

Have Courage to Use your Own Mind, with or without AI: The Relevance of Kant's Enlightenment to Higher Education in the Age of Artificial Intelligence

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Abstract: Artificial intelligence (AI) in higher education is a complex issue that can be discussed from many different perspectives. There is currently a great need for ethical discussions about the use of AI in universities. For example, educational researchers and teachers are already talking a lot about fairness, accountability, transparency, bias, autonomy, agency and inclusion of AI applications, and discussing these in terms of concrete teaching-learning settings. However, less explored are the implications of AI-enhanced teaching and learning in relation to fundamental educational ideals and goals. The article takes this research desideratum as a starting point by relating the use of AI in universities to Kant's reflections on enlightenment. The aim of this article is to theoretically analyse the compatibility of various AI tools with the ideal of maturity on an educational philosophical level and to formulate recommendations for action based on the results. Through a comprehensive literature review, the article analyses the impact of intelligent tutoring systems, ChatGPT and AI-supported research tools on students' maturity and discusses both opportunities and challenges for higher education. The theoretical analysis shows that intelligent tutoring systems and ChatGPT threaten student maturity, while AI-supported research tools can have a positive effect. In addition, the analysis provides several recommendations that can help to minimise the risks of AI applications in terms of student maturity. The educational principle of research-based learning is of particular importance in this context, illustrating how students can learn to use AI tools responsibly and maturely. In this sense, the paper presents a theoretical study that fundamentally reflects on the maturity of students in the age of AI and thus both encourages teachers in the field of e-teaching to critically reflect on AI-based tools and provides a basis for further empirical research.

Keywords: Kant's enlightenment, Infantilisation, Intelligent tutor systems, ChatGPT, AI-based research and visualisation tools, Research-based learning

1. Introduction

Since the release of ChatGPT3 in November 2022, Artificial Intelligence (AI) has been a prominent topic in all higher education institutions, sparking countless discussions about how this new technology is changing teaching and learning (Farrokhnia, et al., 2023; Gimpel, et al., 2023; Lo, 2023). The use of AI has an impact on different disciplines and can be used in humanities and natural science, as well as in computer science (Crompton and Burke, 2023). Furthermore, AI in Higher Education (AIEd) is characterised by a wide range of diverse applications. This ranges from general AI-based tools (e.g., ChatGPT3.5/4) (Gimpel, et al., 2023), to specific research tools (e.g., visualisation and research tools, such as litmaps or research rabbit) (Pessin, Yamane and Siman, 2022), to intelligent tutoring systems and adaptive learning environments introduced by universities (Zawacki-Richter, et al., 2019).

AIEd can be used by students and teachers in many ways, opening research desiderata (Crompton and Burke, 2023; von Garrel, Mayer and Mühlfeld, 2023). Therefore, not only do AI-assisted teaching and learning practices present new opportunities for higher education, but also challenges and threats (Farrokhnia, et al., 2023; Lo, 2023). Alongside these opportunities and risks, ethical issues related to using AIEd are becoming increasingly recognised. There are already numerous approaches that address educational ethics and discuss AI in terms of "fairness, accountability, transparency, bias, autonomy, agency, and inclusion" (Holmes, et al., 2023). In addition to these specific topics, there are also general examinations of the impact of AI and new technologies on social life (e.g. Coeckelbergh, 2018; 2022; Friederich, 2023; Gordon and Becevel, 2021). In higher education, these broader considerations of the relationship between technology or AI use and universities are peripheral to current debates and tend to be considered sporadically (e.g., Castañeda and Selwyn, 2018; Macgilchrist, 2019; Watanabe, 2023a). However, as universities function as important public spaces, there is a need for a more intensive discussion on the extent to which AI-based teaching and learning are compatible with the fundamental goals and ideals of universities.

Taking this idea as a starting point, this article examines the relationship between Kant's educational ideal of maturity (Kant, [1784] 2013) and the use of AIEd from a theoretical perspective.¹ Kant's thoughts on maturity, included in his essay *'What is Enlightenment'*, are particularly well suited for this investigation. They have been considered a central educational goal of the university since Humboldt (Sharrock, 2010) and have lost none of their relevance (Herwald, 2022, p. 46). With this approach, the article opens a new perspective on AIEd and shows how fundamental ideals of universities can be addressed in this field. The analysis focuses on how selected AI applications present opportunities or threats to the Kantian goal of maturity through education. On this basis, the article discusses ways in which potential threats can be addressed and how potential opportunities can be further considered. The aim is to reflect on Kant's principle of maturity regarding AI-supported teaching and learning and then to identify possible recommendations for educational action. In this context, on the one hand, general considerations, such as AI-free zones, are expressed and, on the other hand, research-based learning (RBL) (Huber, 2009; Wessels, et al., 2020) is discussed as a concrete approach.

