A Philosophical Inquiry Into the Educational Impacts of Technology on Student Agency

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Abstract

In an effort to contribute to the philosophical investigation of a broad range of issues related to technology's application in educational contexts, this thesis addresses the question of how the use of technology impacts student agency. A complex of ideas regarding the two central concepts at issue— 'technology' and 'student agency'—are unravelled to offer a conceptual framework prior to being discussed together in a concrete case analysis. To begin with, three philosophical theories of technology—technological instrumentalism, technological determinism, and the postphenomenology of technology—are explored to elucidate different conceptual and normative assumptions that can be brought to bear when interpreting the roles and impacts of technology in educational contexts. The conceptual characteristics and/or limitations of these theories reveal the dynamic nature of human-technology relations and encourage us to seek out complex rather than simple answers to the research question. Then, four integral aspects of the concept of student agency— 'action', 'intention', 'reflection' and 'interaction'—are identified based on the broader philosophical conceptions of human agency as well as the multi-faceted conceptions of student agency developed by qualitative educational researchers. It is argued that these four aspects are closely related to broader educational aims, including both the morally and epistemically important ones, which highlight the significance of positioning 'student agency' as the point of reference and focus for the reflection on the technological impacts facing today's educational landscape. The multidimensionality of student agency again indicates that there is no simple answer to how technology impacts student agency. Finally, a case analysis of the impacts of artificial intelligence in education (AIEd) on student agency is developed to bring the conceptual ideas regarding 'technology' and 'student agency' together and to illustrate the value of this synthesized framework for studying technology's application in education.

Résumé

Dans le but de contribuer à l'investigation philosophique d'un large éventail de questions liées à l'application de la technologie dans des contextes éducatifs, cette thèse aborde la question de l'impact de l'utilisation de la technologie sur l'agentivité des étudiants. Un ensemble d'idées concernant les deux concepts centraux en question - la " technologie " et " l'agentivité de l'étudiant " - sont démêlées pour offrir un cadre conceptuel avant d'être discutées ensemble dans une analyse de cas concrets. Pour commencer, trois théories philosophiques de la technologie - l'instrumentalisme technologique, le déterminisme technologique et la postphénoménologie de la technologie - sont explorées afin d'élucider les différentes hypothèses conceptuelles et normatives qui peuvent être utilisées pour interpréter les rôles et les impacts de la technologie dans les contextes éducatifs. Les caractéristiques conceptuelles et/ou les limites de ces théories révèlent la nature dynamique des relations entre l'homme et la technologie et nous encouragent à chercher des réponses complexes plutôt que simples à la question de recherche. Ensuite, quatre aspects intégraux du concept d'agence de l'étudiant - " action ", " intention ", " réflexion " et " interaction " - sont identifiés sur la base des conceptions philosophiques plus larges de l'agentivité humaine ainsi que des conceptions à multiples facettes de l'agentivité de l'étudiant développées par les chercheurs en éducation qualitative. Nous soutenons que ces quatre aspects sont étroitement liés à des objectifs éducatifs plus larges, y compris ceux qui sont moralement et épistémiquement importants, ce qui souligne l'importance de positionner " l'agentivité de l'étudiant " comme le point de référence et le centre de la réflexion sur les impacts technologiques auxquels est confronté le paysage éducatif actuel. La multidimensionnalité de l'agentivité de l'étudiant indique à nouveau qu'il n'existe pas de réponse simple à la question de l'impact de la technologie sur l'agentivité de l'étudiant. Enfin, une analyse de cas des impacts de l'intelligence artificielle dans l'éducation (AIEd) sur l'agentivité de l'étudiant est développée pour rassembler les idées conceptuelles concernant la " technologie " et " l'agentivité de l'étudiant " et pour illustrer la valeur de ce cadre synthétisé pour étudier l'application de la technologie dans l'éducation.

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CHAPTER ONE: Introduction

1.1. Research Question and Approach

In this thesis, from the philosophical perspective, I address the research question of how the use of technology in educational contexts impacts student agency. There are two central concepts/variables at issue— 'technology' and 'student agency'. Accordingly, I adopt a two-layered conceptual approach to unraveling the complexities of these two variables. The first layer interrogates the different and potentially conflicting conceptual assumptions of the roles and impacts of technology in educational contexts; the second interrogates the essential aspects of 'student agency' and their connections with important aims or values of education. Then I bring these two layers together to clarify and answer the research question.

The three philosophical theories of technology that recur in the the scholarly literature in philosophy of education—*technological instrumentalism, technological determinism and the postphenomenology of technology*—provide the philosophical foundation for the first layer of interrogation. These three theoretical orientations represent and highlight several contending ways of understanding human-technology relations. Through exploring the major conceptual characteristics and/or limitations of these views, we gain close insight into the roles and impacts of technology in human life and human endeavors, particularly in educational contexts.

For the second layer, i.e., the layer of 'student agency', the philosophical foundation is a multi-faceted conception of student agency grounded in both broader philosophical conceptions of human agency and the multi-faceted conceptions of student agency developed by qualitative educational researchers. Based on this philosophical foundation we can identify and delimit four essential aspects of 'student agency'— 'intention', 'action', 'reflection' and 'interaction'—are identified, which can serve as the points of reference for us to capture the specific technological

impacts facing student agency. In addition, the concept of 'student agency' itself is also a point reference for the reflection on the values and aims of education, particularly because, as I will argue, the four integral aspects of student agency are closely connected to two important types of educational aims—the moral aim of promoting human flourishing and the ideal epistemic aims concerning propositional knowledge and perceptive or cognitive skills. In light of this, while this thesis focusses specifically on the technological impacts facing student agency, the conceptual exploration of student agency is meant to illustrate the value of this thesis for addressing a wide range of issues related to technology's application in educational contexts.

