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ARTICLE

Teaching Skills and Intellectual Virtues with Generative AI

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Abstract

Education aims to improve our innate abilities, teach new skills and habits, and nurture intellectual virtues. Poorly designed or misused generative AI disrupts these educational goals. I propose strategies to design generative AI that aligns with education's aims. The paper proposes a design for a generative AI tutor that teaches students to question well. I argue that such an AI can also help students learn to lead noble inquiries, achieve deeper understanding, and experience a sense of curiosity and fascination. Students who learn to question effectively through such an AI tutor may also develop crucial intellectual virtues.

Keywords: Intellectual virtues; intellectual skills; goals of education; generative AI; LLM; ChatGPT

1. Introduction

Generative AI, such as Large Language Models (LLMs), have become a ubiquitous part of our lives. Users can prompt these systems to brainstorm ideas, draft essays, copyedit writing, create artwork, produce music, solve equations, write code, and so much more. But this convenience comes at a cost. As students and educators alike embrace these tools, we face a growing tension between education's goals and the way students are employing generative AI for schoolwork. Epistemic goals of education are to improve our onboard cognitive abilities, help us acquire new skills, and cultivate an intellectually virtuous character by instilling intellectual virtues such as open-mindedness, creativity, and more (Siegel 1980; Battaly 2006; Baehr 2013; Pritchard 2014; 2015; Kotzee, Carter, and Siegel 2021).

Reports show that student reliance on generative AI conflicts with the main objectives of education (Hicks *et al.* 2024; Sparrow and Flenady 2025; Giannakos *et al.* 2024; Alier *et al.* 2024). While education aims to teach students intellectual skills, relying on generative AI is *deskilling* them (Sternberg 2024; Krook 2025; Ahmad *et al.* 2023; Zhai *et al.* 2024; Shukla *et al.* 2025; Lee *et al.* 2025; Laak *et al.* 2024; Cassinadri 2024; Kasneci *et al.* 2023). Students outsource essential cognitive tasks such as writing, brainstorming, critical thinking, or problem-solving and therefore miss opportunities to develop their cognitive abilities and acquire new skills. Additionally, an important aspect of the

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deskilling worry is that outsourcing creative endeavours to generative AI is causing us to lose our creative skills (Vigeant 2024; Sternberg 2024; Krook 2025; Zhou and Lee 2024).

These are legitimate threats to education, and some might reasonably wish to ban educational AI tools entirely. However, several considerations suggest otherwise. First, given the increasing investment in educational AI tools and language models, it appears likely that more of education will involve using these technologies. Second, at least regarding homework assignments, it seems difficult to envisage how educators could prohibit students from using these tools. Third, there may be positive reasons to employ generative AI in education. These tools are scalable and personalisable and can therefore effectively support individual students in ways that suit their unique learning styles. Additionally, while human teachers may provide higher quality education, the standard of educators varies considerably worldwide. These considerations raise questions about whether fully prohibiting such tools is even feasible or desirable. Hence, my central question is: how might we design generative AI tools to nurture, rather than undermine, our intellectual character? I am particularly interested in proposing design examples that address concerns about deskilling by demonstrating how generative AI might help us teach essential skills and intellectual virtues.

I give an example of a generative AI system for elementary school education that is designed to help students learn how to ask good questions, think more deeply, understand better, choose good inquiries, generate novel ideas, consider alternative perspectives, and so on. The fundamental design of the AI is based on teaching through asking questions.[1] I develop the app design further to show that such a generative AI can also teach these skills in a way that helps foster intellectual virtues, especially open-mindedness and creativity.

The paper is structured to first give a brief overview of education's epistemic goals (in section 2). Section 3 outlines the deskilling worry and the specific concern about losing creative skills. Section 4 presents a framework for designing AI systems that develop students' ability to ask good questions and help them acquire various other intellectual skills. Section 5 furthers this design by showing that generative AI may help foster intellectual virtues of open-mindedness and creativity.

2. Epistemic goals of education

Education helps students build an intellectual character by enhancing their cognitive abilities and facilitating the acquisition of new intellectual skills. Arguably, some also think that education ought to help students cultivate a *virtuous* intellectual character – one that not only embodies intellectual skills but also epistemic virtues such as epistemic humility, courage, open-mindedness, and creativity (Siegel 1980; Battaly 2006; Baehr 2013; 2016; Pritchard 2014; 2016; Kotzee et al. 2021; Watson 2016). This section elaborates on these goals. Later, I argue that while generative AI systems may pose threats to these aims, they need not do so if designed and used thoughtfully.

Education plays a significant role in helping us develop and improve our onboard cognitive abilities (Pritchard, 2014). For instance, when we are younger, we exhibit proto-arithmetic abilities like subitising and estimating (Pantsar, 2023), which are transformed into advanced arithmetic abilities by formal education. Similarly, as infants, we grasp the basics of language; formal learning refines these abilities by teaching sentence construction and rules of grammar. In these ways, education plays a vital role in developing and enhancing our innate faculties.

[1]Notably, Watson (2018) provides a detailed overview of teaching how to question well. See, also, Williamson et al. (2002) and Elder and Paul 1998) for works on teaching through questioning.

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Education enables us to acquire new skills, especially intellectual skills.[2] Reading and writing, for instance, emerge through learning. Basic reading and writing later evolve into advanced skills like outlining, structuring, summarising, and arguing. We learn to compose detailed prose, inform readers, and advocate for ideas. Similarly, education allows us to develop new mathematical skills such as algebra, geometry, and statistics. Many of us also gain computer skills in school, including typing, coding, searching the web, and mastering other modern competencies. These are all new skills that education helps instil.