1.1 Methods and Structure

The article takes a theoretical approach and combines various empirical, historical and pragmatic references (Bellmann, 2020) to discuss the extent to which different AI applications influence students' maturity from a philosophical perspective. This interdisciplinary approach draws on different disciplines (e.g., philosophy, education, technology) and is based on a comprehensive literature review (JSTOR, ERIC, Google Scholar), which is characterised by a systematic analysis of the literature on different AI applications and uses a snowballing method to identify further relevant papers (especially regarding the debate on students' maturity). The main criteria for evaluating the literature were its significance and relevance to the research question.² Another key criterion was the quality of the articles, which could be ensured by journals, institutions or peer reviews. For the literature on the various applications of AI, currency was also an important factor, which was why no articles published prior to 2016 were used in this context. Based on this literature review, it is possible to first present the debate on maturity in higher education, derive characteristics of maturity from it, and then analyse them with different AI applications in the context of higher education. The results of the analysis can then be used to present appropriate solutions based on literature research. In addition, the educational principle of research-based learning (RBL) is applied to show how teachers can promote the maturity of students using AI tools. This consideration can be illustrated by the structure of the article: The first section begins with an explanation of Kant's ideal of maturity in the educational context and looks at the phenomena of student customer orientation and infantilisation as counter-movements. The second section introduces and classifies current applications of AIEd. Building on the first two sections, the third section examines the extent to which certain AI applications may contribute to the infantilisation and immaturity of students. Based on the findings, the fourth section discusses how the problems of AI applications can be addressed. The fifth section summarises the considerations, points out limitations, and provides an outlook for further research.

2. From The Educational Ideal Of Maturity to the Infantile Student

The educational ideal of the enlightenment originated in the 18th century and has been a central aspect of university learning and teaching ever since. The German philosopher, Immanuel Kant, described fundamental aspects of the enlightenment in his essay *'What is Enlightenment'*, published in 1784, and defined the motto of the enlightenment: "Sapere Aude! [...] Dare to know [...]. Have courage to use your own mind." (Kant, [1784] 2013, p. 2). For Kant, enlightenment means the liberation of a person from his or her "self-imposed immaturity" (Kant, [1784] 2013, p. 2). The philosopher defines self-imposed immaturity as "the inability to use one understanding without guidance from another", where this is "self-incurred [...] when its cause lies [...] in lack [...] of resolve and courage to use it without direction from another" (Kant, [1784] 2013, p. 2). Kant sees the reasons for choosing an immature life primarily in the human traits of laziness and cowardice. They make it difficult for the individual to reach maturity, because it is more comfortable to remain dependent and uncritical. According to Kant, freeing oneself from the "yoke of immaturity" (Kant, [1784] 2013, p. 3) requires the freedom to use one's public reason. In this context, Kant distinguishes between the private and the public use of reason.

¹The article focuses on the impact of AI on student maturity and aims to examine it in a deep analytical discourse. Other ethical issues such as fairness, accountability, transparency, bias, autonomy, agency, and inclusion are therefore not addressed. For an overview of ethical aspects of AI in higher education, see e.g. Holmes, et al. (2023).

²As the article asks to what extent AI applications influence the maturity of students in general, rather than focusing on specific students (e.g., undergraduate students, discipline-specific), conceptual or theory-based papers and reviews proved particularly helpful as references. Specific empirical studies were also considered but were less central.

Consequently, freedom of reason can be restricted in the private sphere, while it must always be present in the public sphere. Thus, in Kant's view, it is possible for someone to be immature in his professional role (e.g., as an officer, civil servant or clergyman) and to obey orders, while in his role as a mature member of society, he critically questions and discusses issues (Kant, [1784] 2013). Enlightenment is a social process of educating people to think and act independently, challenging political doctrines with the aim of social change (Sharrock, 2010). Following Kant, public institutions, such as universities, have the task of promoting the freedom of reason (Hoyer, 2006).

Kant's thoughts on the enlightenment were taken up by Wilhelm von Humboldt who formed a pillar of his ideal of university education (Sharrock, 2010), which focuses on, among other things³, freedom through education. Therefore, education liberates people from their immaturity by eliminating and recognising heteronomy (Herwald, 2022, p. 45; Williams, 2016). Both theorists see higher education as a "public good" and attribute to universities the function of playing "a critical role in holding state bodies and the professions to account" (Williams, 2016, p. 619). Kant's and Humboldt's reflections on the enlightenment represent fundamental ideals of universities (Côté and Allahar, 2011, p. 11) and have become increasingly important due to current social dangers, such as fake news (Herwald, 2022, p. 46). How fundamentally the principle of maturity is anchored in the university sector becomes apparent in line with the goals of the European Union regarding higher education. Thus, along with career preparation and academic education, the European Union considers personality development and active citizenship a key objective for higher education (Camilleri, et al., 2014). In this context, critical thinking⁴ and the ability to independently evaluate topics or situations play an essential role (van Damme and Zahner, 2022; Wissenschaftsrat, 2015), illustrating the way in which Kant's enlightenment approach still resonates in the university today.

