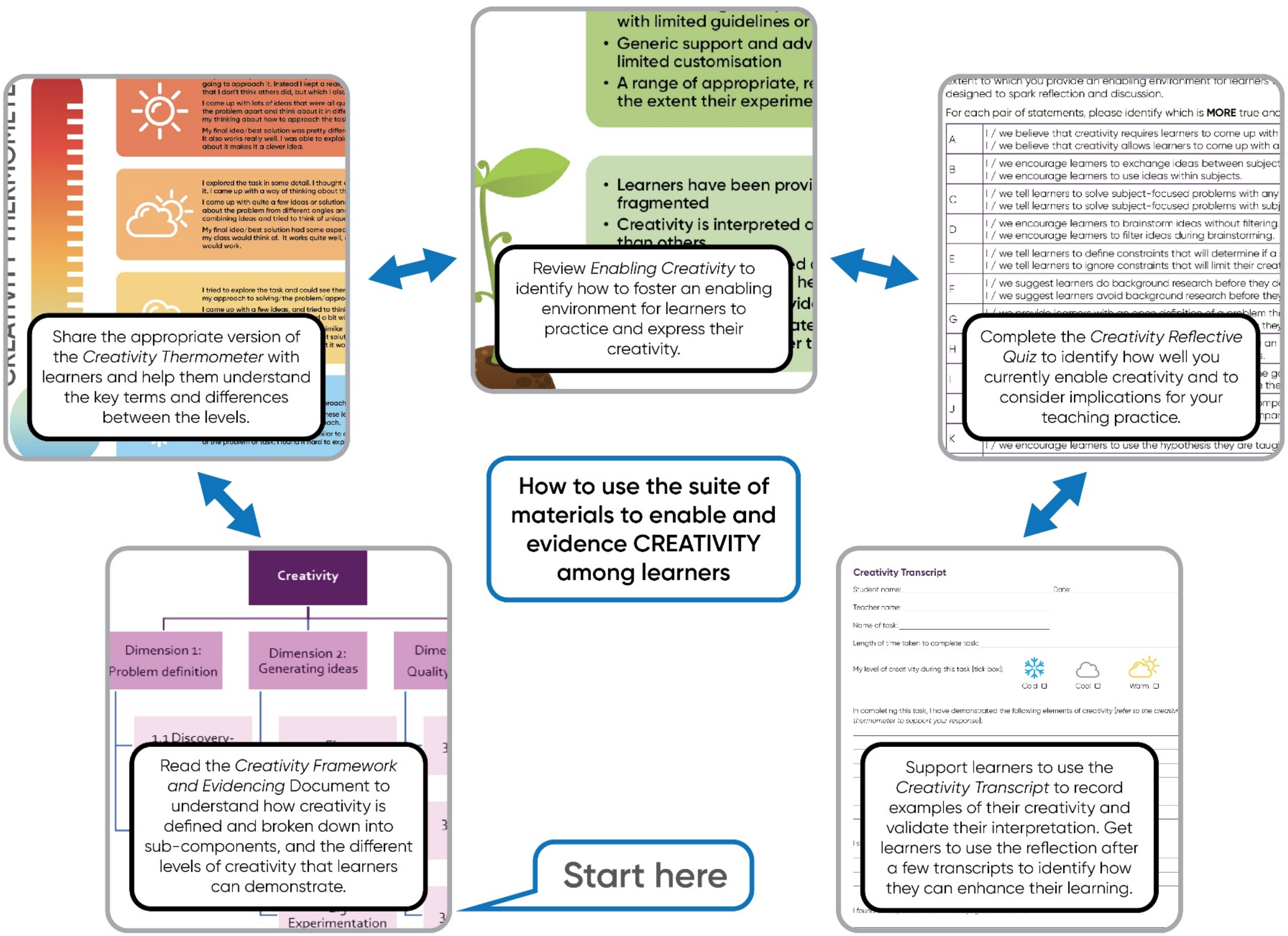
Participants were further asked how well the symposium supported cross-sectoral discussion and collaboration (e.g., between academics, educators, IB staff). They rated this 4.1 out of 5. They were also asked to indicate if there was anything that they would like to have changed about the symposium. They suggested:

- Just the length of time to discuss.
- The time because some of us were in different parts of the world. It was challenging for some of us to really be our best especially when we had work all day, and have a symposium late at night.
- Summary of practical application in schools.
- No need for poet on day 2. Start on day 2 was not very strong.
- Giving sessions a bit more time, it felt a bit rushed and perhaps it would be best to organize more 3 day meetings across time and spread the themes than have them all in 3 days.
- Face to face would be nice =)
- The whole structure was perfect.
- Making it in-person :) It would have been interesting to hear more about what others were hoping to get from the symposium / to know more background about others.
- More time for discussion and also smaller group discussion opening up into larger group discussion. For example, I might have put us in groups of two or three and then broken us up into our expertise groups and then into the overall group discussions. It felt like some people never got to speak in the larger groups, and there wasn't enough time for everyone to think and discuss. Just more time overall! It was all so interesting!
- Nothing
- I would have liked to spend some time on next steps in these collaborations, as I feel that this was a unique group of scholars who might want to remain connected / collaborative.
- Allow the participants to create or to make something, to think, make and present.
- A way to share personal conclusions into a shared document (i.e. padlet).
- It was all far too abstract and as an educationalist, I unfortunately took nothing tangible away.
- More opportunity to hear from the invited experts in individual brief presentations (prior to breakout sections). Also, should pay folks for attending.
- The symposium sessions brought together different perspectives and triggered wide-ranging discussion on pertinent issues concerning the place of curiosity and creativity in a sound educational program. I felt the discussion was moving towards the goal but there is still some way to go … so maybe one more session would have brought us closer to the goal. However, it

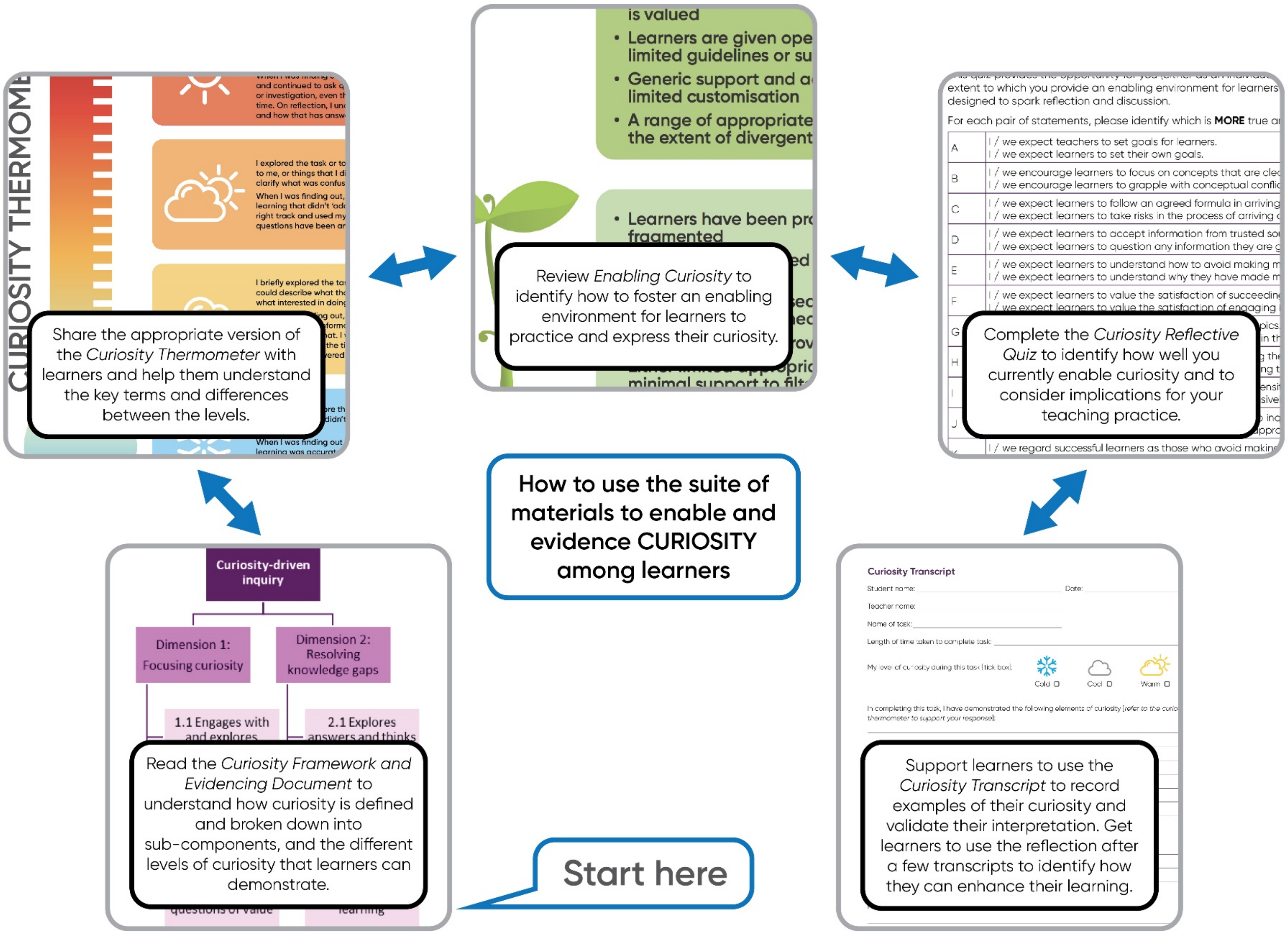
may be that the smaller group involved with overseeing the project now have a chance to bring a mastery transcript to fruition.

