

# GENERATIVE AI IN MATHS EDUCATION AND EMPLOYABILITY

A REPORT TO THE GATSBY FOUNDATION

DAVID JENNINGS, DJ ALCHEMI LTD

February 2025



GATSBY

## **ACKNOWLEDGEMENTS**

Thanks to the teachers who participated in the workshop reported in [Section 3](#), and to Professor Geoff Wake for both convening the workshop and for contributing to the ideas behind the report. Thanks also to Daniel Sandford Smith for steering the work and the report through two iterations and to Seb Schmoller for helpful suggestions on draft versions.

## **DISCLAIMER**

The views and opinions expressed in this report are those of the author and do not necessarily state or reflect those of the Gatsby Charitable Foundation.

# I. INTRODUCTION AND BACKGROUND

## PURPOSE

The Gatsby Foundation wants to explore the potential roles that generative artificial intelligence (GAI) might have in the education for employability field. As a test case, Gatsby chose maths taught in vocational settings because of the different types of teachers involved – maths teachers and vocational teachers – which provided the opportunity to see if GAI might enable new ways for them to work together.

This report sets out our initial findings on a process that involves these teachers – and potentially other education professionals – in mapping and planning future applications of GAI for vocational maths education.

## APPLICATION AREAS

We identified three semi-distinct application areas within the field:

- learning maths, both as a subject in itself and as part of occupation-specific vocational courses
- careers advice
- institutional concerns about the use of GAI, for example, for governance, regulations, taxonomies and standards to prevent harm.

This report focuses on the first of these areas, the learning and teaching of maths. The work reported here is modest in scale and is one of many initiatives exploring the application of GAI in further education.

## TECHNOLOGIES

In this report, we focus on large language model technologies (LLMs) that are ready-to-use examples of GAI. ChatGPT,<sup>1</sup> Google Gemini and Claude are all LLMs. In this fast-moving field, names and versions are changing all the time. New versions of these tools became available during the work reported here, and we experimented with them. However, except where noted otherwise, we used ChatGPT Plus, which gave access to ChatGPT 4.

---

<sup>1</sup> GPT is short for generative pre-trained transformer, which is a type of AI trained on large amounts of linguistic data that can generate natural text that closely resembles text written by humans.

## 2. INITIAL OBJECTIVES AND USE OF SCENARIOS

We set out to:

- generate scenarios that showcase how GAI could benefit relationships between students, teachers, providers and employers
- help stakeholders assess the feasibility and desirability of these scenarios effectively.

We chose to focus on scenarios because they provide concrete and vivid accounts that help stakeholders visualise how GAI might influence education. Scenarios are holistic snapshots that can capture some of the richness of the vocational maths ecosystem, including the diversity of:

- relationships between the different actors<sup>2</sup>
- settings, including teaching, advice and guidance, and potentially recruitment and selection
- detailed dialogues involving human actors and GAI.

Using scenarios to explore future possibilities has a rich history, from long-term corporate planning to designing the user experience for new technologies with use cases.<sup>3</sup> Our approach is closest to that of use cases. The aim is to describe options of what a future with GAI might look and feel like and to then test both the plausibility and the desirability of each option with the practitioners and other stakeholders.

One key benefit of scenarios should be that they give those involved a concrete sense of how the future might look and feel. Frequently descriptions of the use of AI in education refer to 'personalised learning pathways' that are 'seamlessly integrated' with face-to-face teaching. It can be hard to effectively challenge such abstractions. In contrast, with our scenarios, we aimed to give tangible accounts of interactions between teachers, learners and GAI.

Another benefit of scenarios is that they meet practitioners in their own territory – such as the dialogue in a classroom or a careers advice consultation – where they feel confident to criticise and improve. Getting teachers, providers and learners to engage with refining scenarios can act as a form of participative design, capturing the know-how of practitioners and the expectations of learners.

One of the best ways to understand scenarios is through examples. Here is an [extended scenario focused on the future](#), which has been generated by ChatGPT (not included in this report since it runs to 15 pages when printed). It shows potential changes to roles and explores the distinction between a personalised AI tutor and a human teacher and mentor.

<sup>2</sup> Actors are the users or systems that make up the vocational maths ecosystem and they can be human or an external system.

<sup>3</sup> A use case describes how an actor interacts with a system to achieve a specific goal.

### 3. PILOT STUDY: TEACHERS' PERSPECTIVES

#### HOW WE INVITED TEACHERS TO WORK WITH SCENARIOS

During February half-term, we invited a group of 14 teachers, mainly from further education colleges in the East Midlands, to a four-hour workshop on GAI and vocational maths. The teachers worked mostly in pairs, with one maths teacher and one teacher of a vocational course that included some maths from each college.

After explaining the purpose of our work and the rationale for a scenario-based approach, we gave the participants a quick guide in how to develop scenarios, together with some template prompts that they could copy and paste into ChatGPT.

For the main part of the workshop, the teachers worked in pairs, or sometimes in threes, to develop their own scenarios. Because of complications caused by having to commit to a ChatGPT 4 subscription, most of the participants used ChatGPT 3.5 and one used Google Gemini. During the workshop, our team circulated, answering the participants' questions and providing guidance.

Moving from a cold start to the participants developing their own scenarios in a matter of hours was bound to be challenging. In a pre-event survey, none of the participants claimed more than "occasional and casual use – dipped my toes in" familiarity with ChatGPT or other GAI. They were also unfamiliar with the scenario approach, so the workshop was asking them to learn both a new technology and a new method in the space of half a day.