Pritchard (2014, 2016) discusses whether technology is in tension with the goals of education or is a fundamental scaffold for learning. Pritchard (2014) elaborates how technology can scaffold an existing ability in two ways: the agent can go on to exhibit the ability even when the scaffold has been removed, and at other times, the scaffolded technology becomes an essential component of the skill itself. Abacus, for instance, is a scaffold that helps teach an ability, but once the abacus is gone, the student retains the ability. We teach computer skills to students and require a computer to teach them, but you can't take away the computer. The computer is an essential part of the skill.[3]

Arguably, an important role of education is to help students build an intellectually virtuous character (Battaly, 2006; Baehr, 2013; 2016; Pritchard, 2014; 2016; 2018; Kotzee, Carter, and Siegel, 2021; Watson, 2016). Intellectual virtues are stable cognitive character traits or habits of thinking and reasoning, such as epistemic humility, open-mindedness, attentiveness, creativity, tenacity, thoroughness, and epistemic courage. A characteristic feature of these intellectually virtuous traits is that they are motivated by love for epistemic goods such as truth, understanding, knowledge, true beliefs, and so on (Zagzebski, 1996; Battaly, 2008; Baehr, 2011; Kvanvig and Montmarquet, 1996).

To teach and cultivate intellectual virtues, students ought to acquire proficiency in the underlying virtuous skill, but, on top of that, learn to manifest that skill routinely (or when the situation arises for it) because one is motivated by epistemic goods (Baehr, 2011; Battaly, 2008). For instance, to foster the virtue of creativity, one must possess proficient creative skills (the ability to generate new and novel ideas) and exercise such skills through love and motivation for epistemic goods. This means that you may possess the intellectual skill of creativity, but you may not have cultivated the intellectual virtue of creativity unless you habitually manifest the skill of creativity because of your love for epistemic goods.

[2]While formal education imparts practical skills such as piano playing, sports, and so on, I am interested in intellectual skill in this paper. Intellectual skills are abilities to perform 'certain technical intellectual tasks' (Baehr 2011, 29), such as writing, critical thinking, reading, and so on.

[3]Pritchard forwards a crucial argument about how technology scaffolds learning (Pritchard 2014, 2018; Pritchard, English, and Ravenscroft 2021). In some of these works, Pritchard and colleagues also show how learning may sometimes involve helping students acquire new extended cognitive abilities. For example, while some technology, such as an abacus, scaffolds student's onboard abilities, other technologies may become an integral part of their new extended acquired abilities. The extended cognition thesis posits that our cognitive processes, abilities, and skills may extend into artefacts outside our skin and skull boundaries, depending on how we employ these artefacts (Clark and Chalmers 1998; Rowlands 2009; Menary 2013; Pritchard 2010). See more recent discussions on AI and extended cognition in Hernández-Orallo and Vold (2019); Telakivi et al., n.d.; and Naeem and Hauser (2024). Most importantly, read Battaly (2018, 2019), Carter (2018), Wheeler (2018), Alfano and Skorburg (2018), and Heersmink and and Knight (2018) for arguments on how intellectual virtues may extend depending on how we rely on technology. Other than the extended virtue epistemology literature, the discussion that has inspired me to think in the direction of this paper is the one on how intellectual virtues may help us combat vices of the online world (Heersmink 2018; Schwengerer 2021).

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The distinctive traits of intellectual virtues are most evident when contrasted with skills and cognitive abilities (Baehr, 2011). While abilities may be innate, intellectual virtues are acquired over time through effort, practice, and reflection. For example, memory may be an innate ability, but one comes to possess attentiveness (as an intellectual virtue) through consistent practice and by manifesting deep focus towards motivated epistemic goals. Unlike skills and abilities, intellectual virtues must be actively exercised. You may have a good memory and not use it, and you may be a great piano player and decide never to touch a piano again, but you are not an open-minded person if you do not manifest open-mindedness routinely when the situation calls for it. Another difference between skill and intellectual virtue is that while skills say something about an action, an intellectual virtue says something about the person's character (not just about something they do, but who they are). For instance, if someone is very good at writing philosophy, it is something that they perform meticulously. Whereas, if someone possesses the intellectual virtue of epistemic humility, that says something about who they are as a person.

Intellectual virtues guide the responsible and ethical use of skills, shaping how a person approaches knowledge and truth in meaningful ways. For instance, an attentive person is likely to pour more effort into besting skills that align with their attentive character, such as listening deeply and concentrating on different perspectives. Unlike skills, which can exist without a deeper purpose, virtues require a commitment to personal growth. It therefore makes sense to educate students to instil intellectual virtues, and not only skills.

Several virtue epistemologists and philosophers of education have discussed teaching intellectual virtues at great length (Brady 2019; H. Battaly 2006; 2016; Porter 2016; Kotzee, Carter, and Siegel 2021; Smith 2023). Many agree that such character education is important and requires going over and above teaching intellectual skills.[4] In general, teaching intellectual virtues may require instructing students in the specific virtue, giving them lots of exemplars of how that virtue is manifested, and providing students with ample opportunities to practise identifying the virtue. Fostering virtues would also require helping students build the right skills. If the goal is to cultivate the intellectual virtue of creativity, educators can first help students be proficient at the skill of creativity (i.e., generating new and valuable ideas). Practising the underlying skills required for the specific intellectual virtues is therefore an important part of fostering intellectual virtue. There are other accounts of how to teach and learn intellectual virtues, from Brady's (2019) emotion-based account to Porter's intellectual therapy-based account (2016).