- More time in smaller groups.
- we would have had a better idea who did what in the day job-
- It could be more interactive - it was difficult to have conversational discussions. Also, Zoom chat was not suitable to see other opinions. It would be better to use other platforms for different activities (ex. Padlet).
- A few more slight breaks. It was difficult to take my own breaks because everything was so interesting; there were also people who I really wanted to interact with more but was not in their groups.
- "I would have allowed more time for brainstorming and used an approach that all the idea's of people who directly come on the screen. In my opinion the generations of ideas was so short that we did not build and associate on each other. And as a result, we only collected existing ideas instead of developing new ones.
- More chance to agree on a practical and assessable definition of creativity.

APPENDIX 16: TEACHER GUIDANCE CREATIVITY


How to use the suite of materials to enable and evidence CREATIVITY among learners
Start here
Read the *Creativity Framework and Evidencing* Document to understand how creativity is defined and broken down into sub-components, and the different levels of creativity that learners can demonstrate.
Share the appropriate version of the *Creativity Thermometer* with learners and help them understand the key terms and differences between the levels.
Review *Enabling Creativity* to identify how to foster an enabling environment for learners to practice and express their creativity.
Complete the *Creativity Reflective Quiz* to identify how well you currently enable creativity and to consider implications for your teaching practice.
Support learners to use the *Creativity Transcript* to record examples of their creativity and validate their interpretation. Get learners to use the reflection after a few transcripts to identify how they can enhance their learning.
Creativity
Dimension 1: Problem definition
Dimension 2: Generating ideas
Creativity Transcript

APPENDIX 17: TEACHER GUIDANCE CURIOSITY


How to use the suite of materials to enable and evidence CURIOSITY among learners
Start here
Read the *Curiosity Framework and Evidencing Document* to understand how curiosity is defined and broken down into sub-components, and the different levels of curiosity that learners can demonstrate.
Curiosity-driven inquiry
Dimension 1: Focusing curiosity
Dimension 2: Resolving knowledge gaps
Share the appropriate version of the *Curiosity Thermometer* with learners and help them understand the key terms and differences between the levels.
Review *Enabling Curiosity* to identify how to foster an enabling environment for learners to practice and express their curiosity.
Complete the *Curiosity Reflective Quiz* to identify how well you currently enable curiosity and to consider implications for your teaching practice.
Curiosity Transcript
Support learners to use the *Curiosity Transcript* to record examples of their curiosity and validate their interpretation. Get learners to use the reflection after a few transcripts to identify how they can enhance their learning.

APPENDIX 18: EXEMPLAR TRANSCRIPTS

Learner 1 Creativity Transcript (Middle Years Programme)

My level of creativity during this task [tick box]:
Warm

Cold • Cool • Warm • Hot •

In completing this task, I have demonstrated the following elements of creativity [*refer to the creativity thermometer on page 3 of the document to support your response*]:

While completing this task, I would grade myself in the 'warm' category. I would do so because my ideas were unique, but others' ideas were creative too. I tried thinking out of the box and used various props to bring out my character. I spent lots of time practicing and trying to make it sound appealing. There were a few things that I don't think most of my classmates would have thought of, like using sound effects, using lego props (the car and the digger) and asking a rhetorical question in the beginning.

I still need to work on:

I think I still need to work on my voice modulation and hand gestures, so that people get a clearer idea of what I want to convey.

I encountered the following barriers in practicing my creativity:

At first, when I put a virtual background, the car and the digger (the lego) weren't seen clearly. I decided to put them on my chest and then they were seen. I also needed my sister to help me with the sound effects, as I was unable to play them while recording my video.