To bring the two layers together, I develop a case analysis of artificial intelligence in education (AIEd) to synthesize and test the conceptual ideas with respect to 'technology' as well as 'student agency'. More specifically, I analyze how AIEd interacts with the four aspects of student agency through the theoretical lens of the three philosophical conceptions of technology. AIEd is arguably one of the most pioneering, influential and thus controversial educational technologies of today. In this sense, this case analysis of AIEd does justice to the common concern over the educative use of pioneering technologies and hence addresses the conflict between the significant technological changes and the humanistic values in the conventional education.

1.2. Research Rationale and Significance

This section further elaborates on the rationale and significance of this philosophical research and is divided into two parts. First, I explain how my research question together with my two-layered approach help clarify the roles of technology in education and the valuable aims of education and why such clarification could address a wide range of issues. Second, I compare my thesis with the existing literature on education and technology to highlight my contribution.

1.2.1. Clarifying Aims of Education and Roles of Technology

The major significance of my philosophical discussion of how technology impacts student agency consists in its value for clarifying the valuable aims of education and the possible impacts of technology on these aims. But why the clarification of them is important and how can the two-layered philosophical approach help us clarify them?

The clarification of educational aims and possible technological impacts is important because it enables us to understand and address a wide range of issues related to today's educational landscape in which the presence of technology has become increasingly pervasive and influential. A growing body of recent educational research has focused on how to advance educational goals by taking advantage of the opportunities brought by available technologies, particularly emerging technologies such as artificial intelligence (AI), augmented reality (AR) and big data (see Baig et al., 2020; Dishon, 2017; Holmes et al., 2019; Marín et al., 2020). However, apart from the supportive strategies developed at the level of curriculum, pedagogy, policy and technological research and design, the success of such pursuits also requires a sophisticated and in-depth understanding of what the valuable aims of education are and how the use of technology would affect these aims, particularly because there are certain tendencies in public discourse about education and technology that are misleading, problematic and even harmful and ought to be avoided when we seek to use technology for educational good. For example, there might be a tendency for us to engage in confirmation bias—if certain technology happens to promote some value or facilitate certain skill I desire or hold dear, then I tend to consider the educational impact of this technology to be "valuable or positive". But what if the value in question is in fact only part of the educational picture and perhaps a relatively small and unimportant part? If so, there is a strong likelihood my confirmation bias will distort my

judgments about the real or full impacts of the given technology on education. A case in point is the use of personalized learning (PL) system, which is able to improve the efficiency of education in the sense that it frees students from the standardized and uniform learning trajectory (Pane et al., 2015). Arguably, the use of PL is efficient in promoting a number of skills that are widely taken to be indicative of educational success including, say, memorizing a poem within a short time because PL can quickly figure out which part of the poem this individual student needs to focus on most. In this case, people who value fast memory might elevate PL's educational value of efficiency while neglecting the possibly harmful impact of this same PL on other educational aims of which they are personally not aware. As Dishon (2017) points out, PL is "in the danger of concurrently intensifying the isolated nature of education" (p. 281); in this sense the educational efficiency promised by the PL system is achieved at the cost of social interaction which, however, is viewed by many educational scholars as one of the most important components of ideal education (Brighouse, 2006; Dewey, 1899; E. Robertson, 2009; Schutz, 2001). After taking the educational value of social interaction into consideration, it is difficult and irresponsible to determine in an immediate manner whether the PL system is a desirable educational choice. The educational aims by which we evaluate the 'educational impacts' of certain technology ought to include a host of capacities and not merely those that are popularly thought or assumed to be indicative of educational excellence. Therefore, for us to better evaluate the real educational value of certain technology, it is crucial to clarify what the valuable aims of education are and are involved in the use of certain technology and then to analyze how the specific technology's specific features impacts those different aims of education. As such, the clarification and analysis require a sophisticated understanding of educational aims and the roles of technology in education, especially because we often need to find out, in the given context,

which technological impacts prevail or whether certain educational aims are equally or more important than others.

My two-layered philosophical approach is intended to clarify the two major conceptual issues that matter here.

The first layer of my philosophical analysis seeks to clarify the concept of technology by capturing and comparing the three different conceptual assumptions and implications about the roles and impacts of technology in educational contexts. As I will argue, technological instrumentalism views technology as the neutral means which can be put into both good and bad educational uses, yet this theoretical orientation encourages us to hold humans solely responsible for any problems arising from the use of technology and encourages a possibly inflated sense of optimism towards human power. Technological determinism views technology as the ultimate determining force of education, which means that humans are no longer the decision makers of the goals and development of education; this determinist account provokes us to critically assess the choice of technology while overhyping the power of technology. Both of these two particular views seem to get into the idea of 'who controls who' when it comes to human and technology; as a consequence, each of them manages to capture an important dimension of human-technology relations while neglecting another. The postphenomenology of technology overcomes this limitation—it views technology as the mediator of student-teacher-world relations, and it views the impacts of technology as largely contextual, which deserve a sophisticated analysis. These three views can by no means cover all the understandings of technology's role in education. However, through an elaborate discussion and comparison of the conceptual characteristics and/or limitations of them, we will be more likely to capture any possible impacts

certain technology might have on our educational endeavors in a given context and hence we can be better prepared for them.

The second layer of the philosophical analysis seeks to clarify the valuable aims of education via a focus on the multidimensionality of 'student agency'. I select 'student agency' as the point of reference for the reflection on important educational aims mainly for two reasons. First, the promotion of student agency per se is a specific and desirable aim of education. Student agency is widely regarded as an attribute of prime importance for educational success (see Klemenčič, 2015; Marín et al., 2020; OECD, 2019; Vaughn, 2020; Zeiser et al., 2018). In a recent OECD report on the "future of education and skills 2030" (OECD, 2019), student agency is positioned as one of the seven elements of the learning compass for the future, one of the "point of orientations" that "help navigate towards the future we want" (p. 24) and "an invaluable skill that they (students) can and will use throughout their lives" (p. 32). Second, as I will elaborate in the thesis, student agency is closely related to major educational aims—the moral aim of promoting human flourishing as well as the ideal epistemic aims. Therefore, examining the technological impacts facing student agency will shed light on how technology impacts the broader educational aims. To capture the educational values embodied by student agency, first, I interrogate the broader philosophical conceptions of human agency in the works of philosophers including Harry Frankfurt, Charles Taylor and Sue Donaldson. There are two major points highlighted in their works—human agency is based on cognitive thinking and is also socially developed. Then I also interrogate the conceptions of student agency developed by qualitative educational researchers to position the philosophical conceptions in the educational context. Eventually, I identify four integral aspects of student agency—intention, action, reflection and interaction, and, as I reiterate, these four aspects are closely related to broader

educational aims. As such, the discussion of student agency serves well as a point of reference for us to understand what the valuable aims of education are. Next time when we want to evaluate the educational value of certain technology, we need to fully assess its impacts on many dimensions—at least on four aspects of student agency.