#### WHAT THE TEACHERS PRODUCED

Nevertheless, the results showed promise. One pair developed a scenario where ChatGPT generated an activity combining maths and animal care (which one of them was teaching). They developed a prompt to get an outcome stated in terms of the General Mathematical Competences (GMCs)<sup>4</sup> and then over the course of a few weeks they refined the response to create a collaborative project between animal care and maths. This project is called *Designing and Optimising Poison Dart Frog Enclosures* and part of it can be found in [Appendix I](#). The teachers involved commented that this:

*would work well as a way to contextualise in sessions. Though in the 'real world', maths lessons are often populated by a range of different vocations, so this would need refining further to work properly.*

This need for refinement that they identified could be achieved with just a little more time and work. We could imagine tweaking the ChatGPT prompt to generate sister activities, including enclosures for lambs, fish or other animal shelters. So a series of related prompts could generate multiple activities, each of which is niche to a specialised work context, but which test the same GMCs at roughly the same level.

4 The GMCs "have been designed with the purpose of enabling students to engage with mathematics in ways that capture the essence of working mathematically in vocational contexts". The Royal Society (2019) *Mathematics for the T Level qualifications: A rationale for General Mathematical Competences (GMCs)*. p.2.

Another teacher developed a scenario based heavily on her own experience of teaching the Education and Early Years T-level. She explained that many of her students chose an early years career path, expecting it to involve very little maths and they were disappointed to find this is not entirely the case. Consequently, she needs to smuggle maths into her teaching under her students' radar. Here is the prompt she created (with formatting added to improve clarity):

- **Characters:** Niamh teaches the Education and Early Years T-level. Her students have anxiety around maths, but the exams for the T-level include maths questions. Olivia, Priya, Ruby and Sofia are doing the course. They all have differing degrees of anxiety around maths, from Olivia, who carries her dyscalculia diagnosis as a badge of pride, to Sofia, who is actually quite good at calculations but struggles to recognise which calculation is needed.
- **Context:** The T-level requires competence in calculating ratios and areas, and in costing projects. It also requires data interpretation, such as using tracker sheets for each child to monitor that they are progressing as expected and to check that any special needs are addressed.
- **Purpose:** Niamh is always working on new ways to covertly introduce maths into the curriculum.
- **Request:** Generate a set of three activities for self-study that include some maths. Provide instructions for the students, including suggestions for how they might use ChatGPT to help them, if they need it. Then generate dialogue scenarios for each of the students doing the activities – Olivia, Priya, Ruby and Sofia. Make sure these scenarios include some actual calculations and include the struggles that the students may have with them. Finally, generate a dialogue scenario where Niamh leads a review session of the self-study and the students give feedback on what they found easy and what challenges they experienced.

The two examples above were both based on template prompts provided to the teachers. Those who took this copy-and-adapt approach were generally more successful in developing scenarios. Those who developed prompts from scratch gravitated to more conservative approaches that focused on GAI acting as a combination of personal assistant and all-purpose oracle. Their prompts tended to use GAI to generate a learning activity or project that they would give to their students to achieve a particular learning outcome. This domain has already been commercialised by services such as TeachMateAI.<sup>5</sup>

The teachers who started their prompts from scratch did not consider the scope for other actors, particularly their students, to use GAI themselves. Their focus was personal – how can GAI help me with my tasks? – not systemic – how can GAI enrich the processes and systems that connect my work to other actors and their goals? As with any pilot, there are lessons we can learn about how to brief and prepare participants to help them think more creatively and consider more transformative changes.

<sup>5</sup> TeachMateAI (accessed 19 December 2024) [Home](#).

## LESSONS FROM THE PILOT

We learned at least three lessons:

- **GAI is primarily being used for augmentation rather than disruption – at least initially.** ChatGPT usage has spread like wildfire,<sup>6</sup> suggesting that disruptive change might be imminent. However, education is not alone in seeing GAI initially as “a job-improving ‘augmenter’ rather than a job-destroying ‘disrupter’, a revenue enhancer rather than a cost reducer”, to use the words of the Financial Times.<sup>7</sup> Initially teachers may use GAI to do more for their students without having to work harder. In particular, they may use it to present and assess maths embedded in vocational contexts, demonstrating the relevance of maths and thus motivating their students. This does not exclude the possibility of more radical changes once users have developed a richer understanding of the technological possibilities.
- **Institutional change always takes time.** Education institutions and practices – including relationships between the main actors – take time to absorb new technologies. When factories moved from being powered by coal to electricity, it took almost a generation for engineers to work out how to reorganise production to increase productivity. More exploration is needed of the potential uses of GAI for maths education.
- **In the medium term, GAI could transform how we decide where we want to go at least as much as where we end up.** We started with the intention of developing some products – the scenarios for implementing GAI that would benefit multiple actors in the vocational maths field. What we may have arrived at, almost by accident, is a process which uses GAI to accelerate our exploration of options for transformative change.

The next sections explore the last of these lessons in greater detail.

<sup>6</sup> Visits to ChatGPT increased twelvefold between November 2022 and April 2023. They then remained roughly level for a year, before more than doubling between April and November 2024. Duarte, F. (accessed January 2025) [Number of ChatGPT users \(Jan 2025\)](#). *Exploding Topics Blog*, 6 January 2025.

<sup>7</sup> Hill, A. (2024) [Can AI make brainstorming less mind-numbing?](#) *Financial Times*, 5 February 2024.

## 4. PARTICIPATIVE FUTURE MAPPING

### HOW WE USED TO DO TECHNOLOGY-ENABLED CHANGE

By running the scenario workshop with teachers and reflecting on the process afterwards, we have come to see how GAI could transform the way change is managed in the education sector (and possibly other sectors as well).