However, there are currently some countervailing trends in higher education that raise the question of whether Kant's reflections are still relevant in contemporary university life. For example, Macheridis, Paulsson and Pihl (2020) point to an increasing market orientation in higher education institutions, with a focus on employability rather than critical thinking or the development of maturity. In this context, students are often viewed in terms of customer orientation. Thus, higher education institutions are increasingly courting students, who progressively see themselves as customers of the educational offer (Guilbault, 2016; Calma and Dickson-Deane, 2020). This development leads, for example, to students expecting a good grade regardless of their performance or feeling less responsible for failures, instead blaming the system or teachers (Clayson and Haley, 2005; Guilbault, 2016).

As a result:

"students seek to secure a degree, rather than experience an education, with their goals limited to the acquisition of skills needed for employment and maximizing income. Within this context, universities are being pushed to produce knowledgeable students that society and employers deems valuable—not knowledge for its own sake or classical approaches that focus more on the process and ability to think" (Natale and Doran, 2012, p. 188).

Besides the tendency for universities to be market-oriented and the associated view of students as customers, the phenomenon of infantilisation can also be discussed (Giroux, 2015). A general definition of infantilisation is provided by Levi (1943, p. 53) in his work *Maternal Overprotection*: "Infantilization also refers to the continuity of the same type of care ordinarily modified in later years." Both Levi (1943) and Postman (1982) point out that infantilisation is no longer confined to individuals, but rather a growing trend in society as a whole. Stiegler (2010, p. 2) also deals with the infantilisation of society and comes to a similar conclusion: "[U]ndermining the difference between minors and adults is at the very heart of contemporary consumer culture, which systematically defines consumers, minors and adults alike, as being fundamentally, structurally irresponsible."⁵

³Other aspects of the Humboldtian ideal of education are, for example "[t]he unity of research and education/teaching [...] [,] [t]he primacy of research [...] [or] [a] national culture dominated and distinguished by higher learning" (Nybom, 2003, p. 144).

⁴Critical thinking is understood in this context as: "the intellectually disciplined process of actively and skilfully conceptualizing, applying, analysing, synthesizing, and/or evaluating information gathered from or generated by observation, experience, reflection, reasoning, or communication as a guide to belief and action" (Stanford Encyclopedia of Philosophy, 2018).

⁵A particular feature of Stiegler's work is that in many places he equates infantilisation with Kant's account of immaturity (Keij, 2021), underlining the topicality of the enlightenment agenda.

In the university context, infantilisation can be seen, for example, in the aforementioned customer orientation (Giroux, 2015), where students expect universities to guide them through their studies as quickly and directly as possible through teaching and service provision (Natale and Doran, 2012). Another indication of students' immaturity is the active role of parents in their adult children's studies (Vinson, 2012), which is reflected, for example, in the introduction of so-called parents' days (Jornitz, 2012). In addition, the decreasing ability to think independently and critically (Arum and Roksa, 2011) or the lack of willingness to read (Hoeft, 2012) are signs of the increasing immaturity of students. From the perspective of these infantilisation tendencies, students may well "fall into the role of being a passive vessel to be filled with information and/ or consumers entitled to high marks and credentials in exchange for tuition fees; ultimately, in either case, standards slide" (Côté and Allahar 2011, p. 90).

This brief description already shows the extent to which the educational ideal of student maturity can be renegotiated and discussed in a perspective-rich way. The use of new technologies, such as AI, now raises the additional question of how AI-assisted teaching and learning will affect students' personal development, critical thinking and questioning, as well as their independence. With the help of Kant's fundamental considerations on aids, this question can be made concrete. According to Kant, an aid (such as a book or, in this case, an AI-based tool) can either promote people's maturity or have precisely the opposite effect and cause people not to use their own reason. Kant illustrates these considerations in the concept of *pharmakon*, which in the medical field represents a drug that influences people positively or negatively (Stiegler, 2008, p. 44). Using the example of a book as an aid, this double meaning becomes visible:

"[T]he book reveals itself as such a *pharmakon*, potentially remedy and poison. Maturity is the result when the book acts as a remedy of the mind's minority, while infantilization or adult immaturity is the result of a poisoning of the mind, which occurs when the book takes over the role of the understanding rather than being a necessary aspect of critical thinking" (Keij, 2021, p. 71).

In terms of AI-supported teaching and learning, the central question is whether the use of AIED will reinforce the trend toward customer orientation and the infantilisation of students or, on the contrary, contribute to the development of empowerment. Before exploring this question in the next chapter, three key elements of mature students are summarised. Firstly, maturity is characterised using the student's own mind without outside help. Secondly, mature students can deal with issues and situations independently and critically. Thirdly, they are able to present their positions publicly as active members of society.