Philosophical analysis is believed to supply the "(conceptual) resources for thinking better about the goals or values that decisions are, or should be, trying to achieve" (Brighouse et al., 2018, pp. 1-2). Therefore, this two-layer philosophical inquiry into how technology impacts student agency is expected to provoke us into rethinking the questions regarding the specific educational blueprints made at different levels and involving different stakeholders—to name a few, whether the school management or governmental authorities should consider spending a large portion of budget on the procurement of advanced technologies for schools, and what kind of technologies are desirable; whether it is imperative for educators to redesign the pedagogy and curriculum simply to accommodate the use of a new technology and what would be the focus; whether students' access to technology should be eased or restrained on and off campus; or, why the actual incorporation of technology into the classroom falls short of the ambitious vision and promises which motivate or justify the technological reform or investment in the educational field. The critical reflection on this series of questions is of great significance for both educational research and practice, especially in this post-pandemic era when technology is expected to play an ever more important role given the normalization of remote learning and teaching.

1.2.2. Addressing the Research Gap

The technological impacts facing student agency or the whole educational landscape deserve more philosophical attention than the existing literature has provided, and this thesis

seeks to address this problem. There is no dearth of research which discusses the application of technology in education, yet few of them manage to do justice to the conceptual complexities of technology.

For example, Marín et al. (2020) develop a framework which relates student agency with various features of technology-enhanced learning to back the idea of using educational technologies to support the development of student agency in higher education. This framework is built upon 29 studies in educational sciences, covers a wide range of specific educational technologies and highlights the multiple aspects of student agency. However, its assumption about the roles of technology is still inadequate—it only sees technology as an enabling instrument for the educational aims of student agency while underestimating the possibility that technology might change or obstruct those aims per se. For example, in this framework, the collaborative learning technology is highlighted as a means of supporting social relationship, an important aspect of student agency. Yet what if certain features of the collaborative technology make the social relationship built via this computer-based platform different from or less desirable than the relationship built via, say, face to face interaction? In other words, we cannot take it for granted that the use of technology is only conducive to the results promised by its name or functions; instead, we must critically anticipate, discern and evaluate all possible impacts brought by the use of technology in order to take best use of the given technology. My exploration of the three philosophical views of technology addresses this concern and provides a set of conceptual resources for us to capture the possible impacts of technology.

Indeed, examining the different philosophical conceptions of technology for educational research and practice is nothing new. Blacker (1994), for example, briefly discusses technological instrumentalism and technological determinism while arguing that a critical

synthesis of both positions would help educators rethink and reform their technology-related curriculum design and pedagogical imperative. He elaborates this critical theory elsewhere (Blacker 1993) and builds it upon the Deweyan argument that technology must be contextually defined and technology can enrich student experience if allowed and properly managed by educators (Dewey, 1994). Thus, Blacker (1993) ends up highlighting that "one's underlying beliefs regarding the aims of education are in this way the real determinants of the educative use of educational technologies" (p. 193). In this sense, Blacker' s conclusion in fact assumes technology to be the educational means which are independent from educational aims; the use of educational means is supposed to be directed by educational aims. It is hence implied that technology deserves less attention than the discussion of educational aims because the latter is more important and determines the former. It seems to me that this claim remains insufficiently critical of technological instrumentalism which Blacker attempts to criticize because it still underestimates of the potential for technology to overwhelm human critical capacities and therefore to harness them for imperatives that remain beyond the scope of rational reflection. As such, Blacker's attempted synthesis oversimplifies the relationship between technology and educational aims. Imagine what if technology per se can impact or shape educational aims?

Blacker's limitation is perhaps understandable because his points were made almost three decades ago. The technological landscape of today is drastically different. Technology has arguably become the "skeleton" and "infrastructure" integral to our contemporary life and has "penetrated into the depths of who we are, into our bodies and our communicative relations" (Böhme, 2012, pp. 5-7). The technologies we use every day are increasingly advanced, sophisticated and thus influential. Clearly, technology deserves more philosophical attention, and we need an up-to-date discussion of more theories to reveal the complex and dynamic human-

technology relationship. This research gap is particularly addressed by my exploration of the postphenomenology of technology, a theory developed recently and situated within the contemporary technological landscape. The postphenomenological account of technology also offers a framework for discerning, describing and evaluating the educational impacts of specific technologies. Furthermore, a concrete case analysis of artificial intelligence in education (AIEd)—one of the most pioneering and significant educational technology of today—will be developed to synthesize and test how the conceptual ideas I explore within the thesis can be applied to the issues related to contemporary technology and education.

In the following and the final section of this introduction, I will briefly preview the major themes covered by each following chapter of the thesis.

1.3. Thesis Structure and Major Themes

After this chapter of 'Introduction', in chapter two, the concept of technology is unraveled. Three views of technology recurring in the scholarly works of philosophy of technology—technological instrumentalism, technological determinism, and the postphenomenology of technology—are explored to cast light on the role that technology plays in human life. These three philosophical views of technology offer starkly different answers. Technology is considered as either a passive instrument controlled by humans, or an independent and determining force controlling human life in the other way around, or a mediator of the relationship between humans and the world they are in. It is in exploring the major conceptual issues and limitations of these views that I argue that the former first two views fail to fully capture the valuable dimensions of human-technology relations and reduce the dynamic and complex nature of such relations into an oversimplified causal relation; nevertheless, the third view, namely, the postphenomenology of technology overcomes the shared problems of the them

and provides a critical and systematic framework for analyzing the impacts of specific technologies.