[4]Some critical thinking or other intellectual reasoning skills are a more fundamental epistemic goal of education than intellectual virtues. See Kotzee, Carter, and Siegel (2021) for a discussion. Kotzee, Carter, and Siegel (2021) also observe (as does a reviewer) that teaching intellectual virtue lacks clear action-guidance. Intellectual virtue pedagogy primarily involves providing students with resources, that is, informing them about individual virtues, helping them learn and practise the skills underlying each virtue, and offering exemplars, whilst hoping they will develop a love for epistemic goods themselves. Teaching virtues appears both difficult and without an established pedagogy. Moreover, it remains challenging to assess when students have developed genuine motivation for epistemic goods.

I acknowledge that helping students cultivate intellectual virtues is indeed difficult and may lack clear pedagogical frameworks. Although some scholars have presented coherent pedagogies for intellectual virtues (Smith 2023; Baehr 2022). For reasons of space, I shall not examine which account of intellectual virtue teaching proves most suitable, but in section 5, I discuss Battaly and Brady's approach to teaching intellectual virtues, arguing that we can teach according to their methods. Subsequently, additional empirical work, such as Orona et al. (2024), may be required to assess whether individuals have indeed acquired the virtues being taught.

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Some of these, I will briefly unpack in section 5, when I discuss how generative AI may be designed to teach intellectual virtues.

Roughly, then, the epistemic goals of education are to hone students' abilities, help them acquire crucial intellectual skills, and even build intellectual virtues. In the next section, I'll outline some concerns about generative AI systems and how they are threatening the epistemic goals of education, and later in this paper, I argue that we and our education systems are not doomed to this fate. I present a design example to show (in Sections 4 and 5) that these systems can be designed to help achieve the goals of education.

3. Generative AI, deskilling, and creative deskilling

Generative AI refers to a class of AI systems designed to create new content, such as text, images, or even music. These systems operate by analysing patterns in their learning data to predict what the next data would look like according to already present patterns in the learning data. What they generate as output is what they predict according to the input and the patterns present in the learning data. LLMs are a specific type of generative AI. These models are trained on vast amounts of text to predict the most likely sequence of words based on a given input. The newer models provide better results because the language models undergo additional supervised learning and fine-tuning to allow them to make fewer errors and better predictions. Language models are generative AI systems that are good at human-like language. Prominent examples include OpenAI's GPT, Anthropic's Claude, and Google's Gemini.[5]

The emergence of generative AI systems has significantly impacted education, presenting unprecedented challenges. Because generative AI excels at producing coherent information on various topics, students are increasingly using it to complete their homework, solve practice problems, write essays, brainstorm arguments, and more. While some educators have begun utilising AI systems to create lesson plans and evaluate student essays, this paper will concentrate on the challenges teachers face. Educators are frustrated that scores of students are relying heavily on AI to complete their assignments. Detecting AI use reliably is nearly impossible, and it is not clear whether teachers understand how to help students understand the difference between appropriate and inappropriate uses of generative AI (to write an essay, for instance).

More specifically, educators are concerned that students are heavily outsourcing writing and thinking to generative AI systems and, therefore, forgoing the chance to develop these crucial intellectual skills (Sternberg, 2024; Krook, 2025; Ahmad, *et al.* 2023; Zhai, *et al.* 2024; Shukla, *et al.* 2025; Lee, *et al.* 2025; Laak, *et al.* 2024; Kasneci, *et al.* 2023; Cassinadri, 2024). Whether it is the argumentation of the essay or copyediting to improve the language and presentation of their writing, students are missing the opportunity to develop important skills. The students who are already good at writing are risking losing these important skills by not practising them.

Skills require practice, and if we don't practise them, we lose them. Like muscles, if we do not keep manifesting our skills, we will lose them (Sternberg, 2024; Krook, 2025). Imagine someone who has learned to play the piano from an early age and has become a

[5]Also worth noting are the following generative AI-based educational platforms, such as Khanmigo by Khan Academy, focus on classroom settings with interactive tutoring and personalised exercises. Other tools, like ScribeSense, can grade assignments, while Quizlet's AI features help create study aids. Generative AI also powers apps for early childhood and primary education. Tools like ABCmouse, Lingokids, Reading Eggs, and Osmo teach literacy, numeracy, and language through gamified lessons.

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very skilful piano player. If this person stops playing the piano for an extended period, they will not retain their skill. Following Vygotsky (1981), Sternberg also advises that we must practise our skills at our highest level of competence to improve those skills. Students can retain their intellectual skills, such as writing and brainstorming new ideas, if they practise these skills extensively, and they can enhance these intellectual abilities by exercising them at their highest level of competence.

Generative AI threatens the enhancement of our onboard abilities (Cassinadri, 2024). Proto-abilities present in most of us from infancy improve and develop into full-fledged skills through teaching and practice. However, if, from an early age, students outsource cognitive tasks (such as thinking through problems, asking questions, and generating new ways to solve problems) to AI systems, they miss opportunities to improve their abilities. Depending on AI for tasks like defining terms or recalling historical facts deprives learners of the chance to sharpen their memory faculties. Similarly, as they avoid mentally and critically engaging with information, they don't develop the ability to analyse new information, formulate arguments, and think critically. Over time, this dependence could erode mental discipline and weaken crucial cognitive faculties like logical reasoning, problem-solving, and memory retention. By outsourcing tasks that traditionally exercise the mind, individuals risk losing the chance to strengthen these onboard faculties.