3. AI Applications and Their Impact on Student Maturity

AI has a great disruptive potential for higher education and will strongly influence the future of university teaching and learning (Schön, et al., 2023). In this context, AIED are characterised by different functions and a variety of possible uses (Watanabe, 2023a). While the use of AI was initially characterised by the development and research of assessment and feedback tools, early warning systems, intelligent tutors or adaptive learning environments (Crompton and Burke, 2023; Zawacki-Richter, et al., 2019), educational researchers and teachers are now showing increasing interest in commercial AI-based tools such as ChatGPT (Gimpel, et al., 2023; Lo, 2023; Schön, et al., 2023). In contrast to the first type of application, these are not designed by the university itself, but enter the higher education institutions from the outside. This second type of AI tool can be further divided into two groups. On the one hand, there are tools that are aimed exclusively at research and teaching, such as AI-based literature search applications (e.g., ResearchRabbit, Litmaps). On the other hand, a wide variety of AI tools are currently emerging that are used in different areas of work (e.g., marketing, journalism, sales, graphic design, etc.) (Limburg, et al., 2022): The most famous example of this type of AI are currently conversational agents, such as ChatGPT (Gimpel, et al., 2023). In order to make a meaningful analysis of whether AI applications help or hinder students' maturity, it is important to consider the different ways in which AI can be used in universities. For this reason, the following research will consider all three AIED-types individually, defining and discussing them in terms of maturity characteristics. However, as the different types can have further sub-categories, it seems to be useful to work with selected examples. This allows specific investigation of how particular AI applications affect student maturity. Specific examples used in the analysis are intelligent tutoring systems (ITS), Open AI's ChatGPT as a conversational agent, and AI-based research and visualisation tools.

3.1 Intelligent Tutor Systems and Student Maturity

ITS are receiving much attention in the current debate on the use of AIED (Crompton and Burke, 2023; Wang, et al., 2023). Zawacki-Richter, et al. (2019) identify ITS as a growing AI trend in higher education already in 2019 and show that ITS are grouped under different terms (e.g. intelligent (online) tutors, intelligent tutoring systems, intelligent (software) agents or intelligent assistants). A general definition of ITS is given by Wang, et al. (2023), who refer to Nwana (1990, p. 252): thus, an ITS is a computer system that is “designed to incorporate techniques from the artificial intelligence (AI) community in order to provide (intelligent) tutors which know what they teach, who they teach, and how to teach it.” ITS are mainly used in the seminar setting, for example, to deliver course content, to analyse the strengths and weaknesses of students, or to create personalised learning materials and automated feedback. In this context, educational researchers see personalisation as an opportunity for learners to receive tailored learning paths and recommendations (Crompton and Burke, 2023; Wang, et al., 2023; Zawacki-Richter, et al., 2019).

A comparison of ITS and Kant's thoughts on maturity shows an obvious incompatibility: Kant advocates that students use their minds independently, evaluate situations and take responsibility for their own actions. ITS, instead, reinforce the tendency for students to become infantilised and increasingly rely on the automated recommendations of a system (Utterberg Modén, et al., 2021; Watanabe, 2023b). The main problem here is the goal of ITS to personalise learning paths and materials for students, thus making studying more pleasant and comfortable (Çakir, 2019). This is because, according to Kant, critical thinking and the resulting independent action is a strenuous activity that takes time and cannot be replaced by accepting the views of others (in this case, the view and evaluation of an ITS) (Kant, [1784] 2013; Stiegler, 2008, p. 39f.).

At this point the question can be raised whether ITS should not be seen as a supportive tool that, like teachers, helps students to reflect and thus supports them in maturing. There are two arguments against this: First, ITS are not designed to enable students to think and act independently, as Murphy (2019, p. 6) points out:

“However, the systems are less able to support the learning of complex, difficult-to-assess, higher order skills — such as critical thinking, effective communication, explanation, argumentation, collaboration, self-management, social awareness, and professional ethics — that are increasingly emphasized in state education standards and valued by employers.”

Second, because ITS are AI applications whose choices are based on machine calculations (Kurni, Mohammed and K G, 2023, p. 33), students cannot engage in an open exchange with ITS (as they can with teachers) and cannot discuss or question the decisions made by the system. This problem is exacerbated by the so-called black box phenomenon of AI applications, which makes it impossible in principle to understand the decisions of an AI system (Adadi and Berrad, 2018; Herzberg, 2023).

Another problem with ITS in relation to learning is that it focuses students more and more on their individual learning success and does not create a collective learning atmosphere with other students; “this means that learning is perceived as individual change in incremental steps rather than as a collaborative process taking place in a learning community” (Utterberg Modén, et al., 2021, p. 1540). ITS thus contradict the enlightened claim of universities to educate students to become responsible and committed citizens of society. Instead, they promote the private interests and self-optimisation of students. The comparison of Kant's principle of maturity and the ITS makes it clear that the ITS infantilise students and prevent them from deciding for themselves under what conditions and in what way they want to learn.