Chapter three seeks to demystify and conceptualize another central concept in this thesis—student agency. Drawing ideas from the philosophical conceptions of agency, I identify four essential aspects of student agency—intention, action, reflection and interaction. These aspects are then confirmed with the multifaced conceptions of student agency developed by qualitative educational researchers—which are based on sociological, psychological and educational theories—to ensure a meaningful and defensible account of student agency. In addition, I also elucidate the close relations between these four aspects and the broader educational aims, including the moral aim of promoting human flourishing as well as the ideal epistemic aims of education concerning propositional knowledge and perceptive and cognitive skills, which indicate that the concept of student agency and my conceptualization could cast light on a wide range of issues related to technology's application in education and hence highlights the significance of positioning the concept of 'student agency' as the point of reference for the reflection on technological impacts.

Then, in chapter four, I develop a concrete case analysis of the impacts of artificial intelligence in education (AIEd) on student agency to synthesize and test the conceptual ideas regarding 'technology' and 'student agency' together and to illustrate the value of this synthesized framework for studying technology in education. This analysis encourages us to seek complex rather than simple answers to how the use of educational technologies such as AIEd impacts student agency and suggests that we conduct the inquiry constantly given that the user contexts are ever shifting.

Chapter five is a conclusion of the major ideas, implications and limitations of this thesis.

Before proceeding to chapter two, I would like to clarify two minor issues regarding the scope and wording of ‘technology’ in this thesis, which otherwise would probably be confusing. First, in this thesis, technology is not merely referred to the educational technology incorporated into the classroom; instead, my discussion includes any technology which has educational functions and can be used by students on and off campus such as an iPad. This is because, as Brighouse (2006) puts it, “only part of a child’s education occurs at school, while much else occurs in the home environment and in all sorts of informal ways outside the school” (p. 6). Literacy is constructed and reproduced across a variety of domains (Pahl & Rowsell, 2012). Second, I use both the singular and plural forms of ‘technology’ alternatively; the singular form ‘technology’ normally refers to the general and abstract concept of technology while the concrete technological devices or applications are represented by the plural form ‘technologies’.

CHAPTER TWO: Exploring Philosophical Theories of Technology

The investigation of how technology impacts student agency entails the unraveling of complexities in the concept of technology, particularly in the educational context. More specifically, in philosophical discussions of technology there is no single interpretation of the role and impact of technology. Instead, I find a number of different and potentially competing conceptions. This chapter examines three theoretical orientations—*technological instrumentalism*, *technological determinism* and *the postphenomenology of technology*—that recur in the scholarly literature in philosophy of education. Technological instrumentalism and technological determinism are two contending views of technology recurring in the literature of philosophy of technology and are traditionally deemed as the classic and common-sense theoretical approaches to technology (see Blacker, 1994; Borgmann, 1984; Feenberg, 1999; Verbeek, 2005). However, either technological instrumentalism or technological determinism only captures one important dimension of human-technology relations yet underestimates the value of the dimension captured by the other, and thus both these two classic approaches have conceptual and normative limitations. The postphenomenology of technology is a critical theory of technology that has been formulated by contemporary Dutch philosopher of technology Peter Paul-Verbeek (2005, 2011) to bridge the two dichotomous views and overcome their limitations.

The purpose of elucidating these three theoretical orientations is to highlight several different, potentially conflicting, ways of understanding technology's role in human endeavors, particularly endeavors related to technology's roles in education. Accordingly, the chapter is divided into three major sections, each of which focusses on a single major philosophical conception of technology. The first two sections on the two classic theoretical conceptions are structured as follows: first, I highlight the major conceptual characteristics of the classic

conception in question; second, I discuss the major question arising from this conception by identify its limitations; third, I note some broad implications of this perspective in question for education. For the third section on the postphenomenology of technology, I first elaborate on how it overcomes the shared problems of the two classic approaches, and then I explain how it provides a systematic framework for us to capture the dynamic roles of technology and to evaluate the educational impacts of specific technologies.

2.1. Technological Instrumentalism

2.1.1. Conceptual Characteristics of Technological Instrumentalism

Technological instrumentalism depicts an ostensibly conceptual and causal relation between technology, on the one hand, and human agents or users of technology, on the other—human users are understood to be able to direct and control technological tools in whatever way they prefer, while technology is conceptualized as the instrument "affording possibilities of which we can avail ourselves for better or worse" (Borgmann, 1984, p. 10). In other words, technology is understood as the neutral means at the full disposal of humans—it can be put into good or bad use by humans. This instrumentalist account of technology can be further analyzed into two distinct but related components—the 'functionality of technology' aspect and the 'value neutrality of technology' aspect.

2.1.1.1. Two Conceptual Components: Functionality and Value Neutrality

First, technological instrumentalism highlights the functionality of technology. For technology to be the functional 'instrument' that serves human purposes, it must prove to be useful in the sense that it creates new possibilities which bring humans closer to their goals. This understanding and portrayal is so common that technological instrumentalism is long deemed as a classic and common-sense view of technology (Blacker, 1994; Verbeek, 2005). Indeed,

technology tends to impress us with its useful functions and the new possibilities it brings. As Böhme (2012) puts it, from the outset of modern scientific and technological development, what stood in the foreground was technology's role in "extending the range of the humanly possible" (p. 18). Obviously, for example, without the video-conference technology and its applications, it is impossible for us humans to conduct remote learning or working from home amid the COVID-19 pandemic. This functionality aspect of technological instrumentalism emphasizes the functional 'use value' of technology; furthermore, it also encourages us to see usefulness as an inherent and undeniable part of the nature of technology as an instrument and not merely as a conceptually separable consequence or outcome of technology. Although technology may sometimes fail to serve its intended purposes (e.g., the video-conference software crashes or is used only for casual conversations all day long rather than learning), the misuse or 'brokenness' of the tool is attributed to something other than the tool itself—chance or human failure for example.