Another face of the deskilling worry is that generative AI may impede the acquisition of new skills or reduce their efficient development. Writing, for example, is a critical skill to convey information and present thoughts, and we are at risk of losing our writing skills (AbuMusab, 2024; Sternberg, 2024). Someone who properly builds the skill of writing well can become a poet, a writer, a journalist, and so on. Failing to learn how to write thoughtfully, argue for your ideas, synthesise new information, critically engage with others' ideas, etc., negatively impacts students' education. Writing can also be fulfilling for the soul and a way to inspire others. By not developing such a skill, students miss out on a lot.

One could argue here that new technologies often make some skills redundant while we upskill in new ways. For instance, while students might not be learning how to write like previous generations did, they might learn to *prompt writing* with generative AI systems, and that may be the new important skill to learn for the AI age (Joshi, 2025).

We can imagine resistance to this line of thought in at least two important ways. First, some skills are too valuable, and we must work towards preserving them. Many might press that writing is a crucial intellectual skill that allows one to express oneself freely and artistically and allows the development of new ideas. And, because writing provides so many crucial goods, we shouldn't let the skill of prompting writing replace the skill of writing. On this line of thought, people might worry that students will lose more skills and fail to develop more abilities than the skills they gain. And also, the skills they acquire will be less important than the ones they lose (Cassinadri, 2024). That is, while they acquire different skills, such as crafting effective prompts for LLMs or navigating AI tools, they risk neglecting the more fundamental skills central to education. Some skills are just worth preserving, and writing may be one of them.

Second, sometimes writing is a way of generating new ideas – one could say that, when used in a particular way, writing is a type of creative skill. This brings us to an important aspect of the deskilling problem, which is that by not learning and practising important intellectual skills, they are also not exercising their creative skills. One of the ways I want to discuss creativity in this paper is creativity as a skill: 'Creativity is the ability to come up with ideas or artefacts that are new, surprising, and valuable'

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(Boden, 2004, p.1).[6] Like other skills and our muscles, our creative abilities must also be exercised to improve (Sternberg, 2024).[7]

Human creativity is valuable and a hallmark of intelligence. It leads to problem - solving, discovering new maladies for illnesses, making valuable decisions for the betterment of society and future generations, inventing new machines to help us elevate our cognitive loads, and so on. Some of our other skills may be replaced by skills more relevant to the new technology era, but human creativity, a crucial stamp of human intelligence, must be safeguarded.

However, there is a foreseeable degradation that awaits human creativity if we continue to outsource creative tasks, such as writing poems, brainstorming novel ideas and arguments., to AI systems. We are at risk of losing human creativity. As more students use AI to generate prose, poems, music, art, and so on, fewer students practise these crafts and hone their creative abilities.

I should note that researchers have furthered various other arguments concerning AI and human creativity. One such argument presents the worry that while AI is replacing human creativity, AI creativity is substandard (because it's based on a black box) and is therefore not true creativity (Brainard, 2025). Others have discussed how AI-produced outputs are similar to other AI-produced outputs (Doshi and Hauser, 2024), and therefore, lack the true novelty required for creativity. Using these systems, instead of our own cognitive processes, is causing us to lose the diversity in our creation. Halina (2021) furthers an explanation for this by arguing that AI creativity is domain-limited in ways that human creativity is not.[8] Some discuss the demotivation that comes from AI being trained on stolen work (especially music and art) and the decline in creativity that results from this demotivation (Ali and Breazeal, 2023). These are all noteworthy arguments, but I am going to shelve them for now and hopefully scrutinise them in a different paper. Here, I want the focus to simply be on the concern that students outsourcing their creative abilities to generative AI negatively impacts their intellectual character.

In sum, the main worry is that if students keep outsourcing important tasks to generative AI, they will lose (the opportunity to develop and practice) crucial intellectual skills, the ones that are worth preserving. As a result, our next generations will perform poorly at writing, brainstorming ideas, generating valuable ideas, and so on. If the goal of education is to build an intellectual character, which requires developing and improving intellectual skills and fostering intellectual virtues, it seems, at first glance, that reliance on generative AI only undermines these goals. This is because when students do not build the skills, they also fail to develop important intellectual virtues (as mentioned earlier, virtues require skills). In this way, looking more closely at what exactly the risks

[6]Creativity is discussed in a myriad of ways. Some anthropocentric accounts like creativity to agency (Brainard 2025), and others characterise it in terms of something magical, extraordinary, and mysterious (Gaut 2018). I think these definitions are unnecessarily anthropocentric, and, in my opinion, the gatekeeping serves no important purpose. Others, like me, understand creativity as something that can be explained in terms of our cognitive processes (Newell et al. 1962; Boden 1998; 2004; Moruzzi 2020; 2022; 2025) or cognitive character traits (Audi 2018; Baehr 2011; Zagzebski 1996; Kieran 2014). In this paper, I discuss creativity as the ability to generate novel and valuable possibilities, and later, I discuss the intellectual virtue of creativity. On my view, creativity need not be linked to humans.

[7]Nyholm (2024) presents a similar worry, but instead of framing it in terms of creativity, Nyholm describes our concern about losing intelligence.

[8]Quick note: DeepMind's AlphaFold is often the characteristic example in most of these discussions of creativity. Alpha Fold is a deep-learning model but not a generative AI. My discussion on creativity is significantly different from these other discussions on creativity. It may help to note that my concern with creativity is like Sternberg's (2004) worry about the deskilling of students' creative skills.

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are helps us understand what it is that we find useful about education and what it is that we want to preserve. It seems that some important intellectual skills that also play a role in helping us develop intellectual virtues are what we would like to safeguard.