3.2 ChatGPT and Student Maturity

ChatGPT is an AI-based conversational agent developed by Open AI that enables human-machine interaction using natural language software. While the first versions of ChatGPT and other conversational agents received less public attention, the quality of ChatGPT 3.5 and 4 has greatly improved, and the conversational agent now produces convincing results in various areas. In particular, ChatGPT is becoming increasingly important in university teaching, as this application can summarise knowledge or create analyses according to certain criteria without much human intervention: This means that central tasks in the teaching-learning context can be produced automatically (Gimpel, et al., 2023). In the field of higher education, this new technology has led to a variety of debates and has shown its disruptive potential (Farrokhnia, et al., 2023; Schön et al., 2023). Thus, the reactions of teachers and educational researchers to ChatGPT have ranged from fascination to concern (Rudolph, Tan and Tan, 2023). While critics of the new technology are primarily alarmed about the potential for misuse of ChatGPT, plagiarism and academic integrity (e.g., Sullivan, Kelly and McLaughlan, 2023), proponents

see opportunities in the use of conversational agents, hoping for example to strengthen creativity and writing skills or personalised learning (e.g. Atlas, 2023).

Regarding Kant's thoughts of enlightenment, it should first be noted that the philosopher considers writing and reading to be crucial skills for a mature life (Stiegler, 2008, p. 38). Independent writing plays an important role in this context, since a writing process is always accompanied by an independent thinking process (Luhmann, 1981, p. 222; Sumarno Kusumaningrum and Nurhayati, 2022). In text production using ChatGPT, this thinking has less room, since it is, only reflected in the formulation of the correct instructions to the conversational agent and the subsequent revision of the text (Watanabe, 2023a). The reduced writing experience thus has a generally negative effect on independent thinking and maturity.

It could be argued that it is precisely by processing the generated texts that students learn to deal with them critically, question their content, and thus acquire maturity in their studies. This consideration is supported above all by the fact that ChatGPT does not generate new knowledge, does not present information in its complexity and depth, and does not falsify sources. As a result, automatically generated texts always require a critical examination of the topics and sources presented in them (Gimpel, et al., 2023; Schön, et al., 2023). In this context, the question arises to what extent students (especially at the undergraduate level) can critically examine automatically generated texts that have a higher linguistic quality than texts they have written themselves. This consideration becomes even more problematic when it is assumed that students have less writing experience due to using ChatGPT and that academic writing is a general challenge in studying (e.g. Fernsten and Reda, 2011).

Therefore, it seems that conversational agents can only be meaningfully used in academic writing if students, due to their writing experience and academic socialisation, are already able to write academic essays independently and to interrogate automatically generated texts. To expect students with little or no writing experience to critically engage with an automatically generated text would be like showing a highly complex calculation to a primary school pupil who has just mastered simple mathematics and expecting him or her to be able to judge the correctness of that calculation.

It is also important to bear in mind that students must have a basic interest in editing the automatically generated text. They need to understand that this type of text generation is not a shortcut in the preparation of a written paper, but also requires a lot of time and work. However, the study by von Garrel, Mayer and Mühlfeld (2023) paints a different picture: students want to use ChatGPT to produce a text that meets academic standards, but they have little interest in the actual process of creating and actively shaping the text. In other words, students see ChatGPT as a work relief and not to practise critical thinking and writing. Consequently, the conversational agent is a tool that serves comfort but does not promote students' maturity.

In addition to writing texts, ChatGPT is often used by students to have other texts explained to them or to create summaries (Gimpel, et al., 2023; von Garrel, Mayer and Mühlfeld, 2023). Similar to writing, ChatGPT can be seen as an enemy of students' maturity, because if students do not understand a text and then have it explained or summarised by the conversational agent, they cannot subsequently check the extent to which the ChatGPT analysis is convincing. They remain in a state of immaturity and do not challenge themselves. The same applies if students only use this function to save time or reduce the amount of work, because, according to Kant, they are subject to laziness (Kant, [1783] 2013), which prevents them from engaging with a challenging text and forming their own opinion.