This assumption is closely related to another aspect of technological instrumentalism—the value neutrality of technology. From the instrumentalist perspective, technology is essentially neutral with respect to the values, aims or purposes it serves and disserves. In fact, the supposed value neutrality of technology is the key thesis of technological instrumentalism (Franssen & Koller, 2016), which means that, the 'value neutrality' aspect is what distinguishes technological instrumentalism from other theoretical orientations (e.g., according to the postphenomenology of technology, technology is functional yet non-neutral). Furthermore, as we will see later, the neutrality thesis is the premise of the major implications of technological instrumentalism—it encourages the optimism towards both technology and human power over technology. Feenberg (1999) defines the value neutrality of technology as "the complete separation of means and ends"

(p. 9), which emphasizes that technology is not embedded with its own ends (purposes); instead, the purposes are determined by humans and are thus external to technology. This way, technology does not have a predetermined track on its own to follow; instead, from an instrumentalist view, technology per se is merely the passive means used by human beings for a variety of ends—be they good or bad (Pitt, 1999; Tiles & Oberdiek, 1995; Verbeek, 2005). In other words, according to proponents of technological instrumentalism, technology can be compatible with the pursuit of any purposes—it is not more conducive to certain outcomes than to others. For example, some students mainly use an iPad for certain serious educational purposes including reading, notetaking, information searching, etc., while others treat it more as a video game console. From the instrumentalist view, an iPad does not have its own purposes, and hence neither the educational purposes nor the recreational ones are its own ends. Instead, it can be compatible with both or more. Also, it is suggested that the impact of using the technology is totally subject to the specific aim that humans use it for and the specific way that how they use it. After all, the studying time of a student can increase and reduce with the use of iPad, depending on how the student uses it. The neutrality aspect is also in line with what many people accept as common sense. For example, Feenberg (1991) mentions that the proverb "it is a poor carpenter who blames his tools" is a typical illustration that highlights the neutrality of technology.

2.1.1.2. The Emphasis on Human Responsibility

As we can see, the above two conceptual dimensions—the functionality and the neutrality of technology—together offer an optimistic account of technology—technology is inherently useful and faultless. Even in cases where technology fails to function, its inherent functionality remains conceptually intact, at least when we view technology in purely

instrumental terms. And when the use of technology results in undesirable consequences, according to the instrumentalist account of technology, "the fault lies with its human operators and developers, not with the technology" (Tiles & Oberdiek, 1995, p. 11). Or as Swer (2014) puts it, "value-considerations (political, ethical, etc.) are external to technology itself" (p. 201). Therefore, many philosophers suggest that technological instrumentalism is leaning in favor of an optimistic attitude towards technology (see Feenberg, 1991; Scharff & Dusek, 2014; Tiles & Oberdiek, 1995).

As such, when certain problems arise from the use of technology, instrumentalism encourages us to seek explanations for such problems mostly from the human side—it encourages the interrogation into human intentions, strategies and efforts while the technology per se is absolved from facing responsibility or scrutiny. Some philosophers suggest that it was the popularity and the profound influence of instrumentalism that prevented the ethical studies of technology from developing until the twentieth century even if technology had exerted a tremendous impact on society since the industrial revolution (Franssen et al., 2018). For example, if a student's academic performance sharply declines after he owns an iPad, certain possible explanation as indicated by instrumentalism are as follows: the student himself fails to use the iPad properly; or the developers of iPad design it as an addictive technology which they should not. In other words, according to instrumentalism, when none of the relevant human stakeholders make any errors, it is barely possible for the iPad to distract the student from fulfilling the learning tasks. This call for the reflection on human intentions or human use of technology and the emphasis on human responsibility are the recurring and salient arguments of the proponents of technological instrumentalism. For example, in Karl Jaspers' *The Atom Bomb and the Future of Man* (1963), a philosophical work with strong instrumentalist views, the

danger caused by technology including the atomic bomb and its abuse is portrayed as a consequence of humans' failure to check and handle the progress of technology. This is because, in this book, Jaspers (1963) reiterates that technology is nothing more than a neutral means which serves human goals because it is incapable of generating its own goals, and thus he held human beings accountable for what they make of technology in the first place. In sum, technological instrumentalism encourages the belief that any problems arising from the use of technology should be attributed to human failures.

2.1.1.3. The Optimism Towards Human Power

Furthermore, this emphasis on human responsibility is also accompanied by an expansive sense of confidence in human power over technology. After all, if humans are not confident in their ability to fully control technology in their own favor, it makes little sense for them to hold themselves solely responsible for whatever the technology really offers. As Jaspers (1963) argues, humans have total control over technology, and even though from time to time technology seems to be out of human control—which is not according to technological instrumentalism—humans can always reclaim and exercise their sovereignty over technology by thinking with reason and using technology responsibly; and in this way humans have the full agency to influence the world and history. Blacker (1994) also indicates that, according to instrumentalism, "individual or collective human agency is the locus of all valuation and therefore not the device itself" (Blacker. 1994, p. 3). Similarly, as Tiles and Oberdiek (1995) put it, from the instrumentalist perspective, technology "plays an entirely passive role in the human exercise of power and control" (p. 12). With such conviction in human power, instrumentalists encourage humans to wield their power and harness the power of technology for the sake of their ambitions including economic prosperity, scientific discovery, historical progress, etc. Feenberg

(2003) suggests that the instrumentalist view serves as an inspiring statement capturing the imagination of modernization progress in human history and as an approval of human exploitation of the world. In other words, in instrumentalism, human power is not merely acknowledged and encouraged—it is even celebrated. As such, technological instrumentalism encourages a wave of optimism towards humans' power to fully control technology. This optimism further explains why the instrumentalists only hold humans responsible for the problems of using technology