To best explain this potential it is helpful to share a bit about my background. As an occupational psychologist working in human-computer interaction, I have followed a user-centred approach to creating and testing both scenarios and simple prototypes of new IT systems. This has gradually become a commonly accepted approach over the past third of a century. It has a sequence of steps:

- **research** – understanding both the user context and the possibilities that the technology offers, which informs ...
- **scenario creation** – sketches of possible futures, showing how users' work could change, which then go through a short process of ...
- **iteration and validation** – to sift out the scenarios that are impractical and undesirable, and to refine and elaborate those that look viable, prior to some form of ...
- **dissemination** – to share the results of the process and invite the wider community of practice to explore the scenarios and possibly use them as part of a package of change management guidance.

My original proposal was to follow these steps, where the research and scenario creation are labour-intensive tasks that draw on a fair amount of experience. As I embarked on these tasks, the penny dropped that ChatGPT had already ingested a lot of my research and could create scenarios based on my specifications. So it could augment my work, making me more productive by generating more scenarios more quickly.

But this is only one case where augmenting one role – in this instance, mine – creates an opportunity for transformational change.

### POSSIBILITIES FOR USING GAI AS PART OF THE CHANGE PROCESS

In the standard sequence of steps described above, the iteration and validation step is directed by a professional change agent. This means it is difficult to scale. Consequently, it is usually run with a small sample of the people affected. Our pilot with 14 teachers, described in the previous section, is a typical example of this. It follows the focus group model, where a small group of people is assumed to stand for the wider population.

But what if we could go beyond just making people like me more productive? What if we could use GAI to substitute for me and enable the wider population to control the process. Then they could guide not just the scenario creation, as our teachers did, but also the iteration step. And many more people could participate in the process, not just the small number that I can guide in workshops. Admittedly, this is speculative and optimistic, but the potential rewards may justify giving it a try.



In their book, *As If Human: Ethics and Artificial Intelligence* (2024), Nigel Shadbolt and Roger Hampson write of the choices that affect our futures: “Decisions that affect a lot of humans should involve a lot of humans”.<sup>8</sup> It is worth exploring whether GAI can itself make it easier to involve a lot of teachers – and potentially careers advisers, curriculum leads and employers too – in exploring how AI might transform their work.

### THINKING TOOLS FOR MAPPING THE FUTURE

The speed and capacity of GAI are such that it is feasible to consider other ways it can help future mapping besides scenarios. One example is the use of profiles or personas, which are short pen portraits of individuals’ roles, motivations and needs. By projecting the impact AI will have on these roles and their needs, we can give individuals a sense of what is at stake for them personally. Some example profiles of teaching staff and learners in vocational maths are included in [Appendix 2](#).

By giving people GAI tools to generate their own personas, we can make the projections more personalised. Instead of showing them the impact on people roughly similar to them with similar kinds of jobs, we can invite them to enter their own profile of needs and experience to get an idea of how AI might affect them. However, what is generated may be little more reliable than a personalised astrology chart. It will be important to make clear to everyone that the outputs from GAI tools are speculative and fallible illustrations to be used as thinking tools and prompts for further discussion. They are not an oracle that can predict the future and may be way off track, instances of which have been widely reported and are called GAI ‘hallucinations’.

So we are not attributing any future-gazing prowess to GAI. We are simply using it to do the intellectual grunt work of generating a range of future scenarios, all of which will be filtered and refined by people with knowledge and experience of what works in their roles.

For such novel thinking tools to be used effectively, at the very least, there needs to be a manual and ideally a short training session. Critically they need regular human intervention to steer and guide them, and to catch any hallucinations early in their development. In the next section we outline how this could be achieved.

---

<sup>8</sup> Shadbolt, N. and Hampson, R. (2024) *As if human: Ethics and artificial intelligence*. Yale University Press. p.227.

## 5. TOWARDS A TOOLKIT FOR GENERATING GAI FUTURES

### PARTICIPATION AND POWER

The purpose of creating a toolkit to explore possible futures is to enable stakeholders to be more active in shaping those futures. Because GAI interacts with its users conversationally, using everyday language, it is well suited to being used inclusively by everyone.

But we know that power does not go away just because, in principle, everyone can participate. There are always questions about:

- who frames the questions – setting the agenda
- how the range of responses to questions is explored and by whom – participating in the dialogue
- who chooses the response – decision making.

These will be managed differently in different settings, and a toolkit will not change that. What it does is open up the dialogue stage, creating opportunities for it to be genuinely participative rather than merely consultative.

### THE BENEFITS OF A TOOLKIT APPROACH

We believe there are several benefits to giving people a toolkit, compared with the alternative of trying to map the landscape or recommend destinations ourselves.

A toolkit is:

- **available when you need it.** It recognises that technology-related change is always ongoing; so the needs are not well met by a change management project with a discrete endpoint. Change is an exploratory journey rather than a fixed destination.
- **adaptable to different circumstances.** It meets education professionals and administrators where they are and enables them to explore and plan next steps.
- **participative and interactive.** GAI tools are conversational and require no specialist training, but their limitations must be understood so that users do not project onto them any powers, omniscience or reliability that they do not have.

The intention is to use GAI to create opportunities for exploration and dialogue in a way that aligns with Ivan Illich's vision for technology. That vision was of technology helping people connect with their world and enabling everyone to enrich their environment, rather than creating more distance and alienation from it. People are empowered to generate their own plans, rather than having it done or led for them by outside experts.<sup>9</sup>

<sup>9</sup> Illich, I. (1973) *Tools for conviviality*. Harper & Row.

## THE PART THAT GPTS CAN PLAY IN A TOOLKIT

In our pilot study (Section 3) teachers generated scenarios by copying, pasting and amending a set of prompts directly in ChatGPT. While this was appropriate in a workshop where facilitators were on hand to help, it is not practical when they are not. Happily, there is an alternative.

It is possible to create custom versions of ChatGPT that combine specific instructions, extra knowledge and any combination of skills. Slightly confusingly, these are called GPTs. They operate exactly like ChatGPT and other GAs, with prompts in everyday language, but they are designed for specific purposes.