Teacher validation: To be filled by the teacher

Learner 1 [*student name*]'s level of creativity during this task was [*tick box*].

Cold • Cool • Warm • Hot •

- **Agree – has demonstrated the elements mentioned above**
- Partly Agree – has partly demonstrated the elements mentioned above
- Disagree – has not demonstrated the elements mentioned above

Teacher comments:

The typography and costumes were very creative. Much thought has been given to the entire process.

Learner 1: Creativity Reflection (Middle Years Programme)

Hot

Warm

When my creativity is hot or warm, this helps me to learn because:

When my creativity is hot or warm, this helps me to learn because it enhances my thinking skills and develops my brain to think of unique ideas. In the future, this skill could help me think of solutions to some daily problems, like the challenges I faced in this assessment.

Ignore this question: What do my transcripts (monologue assessments) tell me about my creativity? What could help to warm it up?

My monologue assessments tell me about my creativity and how good my research skills, thinking skills and critical thinking skills are. It tells me about, and gauges my creativity and how I have used different features to enhance my creativity like the use of virtual backgrounds, props, voice modulation, etc. Using different apps, researching about more information and making it sound more interesting can help me to warm it up.

I can take the strategies I use when my creativity is hot and apply them to times when my creativity is cold. I plan to do this by:

I can take the strategies I use when my creativity is hot and apply them to times when my creativity is cold. I plan to do this by using more hand gestures, modulating my voice better, coming up with as many different ideas as I can and then shortlist them and first plan my information, then the other creative elements. I could also include more art and art elements in my work.

My school and teachers can help to support my creativity by:

My school and teachers can help to support my creativity by encouraging me to think out of the box and do a few group activities or have class discussions so I can learn new ways to express my creativity from my friends.

Learner 2 Creativity Transcript (Middle Years Programme)

My level of creativity during this task [tick box]:

Cold • Cool • **Warm** • Hot •

In completing this task, I have demonstrated the following elements of creativity [*refer to the creativity thermometer on page 3 of the document to support your response*]:

I explored the task in some detail. I thought about a few ways I could approach it as I did some thinking about it. I came up with a way of thinking about the task I was pretty sure was going to work quite well.

Warm

I came up with quite a few ideas or solutions that were mostly quite different from each other. I tried to think about the problem from different angles and use any material I had given to help me.

I considered ways of combining ideas and tried to think of unique possibilities.

My final idea/best solution had some aspects to it that were quite different: things not many students in my class would think of. It works quite well, and I could explain how I came up with the ideas and why they would work.

I still need to work on:

Coming up with more ideas, managing my time.

I encountered the following barriers in practicing my creativity:

Pricking my finger with a sewing needle upon multiple occasions, TIME.

Teacher validation: To be filled by the teacher

__________ **Learner 2** ________ [*student name*]'s level of creativity during this task was [*tick box*].

Cold • Cool • Warm • Hot ☑ •

- **Agree – has demonstrated the elements mentioned above**
- Partly Agree – has partly demonstrated the elements mentioned above
- Disagree – has not demonstrated the elements mentioned above

Teacher comments:

Creative expression of the student is evident in all aspects of the work including the use of garbage bags as skirts and dirt on the face to express the landfill. The monologue is well written as well.

Learner 3 Curiosity Transcript (Primary Years Programme)

CURIOSITY TRANSCRIPT

Student name: **Learner 3**

Date: 28th Nov 2021

Teacher name: Ms XXX XXXXX

Name of task: Carbon footprints

Length of time taken to complete task: 1hr 30min

My level of curiosity about this task [tick box]:

Cold ϒ Cool ϒ Warm ϒ Hot ϒ

In completing this task, I have demonstrated the following elements of curiosity [*refer to the curiosity thermometer to support your response*]:
ELEMENTS OF CURIOSITY: Inquiry skills, Critical thinking, open-mindedness, risk taking, self-efficacy and reflection.
In this project I used my critical thinking skills because when I had to answer the questions I had to think on what point I can give. I also used my Research skills because I had to inquire on some points, I am not that clear on. After I finished I rechecked and reflected on each and every point.

I still need to work on:
I still need to validate some of my reasons. I even need to work on not being camera shy.

I encountered the following barriers in practicing my curiosity:
I encountered that I needed to research on every point I did not understand.

Teacher validation:

Learner 3 _______ [*student name*]'s level of curiosity about this task was [*tick box*].