But in times of rapid and quantitatively explosive expansions of technology in human life, such optimism towards human power expects and believes human beings to wield their power to control and make perfect use of technology for their purposes, and thus it places a great deal of pressure on capacities of 'human responsibility', 'human reason' and "human control over technology'—perhaps more than actual human beings and societies can bear in many cases. In other words, it seems that the optimistic sense of human power facilitated by the instrumentalist account of technology is probably exaggerated or distorted. At least for those who support gun control, it is. The reason why the anti-gun groups support gun control is that they do not trust in humans' ability to use guns properly, or in other words, they are extremely pessimistic about the power of humans to control technology. Neither do they believe that gun per se is neutral or blameless—they do not buy the narrative of 'guns don't kill people, people do". For them, it seems that the existence of gun makes it more likely for humans to commit violence—which is diametrically different from the instrumentalist account of technology—neutral and thus blameless. At least from where they stand, technological instrumentalism is problematic. In the next section, I will discuss the major question arising from technological instrumentalism which points to the limitations of this theory.

2.1.2. Major Question Arising From Technological Instrumentalism

Technological instrumentalism depicts technology as a functional and neutral instrument at the full disposal of humans, and thus it places an emphasis on human responsibility and encourages an optimistic attitude towards human power over technology. This instrumentalist account of technology is not exempt from criticism. A series of questions can arise including, to name a few, 'is technology compatible with any human purposes?', 'what will happen if humans hold themselves solely accountable for any problems emerging from the use of technology?', 'are humans able to fully control the use of technology in their own favor?' All these questions point to one central question—is technology really neutral? This is because the neutrality of technology is the key thesis of technological instrumentalism and the premise of the optimistic account of technology as well as the confidence in human power. If technology is not neutral or in other words is more conducive to certain purposes than others, it does not make sense for humans to only seek explanations from themselves any longer. Accordingly, they should also examine whether certain features of the given technology make it more likely for certain problems to take place or, at the very least, make it more likely for its human users to 'fail' or 'misuse' it. Without identifying and curbing such tendencies, it is a delusion for humans to think that they can fully control how the given technology works.

Then, is technology neutral? The answer is 'no' according to many philosophers, especially the technological determinists, as we will see later. But in the following paragraphs of this section, I seek to outline the logical reasoning behind the criticism of technological neutrality and focus on one salient argument against technological instrumentalism provided by the famous philosopher of technology Albert Borgmann. In this way, we can better understand

the theoretical limitation of technological instrumentalism and are better prepared for the other two theories that follow.

Let us start with the general logical reasoning behind the criticism of technological neutrality. According to Franssen et al. (2018), if technology is used as the instrumental means to certain end, it functions in a way that favors certain goals rather than other goals, and this connection between technological artifacts, functions and goals makes the neutrality of technology impossible (Franssen et al., 2018). The logic of this argument goes like this: technology is useful but is not omnipotent, and thus the functions of technology are limited to only a certain few; every time we attempt to achieve certain goals through the use of certain technology, we are actually acknowledging that the specific functions and features of the given technology can influence and change our life in a certain specific way; and in that way we are brought closer to our intended goals other than other goals. As such, depending on the specific functions of the given technology, certain goals are more likely to be achieved than others. In other words, certain ends rather than others seem to be embedded into the technology; technology as the means are not entirely separated from the ends embedded within it; thus, technological neutrality does not exist. For example, if a smartphone has the video-call function, then it is possibly used as a means of enabling video calls rather than, say, encouraging communication via handwriting letters.

In addition, the non-neutrality of technology can also be observed when we take a closer look at what happens once people start using technology. Whenever technology functions to influence and change our life in a certain way for us to achieve our intended goals, all the changes and influences along the way, momentous or meager, also trigger other changes which are unintended and unnoticed by the user. Some of these changes may be intended by other

human stakeholders of the technology such as the designer of the technology while other changes may not be intended by any human party. In the latter case, these changes do not stem from the intended goals of humans; instead, the mechanism which provokes these changes is already there within the technology before the humans chooses to use or market it. In this sense, technology seems to have its own reckoning and goals, which render futile any pledges of technological neutrality.

The renowned philosopher Albert Borgmann further theorizes and sheds light on the implausibility of technological neutrality. In his magnum opus, *Technology and the Character of Contemporary Life* (1984), Albert Borgmann develops a theory called "device paradigm", in which devices refer to the sophisticated technologies which "are instrumental in attaining conveniences [and]…are designed to vanish from consciousness and work in ways unknown to the average user" (Ferré, 2001), in contrast with the more traditional tools. As per the device paradigm, on the one hand, technology's functionality seems to disburden us from the everyday hardship and toil by functioning as an instrument almost entirely on their own. Nevertheless, on the other hand, it also disengages us from the nature and lifeworld around us by deskilling us without requiring us to take effort on our own. By contrast, the less technological tools invite humans to be part of the task to be done, thereby offering the irreplaceably good "focal things" in Borgmann's phrases, the experience with which "is always and also a bodily and social engagement with the thing's world" (Borgmann, 1984, p. 41).

The discrepancy between a hearth and a central-heating system is one of Borgmann's most classic illustrations on focal things vs. devices. A hearth, as a focal thing, brings warmth in a comprehensible way and people interact with the world around them and each other while engaging in all the steps of using it:

> In calling forth a manifold engagement, a thing necessarily provides more than one commodity. Thus a stove used to furnish more than mere warmth. It was a focus, a hearth, a place that gathered the work and leisure of a family and gave the house a center… It assigned to the different family members tasks that defined their place in the household. The mother built the fire, the children kept the firebox filled, and the father cut the firewood. It provided for the entire family a regular and bodily engagement with the rhythm of the seasons that was woven together of the threat of cold and the solace of warmth, the smell of wood smoke, the exertion of sawing and of carrying, the teaching of skills, and the fidelity to daily tasks…Physical engagement is not simply physical contact but the experience of the world through the manifold sensibility of the body. That sensibility is sharpened and strengthened in skill. Skill is intensive and refined world engagement. Skill, in turn, is bound up with social engagement. It molds the person and gives the person character. (Borgmann, 1984, pp. 41-42)