As an example we have developed a GPT that generates scenarios for future uses of GAs in vocational maths education, based on the context and requests of the user. It asks users to specify:

- their involvement in vocational maths education, for example, as a role or job title
- a challenge in vocational maths for which they would like to explore GAI solutions
- whether they would like to explore scenarios for the short term (1-3 years), medium term (4-7 years) or longer term (8 years or more), and how radical they would like to be
- additional details about the specific challenge or scenario, including what current arrangements they want to keep, whether they want to use GMCs in the scenario, or whether they have specific goals or outcomes in mind.

It then generates a scenario and asks the user what they think of it and how it compares with their expectations.

We have called this GPT the Vocational Maths Education Scenario Builder and anyone with a ChatGPT account can [try it out](#). A sample exchange is provided in [Appendix 3](#).

## WHAT A TOOLKIT MIGHT LOOK LIKE

A toolkit to explore future ways of working requires:

- **creativity** – to imagine and explore alternative scenarios
- **control** – to keep the process anchored in, and checked against, operation realities together with ...
- **integration** – so that changes in one role, or one part of the education ecosystem, are linked to changes elsewhere.

GAI can be used for the creative parts because it is quick and safe but only *if* appropriate controls are put in place to filter out or mitigate any hallucinations or other randomness. We can envisage using a small number of bespoke GPTs in different stages of the process, for example:

- 1 **Scenario builder** – as described above and demonstrated in [Appendix 3](#).
- 2 **Profile projector** – to generate personalised projections of what an individual's work might look like based on their inputs about their current role, interests in maths and main goals, similar to the profiles in [Appendix 2](#).

- 3 **Scenario reflection tool** – invites individuals to
  - a identify the parts of the scenarios and/or profiles that they find particularly attractive and why
  - b identify the parts of the scenarios and/or profiles that they find particularly concerning and why
  - c reflect on options for optimising the attractions and mitigating the concerns.
- 4 **Action planner** –
  - a invites individuals to identify options to pursue from steps 1-3
  - b turns these into a personal action plan, including SMART objectives,<sup>10</sup> other roles to contact and tasks to complete.

We know GAI is not suited to controlling and replicating processes because it gives different outputs under similar conditions for no obvious reason. To add control to the toolkit, we need elements that can be reliably replicated. That could be in the form of:

- **written or video guidance** on how to get the most out of the toolkit, or
- **live instruction from a manager or trainer**, either online (Zoom, Teams etc) or in person.

The guidance would provide guard rails for the safe use of GAI elements of the toolkit and would cover:

- how and when to use the GPT tools in the toolkit
- how to sense check the outputs from the GPT tools
- how these are thinking tools, not resources or predictions
- how and when to integrate the results of personal exploration and planning with actions at both team and institution levels.

It is this integration at the team and institution levels that is going to make deeper changes more scalable and sustainable. The toolkit could provide guidance to managers and leaders about which parts could be used collectively by teams and/or how individual work with the toolkit could be joined up.

By combining creativity, control and integration in a toolkit, we can harness the generative power of GAI while optimising human participation and direction. Thus, the process remains human-centred, with the AI being focused on doing the intellectual legwork of producing ideas, lists and plans.

<sup>10</sup> SMART stands for specific, measurable, achievable, relevant and time-bound. Using SMART objectives can help in setting, planning, tracking and accomplishing both short-term and long-term goals in a structured and productive way.

## 6. RECOMMENDATIONS AND NEXT STEPS

We started out with the intention of mapping the territory and perhaps choosing one or more destinations, or at least directions. As we complete the exploratory stage of this work, we are instead proposing new ways of map making, navigating and wayfinding. These new ways use GAI to enable more people to take part in the activities which will come to define the future of their work.

The first step is to try out the components of the proposed toolkit with a range of stakeholders in the vocational maths field and to refine them based on their feedback.

Of course this must be a collaborative endeavour. Ideally, if we can get the interest and the backing, we imagine a community of practice where enthusiastic teachers in schools and colleges, advice and guidance professionals, and HR staff in employer organisations form distributed teams to work on the elements that feel most pertinent to them. Prompt scripts for different purposes and different platforms (ChatGPT, Gemini, Claude) could be shared via GitHub or something similar.<sup>11</sup>

Initially we are using this report as a calling card to float the idea of a GAI-based toolkit to help maths educators explore the potential uses of GAI in their work. We plan to convene one or more meetings to invite relevant stakeholders to interrogate and discuss the work we have done so far.

If there is interest in pursuing the project, based on the elements identified in the final part of [Section 5](#) above, we feel the work could be carried forward in three workstreams:

- developing and testing GPTs and their equivalents on other GAI platforms
- writing and recording guidance on the most effective and safe ways of using GPTs and equivalent tools
- scoping and coordinating the integration work at team level and institutional level across the vocational maths field.

<sup>11</sup> GitHub is a platform that allows developers to create, store, manage and share their code. It provides distributed version control, access control, bug tracking, and feature requests. GitHub (accessed December 2024) *Build and ship software on a single, collaborative platform.*

## APPENDIX I: CHATGPT-GENERATED TEACHING ACTIVITY

This activity was generated by ChatGPT when prompted by two teachers, as part of the workshop described in [Section 3](#) of the report.

### **TITLE: COLLABORATIVE PROJECT – DESIGNING AND OPTIMISING POISON DART FROG ENCLOSURES**

#### **OBJECTIVE**

Over the course of a month, collaboratively integrate animal care lessons with maths lessons to design and optimise poison dart frog enclosures. This interdisciplinary project aims to develop both animal care and mathematical competences, emphasising precision, proportion, risk assessment and cost estimation.

#### **WEEK 1 – INTRODUCTION AND ANIMAL CARE BASICS**

Animal care lesson:

- Introduce poison dart frogs, their natural habitats and specific needs.
- Discuss the importance of enclosure design in promoting the health and well-being of poison dart frogs.