4. Learning intellectual skills with AI

I think these threats are legitimate, but I do not think we are completely helpless in the face of these challenges. We can more intentionally design generative AI systems in ways that help students build the intellectual skills (such as creativity) that we find important to safeguard. Ultimately, I hope to inspire generative AI application designs that align more closely with education's fundamental aims. However, the focus of this paper is not to deny or diminish the risks, but rather to shift our attention towards reimagining these AI technologies. Some students will perhaps always outsource important tasks to generative AI and forego important learning opportunities. But the role of education is less about catching the few who will always take shortcuts, and more about focusing on helping students, from an early age, to develop a genuine desire to learn. Education should help make students want to learn and foster the intrinsic motivation to seek epistemic goods. I think AI systems can help with these goals. And as I mentioned earlier, personalisable and scalable generative AI may even be beneficial. Hence, in what follows, I examine how we might reimagine and redesign generative AI systems to cultivate essential intellectual skills and help students develop intellectual virtues.

In this section, I outline the design of a generative AI tutor aimed at teaching good questioning to elementary school students. As I will suggest, such a system not only fosters the capacity to ask well-formed, purposeful questions but also helps students acquire a broader range of intellectual skills: the ability to identify fruitful lines of inquiry, to engage in sustained and reflective thinking, and to develop deep understanding.[9]

Watson (2018) argues that we should educate students to ask better questions. Questioning allows us to elicit information for various cognitive and practical purposes (Dillon 1990; Watson, 2018). To question well, Watson contends, is to ask the right questions, at the right time, to the right person to elicit relevant and worthwhile information (Watson 2018). Questioning is an intellectual, rather than a practical, skill – more akin to critical thinking than to carpentry. Like other intellectual skills, it admits of degrees of proficiency: one can question well or poorly. While the capacity to ask questions emerges early in human development – often evident even in infancy – it is nonetheless a skill that can be cultivated. With appropriate instruction and guided practice, students can learn not merely to ask questions, but to ask better ones: more focused, more insightful, and more conducive to eliciting information, knowledge, and understanding.

Watson (2018) also draws attention to how the intellectual skill of questioning is a gateway to other skills and intellectual virtues. A good questionnaire can extract useful information and enhance understanding. They can learn to choose worthwhile inquiries and therefore lead more important epistemic pursuits. Questioning well can help people learn to be open-minded (Watson, 2025), and fostering a questioning mind can allow us to be more creative.

[9]I am pressed for space and therefore do not discuss the security concerns in this paper. Generative AI systems bring critical risks, and we should give these risks utmost important, especially in an elementary school setting. I do not want this paper to be considered as downplaying these risks; I am simply leaving the discussion on the safety of students for a different paper.

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Here, I present a possible design for a generative AI application – or AI tutor – intended for elementary school students. At the core of this design is a simple idea: the AI tutor engages students by asking them questions and by providing opportunities for them to practise the skill of questioning themselves. Building on this foundation, I argue that such a system can support the development of a range of intellectual skills and contribute to the cultivation of a virtuous intellectual character. More specifically, I show how the app can be used to teach students how to question well, to understand more deeply, to identify and pursue worthwhile lines of inquiry, and to develop habits of creativity and open-mindedness among others. The central claim is that an app designed to help students ask better questions can also serve as a vehicle for broader intellectual and character development – a theme I take up in greater detail in the following section.

Let's call the generative AI-based conversational tutor the Q-Tutor.[10] The LLM generates questions while the student responds to them. These questions may be closed-ended and, therefore, geared towards helping students elicit useful information on a subject. The Q-Tutor may ask closed-ended questions such as 'What colour is your bag?', 'Who would you go to if you hurt yourself?', 'Where does a nurse work?', 'How many trees are in the garden?', etc. Alternatively, the Q-Tutor can generate open-ended questions to help teach how to question profoundly about difficult subjects. For example, 'Why is the sky blue?', 'What does it mean for something to be blue?', 'What do you like about colours?', and so on.

An additional feature in the Q-Tutor app (say, a practising feature) can allow students to practise their questioning. After a while of following AI-led questioning and learning from its examples, the students can practise asking questions while the AI responds to these questions. Such a feature makes sure that the student isn't simply a passive learner but actively participates and exhibits questioning skills. The LLM can respond in ways to nudge the students to stay on topic, ask clearer questions, and so on. Educators can also use such a feature to evaluate student progress.

As presented earlier, the skill of questioning well opens a gateway to other intellectual skills, such as choosing a worthwhile inquiry to follow and understanding concepts more deeply. In what comes next, I discuss which other skills can be taught with the Q-Tutor and how to design it to teach these skills.

Good questioning can lead to learning how to pursue a *good inquiry* (Watson, 2018). Good questioning requires learning to ask worthwhile questions appropriately, which means the student also learns which questions are worthwhile. This also allows students to know which inquiries are worth pursuing and how to best attend to them by asking the right questions and not distracting from the subject (Watson, 2018). At the elementary school level, leading a good inquiry requires sticking to a subject and pursuing it more profoundly with deeper questions.

The Q-Tutor operates in two distinct modes: the AI leads the inquiry while the student follows, or the student practises leading an inquiry while the AI follows. When the Q-Tutor leads the inquiry, the AI generates a series of questions on a subject to

[10]Conversational one-on-one tutors have long been the focus of interest in educational research, especially on Intelligent Tutor Systems (Rus et al. 2013). Now, that we are in the age of natural language processors, we can anticipate that the quality of the conversations will improve drastically. Jurenka et al. (2024), at Google, discuss their new family of models fine-tuned for learning, called LearnLM. Aspects of the LearnLM models have been trained to converse and prompt students to come to solutions themselves and refrain from giving answers to students. However, the report informs that designing a model for such a conversation has not been easy. This is primarily because of not having a clear pedagogy and that different grade levels and different subjects require different methods of teaching. The design example that I present in this paper answers some of these worries and clearly sets a specific pedagogy for elementary grade level.