However, the central-heating system sends warmth to every corner of the house in an invisible, efficient and automatic way. "When devices fill our lives, we are reduced to disengaged consumers of the commodities these devices provide" (Strong & Higgs, 2010, p. 28) and thus we would no longer bother to establish ties with where we live and whom we live. As a consequence, the machinery of technology "has obviated the forms of human engagement that a [focal] practice entails" (Haworth, 2010, p. 56) and the use of technology would devolve into the procurement of a commodity, like what Borgmann (1984) describes:

> A device such as a central heating plant procures mere warmth and disburdens us of all other elements. These are taken over by the machinery of the device. The machinery makes no demands on our skill, strength, or attention, and it is less demanding the less it makes its presence felt. In the progress of technology, the machinery of a device has therefore a tendency to become concealed or to shrink. (p. 42)

When it enables and favors a lifestyle of enjoying warmth effortlessly all over the place, the central-heating system is no longer a neutral instrument, even though it is invented and used as an instrument. It is used to bring warmth in a more convenient and stable way, and therefore obsoletes the practice of the whole family chopping wood from the wild and stoking the hearth together, which might disengage family members with each other and nature as Borgmann argues. In addition, the prevalence of central-heating systems can trigger many more changes and outcomes other than the disengagement effects raised by Borgmann. To name a few, the layout of the most common houses might be dramatically changed as a result of no need for a large space to install the hearth anymore; those who profit from providing hearth materials might face an economic crisis while the mass producers of the fuel perfect for central heating systems would probably make a fortune. Apparently, users of the central-heating system mainly want to enjoy warmth, and they are very unlikely to include the reshaping of interpersonal relationship, architecture style and even the economy into their goals. In this sense these changes are brought out by goals embedded into the technology. Therefore, with this series of great changes underway, a central-heating system is more than a value-neutral instrument for warmth, it functions in favor of certain goals or outcomes rather than others.

Similarly, for even the most common technological device or application, if we conduct an impact analysis, we are very likely to identify the possible changes caused by the specific technology. A microwave oven is found to "facilitate a particular kind of meal, the frozen, ready-made kind that can be "prepared" in a short period of time and for a single person, [and] it promotes such meals amongst its users, thus fostering a change in eating habits in which fewer are taken in company and more are eaten solo" (Verbeek, 2005, p. 6). The use of a washing machine may increase the standards of cleanness and may actually result in more household burden and responsibility, and at a time when gender inequality is pervasive, this increased burden falls mainly on women (Cowan, 1983; Slack & Wise, 2005). The list can go on and on. And this is certainly true for technologies in the educational context. The ever more pervasive presence of computers or computer-based technologies in the classroom might disengage students from their peers. At the beginning of the COVID-19 pandemic in 2020, most of the educational institutions across the world ranging from kindergartens to universities were all forced to carry out remote or online learning and teaching. In this context, we have sufficient reasons to believe that educators simply want to replicate their usual teaching as much as possible with the help of technology rather than embed some additional purposes in the use of technology—in other words, technology is intended as a pure instrument for human purposes. But still, the technology-based education amid the pandemic brings unintended changes and challenges. In an interview with CBC[1] soon after the lockdown procedures across Canada were put into place, Alex Usher, the president of Higher Education Strategy Associates in Toronto pointed out that teaching and learning with things (computers/internet) differs greatly from teaching and learning with people in terms of how the lessons should be pedagogically designed

[1] CBC (Canadian Broadcasting Corporation) is the oldest existing broadcasting network in Canada.

and how students actually experience with the learning[2]. Similarly, as mentioned in introduction, many educators believe that the personalized learning (PL) system can improve the efficiency of education in the sense that it frees students from the standardized learning trajectory (Pane et al., 2015), but it is also believed to be "in the danger of concurrently intensifying the isolated nature of education" (Dishon, 2017, p. 281), which can be explained in terms of Borgmann's 'device paradigm'— PL is a device offering the convenience of personalized learning and meanwhile promoting the interaction between human students and their computer tutors, which, consequently, disengages students from interacting with their human peers and human teachers.

Although empirical studies are needed to confirm whether the use of central-heating systems, microwave ovens, washing machines, remote learning technology or PL system would result in actual changes as discussed above, the point of the above philosophical reasoning is that the instrumentalist account of technology together with its assumption of technological neutrality are problematic if considered on its own in isolation from other alternative theoretical orientation—it oversimplifies the role and power of technology. As we can see, once humans start using technology for their intended goals, it functions to achieve those goals, but it would not just stop there; instead, it would continue causing a series of outcomes— for example, it might disengage the users from others and the environment as Borgmann highlights. Some of these outcomes may be a far cry from what humans truly intend while others may be neglected for now yet with profound influence to be revealed, which provoke us into rethinking whether humans can truly control how technology works. In this sense, if humans only seek human failure-related explanations for problems arising from the use of technology, they might have difficulty identifying the real or deeper reasons or figuring out the most effective solutions. And

[2] See Galloway (2020).

if humans still immerse themselves in the optimism and delusion that they own the power to hold technology under total control, they are actually underestimating the power of technology; in that way they might not be fully aware and wary of the potential impacts of technology and hence miss the opportunity to prevent the unintended impacts before it is too late.