Maths lesson:

- Review General Mathematical Competences [GMCs] related to precision, proportion and data processing.
- Introduce measurement techniques and calculations needed for enclosure design.

#### **WEEK 2 – DATA COLLECTION AND ANALYSIS**

Animal care lesson:

- Provide data sheets with information on poison dart frog habits, health considerations and environmental requirements.
- Discuss the significance of accurate data in designing appropriate enclosures.

Maths lesson:

- Instruct students to analyse the provided data, identifying correlations and patterns.
- Emphasise the use of maths tools for data interpretation.

#### **WEEK 3 – ENCLOSURE DESIGN AND MATHS APPLICATION**

Animal care lesson:

- Discuss the importance of enclosure features, considering hiding spots, water features and substrate depth for poison dart frogs.
- Encourage students to brainstorm design ideas.

Maths lesson:

- Guide students in applying mathematical competences to design the enclosure.
- Work on precision measurements, proportion calculations and utilising relevant formulas for poison dart frog enclosure design.

#### ***WEEK 4 – COST ESTIMATION, RISK ASSESSMENT AND FINAL PRESENTATIONS***

Animal care lesson:

- Discuss potential risks associated with poison dart frog captivity and ways to mitigate them.
- Guide students in finalising their enclosure designs, considering safety measures.

Maths lesson:

- Instruct students to estimate the cost of constructing and maintaining the poison dart frog enclosures.
- Emphasise the importance of optimising work processes to minimise costs.

#### ***COLLABORATIVE WORK AND PROJECT SUBMISSION***

- Facilitate collaborative sessions where animal care and maths lessons overlap.
- Encourage students to work in interdisciplinary teams, fostering communication between animal care enthusiasts and maths enthusiasts.

#### ***FINAL PRESENTATION***

- Each group presents their finalised poison dart frog enclosure design, incorporating both animal care and maths principles.
- Emphasise the collaboration between the animal care and maths disciplines in creating well-informed and optimised solutions.

#### ***ASSESSMENT***

- Evaluate students based on the quality of their enclosure designs, the application of mathematical competences and the ability to address specific needs of poison dart frogs.
- Assess the collaborative efforts and communication within interdisciplinary teams.

By combining animal care and maths lessons, this project provides a holistic learning experience, ensuring students develop a comprehensive understanding of both fields while actively applying their knowledge to real-world scenarios.

## APPENDIX 2: PROFILES OF TEACHING STAFF AND LEARNERS

The profiles in this table were generated using ChatGPT to illustrate the changes that might take place by the early 2030s. Each persona is presented once as now (on the left) and then in the 2030s (on the right). Note that, for this purpose, the people do not age: the students now are still students in the 2030s and the staff are still in the same roles.

Now	6-10 years in the future
<b>SOPHIE – MATHS TEACHER</b>	
<p><b>Interests in maths:</b> Sophie has a profound interest in applying maths concepts to real-world problems, particularly in engineering and environmental science. She finds abstract algebra challenging but fascinating, as she sometimes struggles to connect it with practical applications. Sophie is passionate about making maths accessible and enjoyable for all students, aiming to dispel the notion that maths is only for the academically gifted.</p> <p><b>Main goal:</b> Sophie's career goal is to innovate maths teaching methods that bridge the gap between theoretical maths and its practical applications in various vocational fields. She aspires to develop a curriculum that not only meets education standards but also prepares students for the challenges of the modern workplace.</p>	<p>Sophie has leveraged GAI to align with her interest in the practical applications of maths, developing interactive modules that simulate real-world problems for her students. This approach has significantly advanced her goal of making maths accessible, showing students the relevance of maths in everyday life and in various careers. Through GAI, Sophie has personalised learning experiences, addressing diverse learner needs and preferences, which has improved student engagement and understanding.</p> <p>However, the automation of content creation and assessment by GAI poses a risk to the traditional role of teachers, potentially reducing their involvement in curriculum development and direct student assessment. There is also a concern that increased reliance on technology might dilute the personal interactions between teachers and students.</p> <p>Despite these challenges, Sophie has found opportunities for greater collaboration with colleagues across disciplines, enriching the curriculum with interdisciplinary projects. Her role has expanded to include mentorship and curriculum innovation, enriching her career and maintaining her relevance in the evolving education landscape.</p>



Now	6-10 years in the future
<b>URSULA – CURRICULUM LEAD</b>	
<p><b>Interests in maths:</b> Ursula has a comprehensive interest in maths, with a particular passion for statistics and data analysis. She recognises the importance of these areas in the modern world, especially in sectors like marketing, healthcare and urban planning. Ursula finds the challenge of integrating technology into maths education both exciting and daunting.</p> <p><b>Main goal:</b> Ursula aims to design and implement a forward-thinking maths curriculum that equips students with the skills needed in the 21st century. Her goal is to ensure that the curriculum is inclusive, catering to students with varying degrees of maths ability and preparing them for a range of vocational paths.</p>	<p>Ursula has harnessed GAI technologies to make the maths curriculum more relevant and responsive to 21st century needs and to better align with her interest in statistics and data analysis. By integrating GAI, she has made significant progress towards her goal of developing a forward-thinking curriculum, which dynamically adapts to student feedback and emerging industry trends, ensuring students are prepared for future challenges.</p> <p>A risk of GAI in curriculum development is a potential over-reliance on technology, which could undermine the role of educators in content creation and diminish their direct influence on the curriculum. Additionally, the ease of customisation and updating curriculum content through GAI might negatively impact the educators' subject matter expertise. Nevertheless, Ursula has capitalised on GAI to foster interdisciplinary collaboration, enhance the curriculum's agility, and engage in higher-level strategic planning and ethical considerations of technology in education, thereby enriching her role and broadening her impact.</p>