3.3 AI-Supported Research and Visualisation Tools and Student Maturity

The search for literature and the presentation of the research state are core tasks of academic activity (Ponsard, Escalona and Munzner, 2016). Bibliometric techniques and science mapping have supported these academic activities since their beginnings in the 1930s. Through new technologies like AI, many tools (e.g., ResearchRabbit, Litmaps, Elicit) are emerging in this area to help researchers and students get a faster and better overview of the research literature (Pessin, Yamane and Siman, 2022): this allows researchers to search and select articles according to specific criteria (title, author, subject, DOI, etc.) and then obtain a map showing how the different sources and references relate to each other. Selected articles can be also stored and filtered in a digital library. In addition, it is possible to use these tools to find out about new publications or to share the results of research with others (Kaur, et al., 2022; Sharma, et al., 2022). Pessin, Yamane and Siman (2022, p. 3716) see these tools as a great opportunity for academic work:

"With this system, scientists will have a powerful tool that provides strategic information, increasing the chances of success in publications by identifying significant research gaps and contribute to an open

science. The expected result is a solution that simplifies researchers' work, expands assertiveness in scientific production, and contributes to knowledge development."

In contrast to ITS and ChatGPT, research and visualisation tools support students in independent research projects and thus promote maturity. These new technology-enabled tools allow even inexperienced researchers (e.g. students at the beginning of their bachelor's degree) to get an overview of the research landscape, to understand connections and to identify research gaps. While the tools take some of the research work off the student's plate, the main work (reading and evaluating the various papers) still needs to be done by the students themselves. Particularly in view of the enormous number of publications now available, Kaur, et al. (2022, p. 7) speak of literature searches in the "ocean of research-based database resources", while Ponsard, Escalona and Munzner (2016, p. 2264) suggest that researchers may be confronted with "hundreds of publications" when researching topics, the importance of these tools increases in relation to the maturity of the students. The sheer volume of articles can therefore overwhelm students, either leading to paralysis and reluctance to search the literature, or severely limiting the search, by focusing on specific authors or terms and overlooking other relevant sources. AI-supported research and visualisation tools can counteract these reactions and make it easier for students to engage with academic papers.

In relation to the maturity characteristics outlined above, one could ask whether technology-enhanced research and visualisation tools promote student comfort. However, this must be answered in the negative, as students first need to familiarise themselves with the software and then still have to identify the relevance of papers to their work. The research and visualisation tools only provide new access to the literature; the student is still responsible for dealing with the material. Thus, these AI applications differ from ChatGPT primarily in the fact that they only support students in a specific aspect (e.g., the overview of the literature), which is not a usable product without further processing. Research and visualisation tools can be then seen, in the Kantian sense, as tools that empower students and give them access to relevant and/or alternative literature. Ultimately, students should not focus on these digital research tools, but rather see them as complementary to traditional sources of literature, such as seminar bibliographies or library catalogues.

3.4 From AI-Free Zones to Research-Based Learning

The examination of the three AI applications through the lens of the enlightenment shows that ITS and conversational agents do not meet Kant's ideal of maturity, while research and visualisation tools can help students to make independent inquiries.

Regarding ITS, it seems especially important that these systems do not place too much emphasis on teaching-learning settings, but rather represent one of many support services in higher education. In this context, particular attention should be paid to ensuring that universities create alternative learning moments in which the development of students' maturity and the learning of independent thought and action are in the spotlight. The proposal by Watanabe and Schmohl (2022) to create technology-free zones in educational settings could help to strike a balance between the efficient and personalised study on the one hand and the education of mature and critically thinking students on the other. Exactly how these AI-free zones are to be designed must be left open at this point, as it depends on specific teaching-learning settings and cannot be generalised. Furthermore, it is important that students can discuss ITS assessments or material suggestions with teachers and are supported in taking a critical stance toward the system.

For the use of ChatGPT, it is also essential for the maturity of the students to create writing and reading moments in which no intelligent technologies are used. Such moments would be characterised, for example, by writing down thoughts on paper without any AI-assisted writing aids, as well as reading classic literature. In addition, students need to familiarise themselves with the general principles and logic of AI tools and understand how they work, as already called for by Gimpel, et al. (2023). To promote critical and independent thinking, there should also be space for general reflection, where students discuss with peers and teachers the use of ChatGPT and possible consequences for independent writing and reading.

However, it is clear from these considerations that teaching and learning with ITS or ChatGPT means a considerable amount of additional work for teachers, not only relieving them of tasks but also creating new ones. Against this background, it seems particularly important for teachers to develop new learning strategies and examination formats for the use of AI applications, on the one hand, and to be informed about the rapidly developing possibilities of AI, on the other hand, to adapt their teaching and examinations accordingly (Gašević, Siemens and Sadiq, 2023; Rudolph, Tan and Tan, 2023). In order to meet these broad educational requirements,

support is needed at this point through "extensive involvement of researchers, technology developers and policy makers" (Gašević, Siemens and Sadiq, 2023, p. 3).