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demonstrate how one conducts a worthwhile inquiry. The AI asks a series of questions about the universe to guide a closed-ended inquiry. For instance, it asks 'What are some of the organ systems in a human body?', then 'Can you name some organs of this system?', followed by 'What is the function of this organ?', and 'How does the structure of the organ relate to its function?' and continues in this manner. The LLM generates a series of questions such as 'What is a colour?', 'What does it feel like to see the colour blue?', 'Are colours good or bad?', and 'How would the world look without colours?' to teach students how they pursue open-ended inquiries. The best examples of inquiries flow naturally from the student's responses rather than following a predetermined series of questions on a specific theme. The LLM naturally asks corresponding questions about the student's responses instead of rigidly following a preset sequence. For example, when the student explains what they think colours are, the LLM engages meaningfully with the student's response whilst also asking a further question about their personal opinions on the subject. Such an inquiry becomes more in-depth and shows students how they pursue an inquiry in a more engaged way.

Q-Tutor's practising mode allows students to rehearse leading their own inquiry while the AI follows like a supportive partner. The AI helps keep the student on track, prevents distractions, and encourages the student to dig deeper into an inquiry when it acts as a supportive partner. For instance, if the student becomes distracted, the LLM responds to reaffirm and remind the student of the subject of her inquiry. The Q-Tutor also gently nudges the student to dig deeper into the inquiry by exploring the more relevant and more meaningful questions on a subject.

Learning how to question well unlocks deeper levels of *understanding* (Watson, 2018). Understanding means grasping explanatory connections (Pritchard, 2009) – the ability to see how pieces of information fit together in a coherent and explanatory way. Questioning well acts like a spotlight, illuminating different angles of a concept students are trying to grasp. It helps students move beyond surface-level facts to explore the 'why' and 'how' behind ideas. Thoughtful inquiry pushes them to make connections they might have missed, uncover hidden assumptions, and challenge their initial understanding. Students start linking new ideas to what they already know, test their theories, and discover gaps in their knowledge as they learn to question well. This active engagement through questioning transforms passive learning into dynamic exploration. Students become active participants in their learning journey when they develop strong questioning skills, and they build a richer, more nuanced understanding that stays with them long after the initial learning moment.

Emphasis on examples, analogies, and other illustrations can help further understanding. Suppose when leading the inquiry, the Q-Tutor provides examples and analogies and explains concepts by building on previous information that the student and the tutor have shared. For instance, the Q-Tutor can begin with a central question, such as 'What is happiness?' and add auxiliary questions about other emotions, 'What makes you happy?', 'Does joy resemble happiness or differ from it?', 'How does happiness differ from sorrow?', and so on. Additionally, the chatbot can provide examples and help students connect concepts such as happiness to their real-life experiences and more. Similarly, when the student leads the inquiry, the AI can prompt the student to give examples related to the concepts in the questions from real-life scenarios, present analogies, and compare a concept with previous ideas. In this way, the Q-Tutor can promote students' understanding, foster critical thinking and deeper reflection, and help them form new connections and insights they may not have previously considered.[11]

[11]Also, see Malfatti (2025) for a more thorough explanation of how AI may further our understanding.

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A key advantage of this design is its potential to enhance students' individual and *personalised understanding*.[12] By engaging with a conversational tutor like this, each student can draw on their prior knowledge to lead or follow inquiries in ways that resonate with their experiences and interests. This approach enables students to develop insights and connections that are uniquely their own. Q-Tutors can facilitate students to integrate old knowledge and link it to new concepts in novel ways specific to them. For example, a student who has previously learned about music growing up with a musician parent may be able to form different (from other students) and more advanced connections to the LLM-led inquiry on musical concepts. Such a student might also be able to foster intellectual emotions such as curiosity and inquisitiveness.

A carefully designed generative AI app, such as the Q-Tutor, helps students foster various intellectual skills. I have shown how such an app facilitates students in learning how to question well to elicit information, question to further inquiry, learn to explore important topics and worthwhile inquiries, exercise assisting with an inquiry, practise leading an inquiry, develop examples and analogies to explain, understand concepts deeply, make deeper connections to the subject, and understand concepts in personalised ways. This, I think, represents the tip of the iceberg. We can tweak the design and prompt the Q-Tutor to teach more skills, like how to reason through an argument, how to consider alternative perspectives more thoroughly, and how to generate novel and valuable ideas. I will discuss some of these in the next section, where the focus will centre on imagining how the Q-Tutor may even help cultivate intellectual virtues.