Cold □ Cool □ Warm □ Hot □

- □ Agree – has demonstrated the elements mentioned above
- □ Partly Agree – has partly demonstrated the elements mentioned above
- □ Disagree – has not demonstrated the elements mentioned above

Teacher comments:
Learner 3 has shown inquisitiveness during this task, he could find answers to the guiding questions. I encourage him to move his curiosity level to 'Hot' by researching about news Articles related to carbon footprints so that more real-life examples can be cited.

Learner 3 Curiosity Reflection (Primary Years Programme)

REFLECTION ON MY CURIOSITY

Student name: **Learner 3** __ Date: 28-11-2021

Teacher name: Ms XXX XXXXX

Hot

Warm

When my curiosity is hot or warm, this helps me learn because:

If my curiosity is warm, I would want to learn about carbon footprint which would make me focus more on the research.

Hot

Warm

When my curiosity is hot or warm, these are the elements of curiosity that I am best at: [*refer to the curiosity thermometer and previous transcripts to support your response*]
ELEMENTS OF CURIOSITY: Inquiry skills, Critical thinking, open-mindedness, risk taking, self-efficacy and reflection.

I am best at Research and critical thinking skills because when I am curious to know something then I put more effort into the work which requires thinking and research.

What do my transcripts tell me about my curiosity? What could help to warm it up?

I was very curious to know what carbon footprint is. So to show my curiosity, I watched videos on what is carbon footprint. To help my curiosity to be warm I need more conceptual questions, I would be really interested in answering.

I can take the strategies I use when my curiosity is hot and apply them to times when my curiosity is cold. I plan to do this by:

I should try to think that I am doing something I do in daily life that interests me.

My school and teachers can help to support my curiosity by:

My school and teachers can help me by telling me to answer more questions which would make me more interested in the topic.

Learner 4 Curiosity Transcript (Primary Years Programme)

CURIOSITY TRANSCRIPT

Student name: **Learner 4**. Date: 27/11/21_

Teacher name: _ XXXX XXXXX _

Name of task: ___Research on Carbon Footprint

Length of time taken to complete task: ____50 min

My level of curiosity about this task [tick box]:

Cold ϒ Cool ϒ Warm ϒ Hot ϒ ✓

In completing this task, I have demonstrated the following elements of curiosity [*refer to the curiosity thermometer to support your response*]:
Elements of Curiosity are - Research skills, critical thinking, open-mindedness, risk-taking, self-efficacy, and reflection

I have demonstrated my Research skills to research facts about the topic and have used my critical thinking skills to analyse, take the information, understand it and by writing it in my own words.

I still need to work on:

I still need to work on my reflection skills as I could partly reflect on what I should have done and shouldn't have done after submitting my video.

I encountered the following barriers in practicing my curiosity:

Teacher validation:

Learner 4 _____ [*student name*]'s level of curiosity about this task was [*tick box*].

Cold ϒ Cool ϒ Warm ϒ ✓ Hot ϒ

ϒ Agree – has demonstrated the elements mentioned above

ϒ Partly Agree – has partly demonstrated the elements mentioned above

ϒ Disagree – has not demonstrated the elements mentioned above

Teacher comments:

Learner 4 is an inquisitive learner and effectively uses research skills to gather information on any topic. He can confidently share his views with his mentors and peers. However, Rian is encouraged to use his critical thinking ability more often to analyse and reason his personal views and of others. Regular reflection of his work will enhance his self-efficacy.

Learner 4 Curiosity Reflection (Primary Years Programme)

REFLECTION ON MY CURIOSITY

Student name: _**Learner 4**_ Date: 27/11/21___

Teacher name: ___XXXX XXXXX_____

Hot

Warm

When my curiosity is hot or warm, this helps me learn because:

When my curiosity is hot, this helps me learn because then, I can retain the information and further explain the concept to someone else.

Hot

Warm

When my curiosity is hot or warm, these are the elements of curiosity that I am best at: [*refer to the curiosity thermometer and previous transcripts to support your response*]

Elements of Curiosity are - Research skills, critical thinking, open-mindedness, risk-taking, self-efficacy, and reflection

When my curiosity is hot then the elements, I am best at are, inquiry and critical thinking skills

What do my transcripts tell me about my curiosity? What could help to warm it up?

I can take the strategies I use when my curiosity is hot and apply them to times when my curiosity is cold. I plan to do this by:

Taking the topics that I am not interested in and then trying to appreciate and understand those topics

My school and teachers can help to support my curiosity by:

My teachers can support my understanding by giving the questions of the day so, that I can research and come back with the answer the next day.

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