Now	6-10 years in the future
<b>VICTOR – VOCATIONAL TEACHER (CARPENTRY AND CONSTRUCTION)</b>	
<p><b>Interests in maths:</b> Victor sees the beauty of maths in its practical application in carpentry and construction. He is particularly interested in geometry and measurements, essential in his teaching field. Victor finds higher-level calculus less relevant to his interests and sometimes struggles to engage with purely theoretical maths concepts.</p> <p><b>Main goal:</b> Victor's main career goal is to integrate maths skills with vocational training, making his students proficient in applying maths in practical construction tasks. He aims to develop a teaching approach that highlights the importance of precision and problem-solving in the construction industry.</p>	<p>Victor has embraced GAI to bring maths concepts to life through virtual simulations and interactive learning tools, using GAI to directly connect practical maths applications with carpentry and construction. This technological integration has propelled him towards his goal of effectively combining vocational training with maths skills, enhancing student proficiency in and engagement with both.</p> <p>The automation of instructional materials and the potential for virtual learning environments to replace hands-on experience pose risks to the traditional vocational teaching model. However, Victor has mitigated these risks by using GAI to complement rather than replace physical training, preserving the value of hands-on learning. He has expanded his role beyond teaching to include developing virtual learning environments and collaborating with industry partners to ensure course relevance, thereby enriching his career and contributing to the evolution of vocational education.</p>

Now	6-10 years in the future
<b>WILLIAM – MANAGER OF A FURTHER EDUCATION COLLEGE</b>	
<p><b>Interests in maths:</b> William appreciates the role of maths in education development and workforce preparation. He understands the need for a strong foundation in maths for students pursuing vocational careers. William is particularly interested in the challenge of making maths relevant and engaging for adult learners, recognising that many find the subject intimidating or irrelevant to their lives.</p> <p><b>Main goal:</b> William's main goal is to oversee the development of education programmes that effectively incorporate maths into vocational training. He aims to ensure that the college produces graduates who are not only skilled in their chosen vocations but also possess the mathematical competences required in the modern workplace.</p>	<p>Under William's direction, GAI technologies have transformed the college's education offerings, aligning with his vision of making maths education more relevant and engaging. This shift has enabled significant progress towards his goal of producing graduates equipped for the modern workplace, through personalised and flexible learning pathways that reflect current industry demands.</p> <p>The integration of GAI raises concerns about the depersonalisation of learning and the potential for technology to diminish the role of educators. Yet William has leveraged these technologies to enhance educator and student autonomy, allowing for a more tailored education experience. He has fostered collaboration within the college and with external partners, expanding education offerings and incorporating real-world applications into the curriculum. This strategic use of GAI has not only enriched the education landscape but also broadened William's impact on the institution and its stakeholders, ensuring the college remains at the forefront of education innovation.</p> <p>William has carefully navigated the risks associated with GAI, particularly the concern that they might impersonalise the learning experience. By integrating GAI as a complement to human interaction rather than a replacement, William has fostered a culture of collaboration among staff and ensured that the technology enhances rather than detracts from the richness of relationships within the college community.</p>

Now	6-10 years in the future
<b>TARIQ – STUDENT</b>	
<p><b>Interests in maths:</b> Tariq is interested in the practical aspects of maths, especially as they relate to computer science and technology. He finds calculus and trigonometry more engaging than statistics, which he sometimes finds abstract and disconnected from his interests. Tariq is motivated by understanding how maths principles underpin the development of software and digital technologies.</p> <p><b>Main goal:</b> Tariq's goal is to pursue a career in software engineering, where he can apply his maths skills in coding and algorithm development. He is focused on gaining a strong foundation in maths to excel in his future studies and professional endeavours in the tech industry.</p>	<p>Tariq's education in vocational maths has been greatly enhanced by GAI technologies, which provide detailed, step-by-step feedback on coding-related maths problems. This feedback mechanism is intricately linked with instructor reviews, which contextualise the GAI's suggestions within broader software development practices. Peers contribute by sharing how they applied similar feedback to their projects, fostering a rich, collaborative learning environment. This method ensures Tariq not only understands maths concepts but also how they directly apply to coding and software design, aligning with his interest in software engineering.</p> <p>The integration of GAI into project-based learning has enabled Tariq to work on software development projects that simulate real-world scenarios, boosting the relevance of his vocational skills and directly contributing to his goal of becoming a software engineer. These projects, enhanced by GAI recommendations and peer collaboration, have significantly improved his motivation and his understanding of his future employment path in the tech industry.</p>

Now	6-10 years in the future
<b>XAVIER – STUDENT</b>	
<p><b>Interests in maths:</b> Xavier has a keen interest in statistics, particularly their use in sports analytics. He struggles with the abstract nature of geometry, preferring the concrete results and predictive nature of statistics. Xavier is motivated by real-world applications of maths, especially those that can be used to improve a sports team's performance and strategy.</p> <p><b>Main goal:</b> Xavier's career ambition is to become a sports analyst, where he can apply his passion for statistics to the sports industry. He aims to develop a strong maths background so he can analyse game data effectively and provide insights that can enhance team performance and strategy.</p>	<p>Xavier's passion for sports analytics has been nurtured by the ability of GAI to offer personalised feedback on the statistical models and performance analysis used in sports. This feedback is enriched by instructors who provide insights on the practical application of these models in professional sports, and by peers who share their analysis on similar datasets, creating a multifaceted learning experience. Such an environment not only sharpens Xavier's analytical skills but also keeps him engaged by directly linking maths concepts to sports analytics.</p> <p>GAI facilitates Xavier's involvement in project-based learning that mirrors real-life sports analytics challenges, encouraging teamwork and the application of statistical theories in practical settings. This approach has enriched Xavier's understanding of the role analytics plays in sports strategy and player performance, reinforcing his career aspirations and motivating him to pursue a future in sports analytics with greater enthusiasm.</p>