In contrast to the other two AI applications, the analysis of the literature search and visualisation tools shows that certain technology-supported tools can support students in their independent research and thus promote their academic maturity. In this context, the research tools are particularly convincing because they only provide support for a very specific aspect (the presentation of literature) within a complex task (the elaboration and summary of the state of research). Students thus receive support, but not a finished product, and must evaluate and process the automatically generated information themselves. The implication of this finding is that, in terms of developing independent thinking and research, students should use AI tools primarily for very specific subtasks that require further processing by the learners. Thus, teaching and learning formats should be characterised by complexity, in which students must master diverse and overlapping tasks. The next section shows how these requirements can be implemented in a concrete teaching-learning setting, using research-based learning as an example. Before that, Table 1 summarises the considerations discussed here.

Table 1: AI applications in relation to Kant's ideal of maturity (own figure)

AI Application	Impact of AI Application on Student Maturity	Resulting recommendations
Intelligent Tutor Systems	<p>ITS deprive students of independent assessment and reflection on their learning.</p> <p>Students cannot discuss ITS suggestions or assessments, which discourages critical inquiry.</p> <p>ITS tend to make students more focused on their own success in their studies and less focused on collaborative learning.</p>	<p>ITS should not be widely used in every teaching and learning environment, but should be complemented by AI-free zones.</p> <p>Teachers and students need to discuss and challenge ITS suggestions and assessments together.</p>
ChatGPT	<p>ChatGPT limits students' reading and writing experiences and prevents students from learning to write and evaluate texts independently.</p> <p>ChatGPT promotes student comfort and results in students being less likely to think, read or write independently.</p>	<p>Students should continue to experience writing and reading moments in their studies where AI technology is not used.</p> <p>There should be courses or workshops in which students are taught how ChatGPT techniques work.</p> <p>Teachers and students need to discuss in teaching-learning settings how the use of conversational agents affects students' maturity.</p>
AI-based research and visualization tools	<p>AI-supported research and visualization tools help students to conduct independent research without doing the main work for them. This promotes the development of maturity.</p>	<p>Students can gain further/ alternative access to the state of research and literature by using AI-based research and visualization tools.</p> <p>AI-based tools should be used for specific aspects of complex tasks.</p>

Case Study: Research-based Learning and AI

Research-based learning (RBL) is a well-known and established learning format in which students carry out their own research projects (Wessels, et al., 2020). According to Huber (2009, p. 11), in RBL students independently go through all phases of a research process and develop results that are relevant for others. Depending on various parameters (e.g., subject, semester, course format), the concrete implementation of this learning format varies greatly, but it is important that students experience the entire research cycle cognitively, emotionally, and socially (Huber, 2009, p. 12). An ideal research cycle in RBL consists of eight different phases and is shown in Figure 1.