5. Cultivating intellectual virtues with AI

As discussed earlier in this paper, intellectual virtues are stable character traits through which one exercises specific skills in motivation for epistemic goods, such as truth, knowledge, and understanding. To break it down, intellectual virtues require a proficient level of relevant skills (Zagzebski, 1996; Roberts and Wood 2007; Baehr, 2011) and exercise of these skills for the love of epistemic pursuit (discussed in more detail later in the section). For instance, someone who is virtuously open-minded is disposed to efficiently generating and appropriately considering alternative perspectives and exercises these skills for the love of epistemic goods. Recall that earlier in the paper, I discussed creativity as a skill and the ability to generate novel and valuable possibilities. Now, let's consider creativity, the intellectual virtue. A virtuously creative person is disposed to proficiently generating valuable ideas because they are driven to do so by

[12]Human educators undoubtedly excel at promoting and inspiring individualised understanding, but not everyone can access education where educators can attend to students personally. Generative AI may offer a more affordable alternative for tailoring education to each student's calibre. Personalised education is one of the most promising features of AI tutors. If developed right, such a technology may be revolutionising for education simply because it allows proper individualised attention for every student, which is near impossible to find in even the best systems of education. This is a topic worth exploring in greater depth, and I do not have the space for it here. I should note however that such a technology would require a better generative AI design than what we have right now. Large Language Models are not yet able to remember long conversations. They need Retrieval-Augmented Memory to store information about the students and be able to prompt it to recall when needed. Which information about the student's interest is worth saving for future discussions and how to prompt that information back to recall are important technical concerns that need to be worked out before we can get decent personalised tutors. We are already seeing studies supporting the positive impact of AI-based personalised education (Pesovski et al. 2024; Laak et al. 2024).

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their love and desire to pursue epistemic goods. Such people manifest creative skills often and very well in pursuit of truth, knowledge, understanding, etc.

In this section, I focus on discussing how the Q-Tutor may help students foster intellectual virtues of open-mindedness and creativity. Before turning to the design of the Q-Tutor app, I briefly consider some accounts of how intellectual virtues might be taught. After presenting these views, I return to the app's design and explore how it might be refined to support the development of underlying intellectual skills, such as the ability to generate novel ideas, and to teach these skills in ways that contribute to the cultivation of intellectual virtues, such as creativity.

Battaly (2016) notes that while there aren't clear rules to teach intellectual virtues, educators can take some steps that can make it more likely that students will adopt these virtues. The first step is to introduce students to the specific intellectual virtue, explain its significance, and provide ample opportunities to practise the underlying skills Battaly and Baehr 2016 . For example, fostering virtuous creativity requires students to engage regularly in the skill of generating novel and valuable ideas. It is also essential to present a range of exemplars who model the targeted virtue in thought and action.

On Brady's (2019) account, teaching intellectual virtues requires teaching in a way that instils important intellectual emotions such as curiosity, wonder, awe, and fascination. Curiosity arises when we recognise a gap in our knowledge and feel a desire to resolve that gap. Emotions, such as curiosity, contain several elements, such as attention, valence, motivation, and more. Brady argues that emotions can affect attention and bring something into focus. When teachers make learning interesting, emotions such as curiosity allow students to attend to knowledge gaps. Such attention can motivate students to follow the inquiry forward, want to know the result, ache in wonder, and more. Teaching in a way that invokes emotions helps students pursue epistemic goals, and such motivation facilitates the acquisition of intellectual virtues.[13]

I will now turn to the Q-Tutor again, this time to show that it can help foster intellectual virtues of open-mindedness and creativity by helping students acquire the underlying skills necessary for open-mindedness and creativity.

To help foster the intellectual virtue of open-mindedness, the Q-Tutor provides students with opportunities to practise the skills required for open-mindedness. We can prompt the LLM-based Q-Tutor to ask questions in a way that nudges students to generate more than one answer. The Q-Tutor can encourage students to provide reasons for their responses and engage in deeper reflection on those reasons. Challenging their reasoning can help students recognise different perspectives and become more open-minded. Additionally, the Q-Tutor may require students to weigh various opinions and generate reasons for their answers. In a similar vein to the Socratic method, the Q-Tutor can bring students to reflect on their responses and prompt them to evaluate differing perspectives and conflicting viewpoints. Hence, while students learn to improve their questioning skills with the Q-Tutor, they also learn to practice open-mindedness skills.

[13]Another noteworthy account: Steven Porter's 'intellectual therapy' instructs educators how to teach intellectual virtues through a therapeutic approach (Porter 2016). Porter argues that educators must perform something like a minimalist version of psychotherapy, specifically designed for educational settings. An educator should first determine whether the student stands ready to acquire intellectual virtues. If the student lacks readiness, the educator must discover why this occurs. This requires the educator to understand the student's representations about their self-image and self-worth and then prepare them through talk therapy whilst gauging their interests. While we are still trying to make generative AI technologies safe to use, it would make sense to be wary of designing these systems for something like intellectual therapy. I also think this subject requires a lot more space than I have left for this paper.

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Likewise, the Q-Tutor can help students foster creativity by nudging for creative skills. We can prompt it to ask what-if questions, role-playing questions, and open-ended questions that nudge students to think out of the ordinary. To give an idea, questions like the following would encourage students to generate novel ideas: How would you design a city with weak gravity? What would transportation look like if the wheel had never been invented? What would you do if you were a butterfly? What if your brain is dreaming right now? In these ways, the Q-Tutor can prompt students to think about unusual things in unusual ways and therefore push them to exercise their creative skills.

We can also imagine that the Q-Tutor, as it is fine-tuned for conversations, can help students think for themselves by nudging them in ways similar to the Socratic method of teaching. This design ensures that generative AI systems converse in ways that prompt the student's own reasoning and thinking, instead of providing direct answers. Consider how Socrates interacts with a slave boy in '*Meno*' to help him arrive at correct answers to geometrical problems, even though the boy has received no formal education on the topic. Socrates demonstrates the theory of recollection here, suggesting that our souls are immortal and can recall knowledge, even when the body has not learned those facts. Some might argue that Socrates didn't nudge students to arrive at answers of their own; he was nudging them to find what he thought was the correct answer. I think they are right, and I therefore propose an update on this design.