Now	6-10 years in the future
<b>YVONNE – STUDENT</b>	
<p><b>Interests in maths:</b> Yvonne is particularly interested in the use of maths in environmental science and sustainability studies. She finds the application of calculus in modelling environmental systems fascinating but admits to finding complex algebraic structures somewhat alienating. Yvonne is driven by the desire to apply maths concepts to solve environmental problems and contribute to sustainable development.</p> <p><b>Main goal:</b> Yvonne’s main career goal is to work in environmental policy or sustainability consulting, using her maths skills to analyse and propose solutions to environmental challenges. She seeks to build a solid foundation in maths to effectively engage with and influence environmental policy and practices.</p>	<p>GAI has profoundly impacted Yvonne’s study of maths, which is focused on environmental applications. These tools provide her with customised feedback on environmental data analysis, enabling her to tackle complex ecological models and sustainability assessments effectively. Instructors and peers enrich this feedback, offering perspectives on the sociopolitical implications of her findings and suggesting areas for further research. This collaborative learning environment not only enhances Yvonne’s analytical skills but also nurtures her ambition to influence environmental policy.</p> <p>The role of GAI in project-based learning has allowed Yvonne to lead initiatives on sustainability projects, integrating maths models with policy development. These projects, supported by GAI-driven data analysis and collaborative teamwork, have made her education journey highly relevant to her career goals in environmental policy, providing a clear pathway into her future profession.</p>

## APPENDIX 3: EXAMPLE DIALOGUE WITH THE SCENARIO BUILDER GPT

**User:** How can you help me explore my professional future?

**Scenario builder:** Hello! I'm here to help you imagine and explore short-term and long-term futures in vocational maths education, with a focus on how generative AI can enhance your professional journey. To get started, could you tell me about your current role or involvement in vocational maths education? For example, are you a teacher, a curriculum developer or perhaps involved in another capacity?

**User:** I teach maths in construction courses, currently a scaffolder tube and fitting course.

**Scenario builder:** Great! Teaching maths in construction courses like the scaffolder tube and fitting course must be quite engaging. Could you share a specific challenge you face in teaching maths in this context that you might want to explore AI solutions for? Additionally, it would be helpful to know if there are aspects of your current teaching methods that you particularly want to preserve.

**User:** Mainly issues to do with load calculations and safety margins.

**Scenario builder:** Understanding the issues you face with load calculations and safety margins is crucial, especially in a practical field like scaffolding where precision is key for safety. Let's think about how AI could be used to enhance learning and application in these areas.

- 1 Would you like to explore short-term (1-3 years), medium-term (4-7 years) or long-term (8 years or more) AI integration scenarios?
- 2 How radical a change are you open to considering for your courses – minor adjustments or a complete transformation of the teaching/learning process?

Also, if you could use General Mathematical Competences (GMCs), which ones do you think would be most relevant to integrate into this scenario? For example, "measuring with precision" or "using rules and formulae" might be directly applicable.

**User:** Medium term, please, and be as radical as you like.

**Scenario builder:** Great, a medium-term and radical approach opens up many exciting possibilities! Given the focus on load calculations and safety margins, we can integrate several General Mathematical Competences (GMCs) such as "measuring with precision", "using rules and formulae", and "optimising work processes".

Here's a scenario for integrating AI in your scaffolding course.

## SCENARIO: AI-ENHANCED LEARNING PLATFORM FOR SCAFFOLDING COURSES

### OVERVIEW

In this medium-term, radical scenario, an AI-enhanced learning platform is developed specifically for construction maths, focusing on scaffolding. This platform uses adaptive learning algorithms to personalise instruction and feedback, helping students master load calculations and safety margins with high precision.

### KEY FEATURES

1. Virtual reality (VR) simulations:
  - Students enter a VR environment where they can practise assembling scaffold structures under various conditions.
  - The AI guides students through the calculation of load capacities, safety margins and risk assessments in real-time, adjusting the complexity based on their progress.
2. AI tutors:
  - AI tutors provide one-on-one assistance. They use natural language processing to answer students' queries about calculations and procedures.
  - The tutors also provide contextual hints using GMCs, like "using rules and formulae" [the fourth GMC], to reinforce maths concepts.
3. Automated error analysis:
  - When students input calculations, the AI automatically analyses errors and provides feedback.
  - This includes detailed breakdowns of where students went wrong in their calculations, suggesting methods to improve accuracy based on "measuring with precision" [the first GMC].
4. Collaborative online projects:
  - Students work in teams on virtual construction projects, applying their skills in a controlled, yet realistic setting.
  - AI monitors these collaborations, offering insights and helping students optimise their processes ("optimising work processes" [the tenth GMC]).
5. Integrated assessment tools:
  - The platform includes AI-driven assessment tools that evaluate students' understanding of maths concepts and their application in practical scenarios.
  - These tools help in continuously adjusting course content and teaching strategies.

**BENEFITS FOR STAKEHOLDERS**

- For educators – enables more focused and effective teaching, with AI handling routine queries and problems, allowing teachers to concentrate on complex teaching tasks and individual student challenges.
- For students – offers a highly engaging and interactive learning environment that adapts to their individual learning pace, improving their understanding and retention of critical safety concepts.
- For educational institutions – positions the institution as a leader in innovative educational practices, potentially attracting more funding and partnerships from industry leaders.
- For employers – graduates are better prepared with practical, tested skills that can be directly applied in the workplace, reducing on-the-job training costs and enhancing workplace safety.

What do you think of this scenario? Does it align with your expectations, and how do you see it fitting into your current education setup?