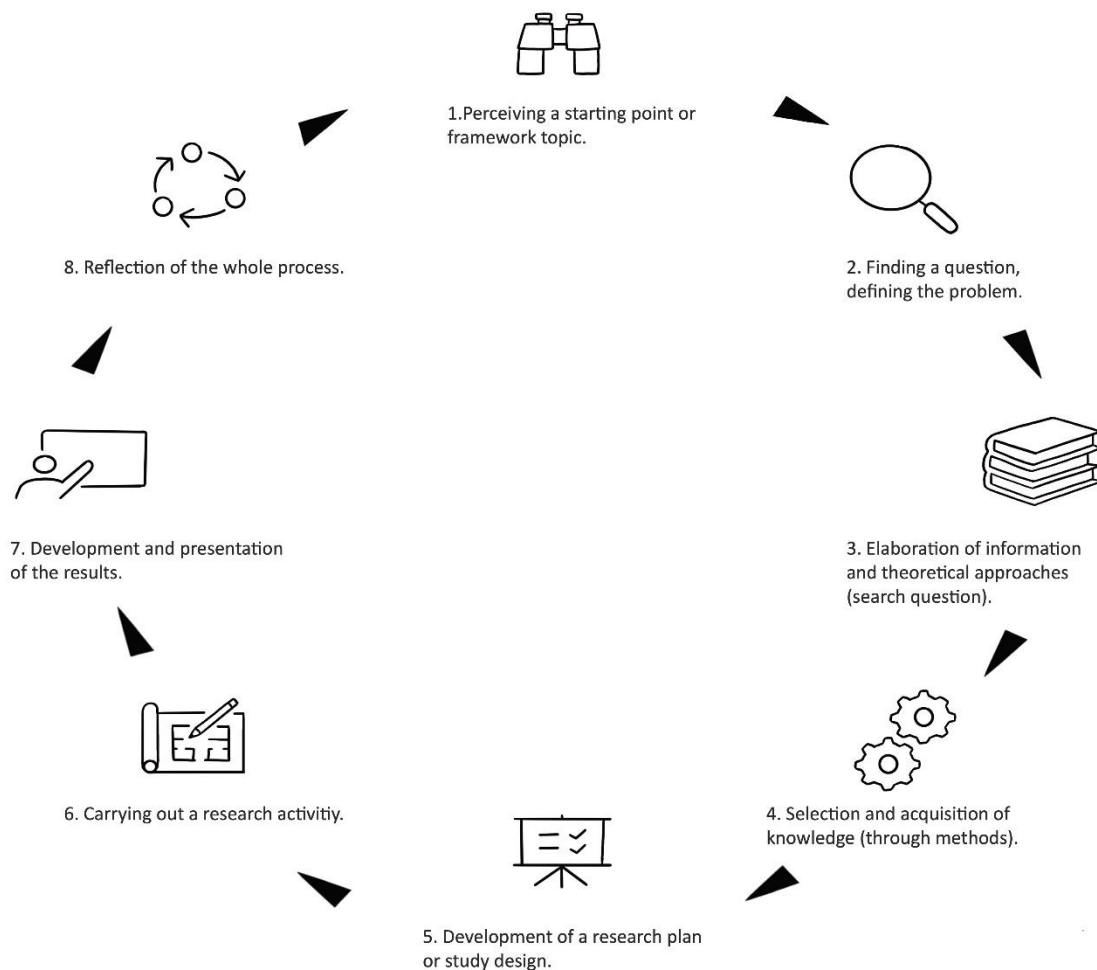


Figure 1: Ideal-typical research process according to Huber and Reinmann (2019, p. 92) (own figure)

RBL is considered an effective teaching format in higher education and is used in various disciplines, which is why Wessels, et al. (2020, p. 1) also describe RBL as a "panacea" in higher education teaching. This also seems to be the case for mature and independent student learning with AI-based tools. The complexity of RBL therefore ensures that students can only use AI-based tools selectively at different stages of their research. In RBL, students must be able to understand and link the individual research phases and their significance for the overall process. Otherwise, they will not be able to successfully complete the cycle and arrive at a coherent result. Accordingly, the research and visualisation tools presented before can be used very well to support RBL. In contrast, it is of little value for students to work with conversational agents, as these AI tools cannot adapt to specific and individual research. For example, it is of little use for students to have a text automatically generated

about an empirical method, because without independent engagement with this method, they will not be able to apply it correctly in their later research. Accordingly, RBL can help students to try out different AI-supported tools in the research process and to question them in relation to independent research or to stimulate an AI discourse on academic work between teachers and students. In this sense, RBL prevents misuse and lack of independent work among students. In terms of maturity, the students' own experience is particularly important here: during RBL, they practise first-hand how certain AI applications can either only produce superficial and unusable products or support the self-organised research process. This experience forms the basis for students to consciously decide for or against the use of selected AI tools without external guidance. In this way, and in the spirit of Kant, they begin to critically engage with new technologies, to question them and to deal with the possibilities in a mature and responsible way.

4. Conclusion

Based on Kant's reflections on enlightenment, the article analyses the extent to which selected AI applications have an impact on students' maturity. It shows that ITS and conversational agents tend to hinder the formation of critical thinking and independent action, while AI-based research and visualisation tools can have a positive impact on students' maturity. As a possible recommendation, AI-free zones in studies are presented, which create a balance between personalised learning on the one hand and the training of independence on the other hand in studies. The example of RBL also shows that complex teaching-learning settings in which students go through a complete research process can lead to a reflective and critical approach to AI-supported tools.

The article raises awareness of the dangers of AI-based tools and outlines possible solutions to ensure the maturity of students in the age of AI. To consider whether and to what extent AI tools pose a risk to the development of students' maturity in specific classroom settings, teachers can, as a first step, ask themselves the following reflective questions:

- How does an AI application prevent or enable students in my course to use their own minds without the help of others?
- How does an AI application avoid or help students in my course to analyse situations independently and critically?
- How does the AI application hinder or encourage students in my course to express their opinions publicly as active members of society?

If teachers then conclude that the use of AI applications can pose a threat to maturity, they can then consider whether any of the proposed solutions are appropriate to address this issue and/or whether the learning content can be linked to the RBL principle.⁶

In addition to these initial critical questions and the recommendation for action, further empirical studies are needed to investigate the design and implementation of AI-free zones to promote maturity or the link between RBL and AI-supported learning. Further research is also required on ethical issues in AIED (such as fairness, accountability, transparency, bias, autonomy, agency and inclusion), which may also be related to student maturity. It should be noted that the use of ITS or ChatGPT is only critiqued here from the perspective of Kantian maturity. In other settings or for other purposes, these AI applications may well be useful for higher education. It is therefore important to continue to explore theoretically the impact of AI on specific university goals and the ways in which students experience their studies with and without AI.

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⁶It should be noted that the study has a general orientation due to its educational-theoretical approach. Therefore, this paper should also be seen as a stimulus for further reflection and for teachers to consider the extent to which AI-based tools hinder or support students' critical and independent thinking and action in their courses. The same applies to the recommendations presented here. They are suggestions that need to be evaluated and concretised by teachers and educational researchers in relation to a specific university context.

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