I think we should model Q-Tutor's conversation style like a psychotherapist (instead of according to Socrates).[14] A psychotherapist discusses our emotions and life events in a way that prompts us to come to our own understanding of matters. For instance, when we ask a therapist why we feel a certain way and how we can address it, they typically guide us with questions, encouraging us to explore these issues ourselves and find our own true answers to these issues. This approach is effective because the answers we find depend on our individual belief systems and the unique connections we make with new insights in our personal context. In this way, generative AI designed to communicate in the way psychotherapists do can inspire students to generate truly novel ideas. Similar to how we derive our own answers in conversations with a therapist, the Q-Tutor can also encourage students to develop new concepts that are not only innovative for the individual but also historically significant. Margaret Boden (1998) distinguishes between P-creativity and H-creativity, where P-creativity refers to ideas that are new to the individual (or the AI), while H-creativity denotes ideas that are new to all of history. When implemented correctly, generative AI in primary education can help students connect ideas to their existing knowledge, fostering both P-creativity and H-creativity.[15]

Additionally, the Q-Tutor may facilitate understanding by helping students form personal connections to new information. This approach also helps students improve their creative skills. Recall how questioning skills facilitate understanding, including

[14]When I speak of designing the Q-Tutor's conversation style like that of a psychotherapist, I am not referring to Steven Porter's (2016) intellectual therapy account for teaching intellectual virtues. I simply want to emphasise how therapists facilitate our thinking rather than tell us how we feel. Therapists help us arrive at answers ourselves instead of providing direct solutions.

[15]An important benefit of this kind of conversational teaching is that it brings the added element of authorship. When students develop new ideas in dialogue with an AI, these ideas can be considered their own, as they have authored or co-authored them. This is different from simply learning mere facts from a generative AI, which can be attributed to the students only as learners of the facts, not the creators of those ideas. Learning facts with LLMs, therefore, should not be the focus of educational LLMs. The emphasis should be to encourage independent thought and pursue personal curiosities, which can help cultivate and enhance intellectual virtues. Like many other themes, I will leave this discussion here to limit the scope of the paper.

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personalised understanding, as I discussed in previous sections. Each student brings their own prior knowledge, which helps them form new connections and comprehend new concepts in their unique ways. For example, a musician's child makes unique connections when following a generative AI-led inquiry on music theory, compared to someone who lacks previous music knowledge. A student interested in the solar system and other mysteries of the universe will bring curiosity to new information on the subject. Such personal connections to new learning material serve as excellent starting points for creativity. If the Q-Tutor converses with the students on these subjects, they are more likely to help students make breakthroughs in generating novel and valuable ideas.

Here onwards, I want to discuss the kind of teaching that allows the Q-Tutor to promote curiosity, fascination, and other intellectual emotions (that may be useful to help foster intellectual virtues). The Q-Tutor needs another mode – call it the storytelling mode. Say, it teaches students about intellectual virtues through stories and whimsical characters when students enter this mode. The Q-Tutor creates countless exemplars of whimsical characters that model intellectual virtues, tailoring these to students' interests. Consider a student who finds the insect world fascinating: the Q-Tutor teaches them about the intellectual virtue of creativity by telling them a story of a spider that creatively constructs webs to escape predators. The student finds the story about the spider and its creativity fascinating, and this helps them reflect more on creativity's usefulness and even makes them ponder how they can become more creative when situations demand it. Similar whimsical characters of students' interests can be thought to inspire them to be open-minded or be curious about open-mindedness. This approach instils intellectual emotions effectively and therefore prepares students to foster intellectual virtues like creativity. Teaching that matches students' specific interests proves very effective in promoting intellectual emotions and consequently prepares them to acquire intellectual virtues.[16]

6. Conclusion

Education enhances innate abilities, teaches key intellectual skills, and nurtures intellectual virtues. Poorly designed or misused generative AI can disrupt these educational goals. I propose strategies to design and prompt generative AI, specifically LLM-based systems, to align with education's aims, particularly in elementary schools.

The paper presents an example of a generative AI tutor designed to teach students how to question well, understand deeply, choose worthwhile inquiries, generate novel

[16]Another way to motivate students to pursue epistemic goods is to lead by example. Some might argue that generative AI cannot model intellectual virtues; only human beings can. I am not sure to what extent this is true. I wonder if there are ways to store relevant information in Q-Tutor's augmented memory and prompt it in a way that it can acquire the right virtuous skill to employ whenever the situation demands. In this way, whether they are virtuous or not becomes irrelevant, as they can mimic a perfectly virtuous being. While this is an exciting idea I would like to explore further, I must put a pin in it for now.

It should also be noted that some may wonder, as I discussed in Footnote 4, whether intellectual virtues can indeed be taught in the ways that Brady and Battaly have discussed and in the manner that I believe would help design the Q-Tutor app. More specifically, some may worry that whilst the Q-Tutor app may successfully teach students about the virtues, make learning engaging for students, and even invoke curiosity and fascination, it remains possible that the app may nonetheless fail to inspire students to develop a love for epistemic goods. While I believe that Brady and Battaly's account of teaching intellectual virtues is extremely helpful and that we should design AI according to their theories, I also believe that we can subsequently conduct empirical work (such as that which Orona et al. 2024 conduct) to assess how effectively these applications are helping students adopt a love for epistemic goods.

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and valuable possibilities, and consider differing perspectives. I also advance the argument that an AI tutor designed for such teaching can also help cultivate intellectual virtues, specifically creativity and open-mindedness.

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