**User:** Can you tell me more about how the AI tutors work, please? Give me an example of how they might provide one-on-one assistance to one of my 18-year-old rookie scaffolders.

**Scenario builder:** Certainly! AI tutors can be incredibly effective in providing personalised learning experiences, especially for practical and technical subjects like scaffolding in construction. Here's how an AI tutor might work in the context of your course, providing one-on-one assistance to an 18-year-old rookie scaffolder.

**EXAMPLE SCENARIO: AI TUTOR ASSISTING A ROOKIE SCAFFOLDER****CONTEXT**

An 18-year-old rookie scaffolder is learning about load calculations and safety margins through the AI-enhanced learning platform. They are currently working on a virtual scaffold-building exercise.

**INTERACTION WITH AI TUTOR**

1. Initial query:
  - Student: "I need to calculate the maximum load for a scaffold section. How do I start?"
  - AI tutor: "Let's begin by identifying the type of load the scaffold will support. Are we looking at a light-duty or heavy-duty scaffold? This will help us choose the right formula."
2. Guided instruction:
  - The AI tutor prompts the student to input the estimated weight of the equipment and personnel that would typically be on the scaffold.
  - AI tutor: "Now, enter the total weight of the equipment and personnel you expect will be on this section of the scaffold."
3. Calculation process:
  - Once the student inputs the weights, the AI tutor displays the appropriate formula from the course material.

- AI tutor: “Based on the weights you’ve entered we’ll use this formula to calculate the maximum load. Here’s the formula we need, which incorporates the safety margin:  $\text{load (kg)} = (\text{weight of equipment} + \text{weight of personnel}) \times \text{safety factor}$ .”
  - The tutor then guides the student through each step, explaining how to substitute the numbers into the formula.
4. Error correction and feedback:
    - If the student makes an error, the AI tutor recognises it and provides immediate corrective feedback.
    - AI tutor: “It looks like there was a small mistake in how you applied the safety factor. Remember, we multiply the total weight by the safety factor. Let’s try that part again.”
  5. Further exploration and concept reinforcement:
    - After the student has successfully completed the calculation, the AI tutor links this task to relevant GMCs, such as “measuring with precision” and “using rules and formulae”.
    - AI tutor: “You’ve done a great job with this calculation! Remember, precision is crucial in construction to ensure safety. Always double-check your calculations and consider what might happen if the load is underestimated.”
  6. Progress tracking and next steps:
    - The AI tutor assesses the student’s understanding and suggests additional exercises or moves the student to more complex scenarios.
    - AI tutor: “Would you like to try a more challenging scenario now, or review another concept?”

### **BENEFITS**

- Personalised learning – the AI tutor adapts to the student’s pace and understanding, providing explanations and feedback tailored to their specific needs.
- Immediate assistance – the AI offers real-time help and clarification, which is especially beneficial in a learning environment where immediate application of concepts is crucial.
- Engagement and interaction – the conversational interface and step-by-step guidance keep the student engaged and make learning interactive and practical.

This example shows how AI tutors can enhance the learning experience by providing targeted, interactive and immediate support, making complex subjects more accessible and understandable. What do you think of this approach? Would it be helpful in your teaching context?

**User:** What role does that leave for me? I’m beginning to wonder if this is more radical than I bargained for.

**Scenario builder:** It’s completely understandable to have concerns about how emerging technologies like AI might impact your role. In this scenario, the introduction of AI tools, such as AI tutors, is meant to enhance and support your work, not replace it. Here’s how you can continue to play a crucial role in the education process, even with the adoption of advanced AI tools:



## THE CONTINUED IMPORTANCE OF THE HUMAN EDUCATOR

1. **Facilitation and oversight**  
As a teacher, your expertise in managing the classroom and understanding the nuances of student interactions remains vital. You would oversee the AI's integration, ensuring it complements the teaching and that students use it effectively. For instance, you might organise group discussions or projects that use insights gained from AI tutoring sessions.
2. **Curriculum design and customisation**  
Your knowledge of the industry's needs and educational standards will be crucial in tailoring the curriculum. AI can provide data on student performance and common difficulties, which you can use to adjust and improve the course content, ensuring it remains relevant and comprehensive.
3. **Mentorship and support**  
Students often need emotional and motivational support that AI cannot fully provide. Your role as a mentor becomes even more critical as you guide students through their education journey, helping them apply what they learn in practical, real-world contexts.
4. **Assessment and feedback**  
While AI can help with regular quizzes and practice exercises, your judgement is essential for more subjective assessments and personalised feedback. You would evaluate projects, presentations and other complex assignments where deeper insight into the students' capabilities and understanding is needed.
5. **Professional development and industry connection**  
You can act as a bridge between students and the industry. By staying updated with the latest trends and maintaining industry connections, you can bring real-world expertise and opportunities into the classroom, something AI cannot achieve.
6. **Adaptation and innovation**  
As an educator, you have the flexibility to innovate teaching methods and experiment with new pedagogical approaches. This could involve integrating AI tools in novel ways that suit your students' unique learning styles and needs.

## ADDRESSING YOUR CONCERNS

It's important to view AI as a tool that can relieve you of routine tasks and allow more time to focus on these critical aspects of teaching that require a human touch. This scenario isn't about replacing teachers but empowering them with technology to enhance the education experience.

How do you feel about these perspectives? Do you think this balanced approach might alleviate some of your concerns about the role of AI in your profession?

---

An extended version of this dialogue, where the teacher asks more questions about the nature and quality of direct teaching with students, is available in this [online shareable transcript](#).

The Gatsby Charitable Foundation  
The Peak, 5 Wilton Road, London SW1V 1AP  
T +44 (0)20 7410 0330 [www.gatsby.org.uk](http://www.gatsby.org.uk)  
Registered Charity number 251988

Copyright © Gatsby Charitable Foundation  
February 2025