For example, as mentioned earlier, in Jaspers' (1963) instrumentalist account of atomic bomb, he argues that the danger of developing this weapon of mass destruction lies only in humans' mishandling of it and humans are completely able to use it right. But why would people spend so much time talking about how humans should take efforts to handle the atomic bomb properly? If the technology under discussion is a toy bubble gun, we would not find it imperative to write a book and caution against human failures. One possible explanation is that the atomic bomb is more likely to be used as a means of creating catastrophic destruction rather than happy times with soap bubbles, while the opposite goes for the bubble gun; it is the possibility of catastrophic destruction that concerns us. Another explanation is that people find the existence of atomic bomb to be more likely for its human users to make huge mistakes; if the saying that 'power tends to corrupt, and absolute power corrupts absolutely' is true[3], then the apocalyptic power of atomic bomb—either the power of military destruction or the power of political corruption—is more likely to put human civilization in danger. Such severe consequences are unlikely to happen due to a bubble gun. Both the two explanations question the neutrality thesis and indicate the problems of the accompanying optimism toward technology and human power. If we let this instrumentalist account of technology encourage us to keep searching for reasons for the danger of atomic bomb only from the human side, to believe in our power to eventually

[3] This well-known was a comment in a letter written by Lord Acton (whose full name was John Emerich Edward Dahlberg Acton), an English historian who lived from 1834 to 1902 and a fierce opponent of state power, whether the state was democratic, socialist or authoritarian. (Martin, 1998)

solve the problems and to find nothing wrong about the very existence of the atomic bomb, we would never ever consider the possibility that the apocalyptic power of atomic bomb is probably beyond human control, and it should never exist. I do not mean to argue for the denuclearization here—which must be based on arguments on a larger range of levels—but my point is that the instrumentalist account of technology discourages us from considering denuclearization as an option or looking forward to its possibility. Acknowledging the non-neutrality of technology enables us to conduct a thorough review of the atomic bomb, to weigh its perils against its promises, and to make well-informed decisions about the future of our planet.

2.1.3. Implications of Technological Instrumentalism for Education

The above conceptual discussion on the characteristics of technological instrumentalism highlights three key ideas: first, according to technological instrumentalism, technology is functional as well as neutral; second, technological instrumentalism suggests that humans hold themselves responsible for any problems arising from the use of technology; third, technological instrumentalism encourages an inflated sense of optimism towards human power over technology. Also, I underline that the major conceptual limitation of technological instrumentalism lies in the implausibility of the neutrality of technology. Accordingly, it seems that the whole instrumentalist account of technology underestimates the power of technology in human life. In this section, I apply all these three key ideas together with the conceptual limitation to understanding the role of technology in the educational context from the instrumentalist perspective.

First, the two conceptual components of technology—the functionality and the neutrality of technology—suggests that technology's role in education should be understood as the neutral means which can be put into good or bad educational use by humans. In other words, from the

instrumentalist view, technology is compatible with any educational aims or values pursued by humans; yet the existing educational aims and values are independent of the technology and hence will never be changed or influenced by the certain technology in use. This instrumentalist logic is often implicit in the advocacy of the educational use of what may be stereotyped as an inappropriate or even undesirable choice of educational technology. For example, a video game console might not seem to be an ideal or relevant educational technology for many people, especially those who view students' enthusiasm for video games as a major threat to their educational activities. However, from an instrumentalist view of technology, a video game console does not "contain" its own ends, and thus can not only be compatible with purely recreational purposes but also be suitable for many educational uses, including the most important educational needs, depending on the intentions of different users. The learning objectives can be converted into the tasks assigned to the characters in the video game, and then students can choose their own characters, undertake different roles and get engaged in the gamification of learning activities. As Annetta (2008) suggests, research literature on video games reinforces the notion that "if one pairs instructional content with certain game features, one can harness the power of games to engage users and achieve desired instructional goals" (p. 237). The key point of this claim/conclusion is that, if used properly by humans, the video game console can function as an engaging and instructive educational means and well serve for educational purposes, and there is no presupposition or value judgement of it as good or bad educational technology.

Therefore, from an instrumentalist perspective, when certain problems arise from the using of certain educational technology, the only thing humans need is self-inspection, which is the second key idea we derive from the analysis of technological instrumentalism. For example,

if the public speaking skills and reading skills of students decline with the use of certain videogame-based educational technology, the instrumentalism encourages us to seek explanations or solutions only from the human agents. We assume the poor public speaking skills to be a result of the teachers' failure to incorporate the videogame-based technology into their pedagogical practices well enough, the students' failure to play this educational game properly, or the developers' failure to design this game with more educational functions. However, obviously, such blame is too unfair and absurd. In light of this example of video games, one might wonder of course how far the instrumentalist claim about the supposed independence of educational goals from technological means can be sustained in practice. If video games are an available option in classrooms, one might expect that teachers and students may choose different game genres, different character choices within specific games, etc. All the students need to do is to promptly interact with an ever-changing screen. In this way, it might equally seem that the content of educational goals will inevitably shift and change insofar as video games become the preferred or required mode of learning as opposed to, say, immersive reading of novels or other forms of literature, or the practice of speaking in front of real audience. If so, the possibility of engaging in deep, slow, careful reading of texts or public speaking becomes more remote. In this sense, it is so difficult for the human agents to train their skills of in-depth reading or public speaking with the use of video game that video games simply cannot be regarded as a neutral means compatible with any educational purposes; instead, video games become modes of learning that restrict and determine what learning goals are possible. Then how could we attribute the problems arising from such a non-neutral technology to human agents' misuse of it?

Similarly, the third key idea, which is the optimism towards human power over technology can also be implausible and even dangerous, especially if humans are encouraged by

this optimism to confidently and actively incorporate new technologies into the classroom and find nothing wrong about it. However, there does exist a bright side of such optimism—it to some extent encourages educators to explore and capitalize on any potential educational value of the technology they have in hand. John Dewey, for example, provides a prominent illustration of the instrumentalist conception of technology which highlights the paramount importance of making the most of any technologies' potential. While exploring the possibilities of occupational education in *The School and Society* (1899), Dewey expresses approval of the idea that even the most commonplace and banal tools and technologies could have inexhaustible educational potential and could bring about impressive educational value. He emphasizes that, for educational purposes, there exist no inherently good or bad technologies; only good and bad human uses exist. Good educative uses of technologies do not arise from thin air. Just because human beings can control the use of technologies does not mean that humans can naturally put technologies into best use. The good uses of technologies must be supported by good educational aims and educational visions:

> The basic point for…Dewey…is that the particular devices employed matter much less than whether or not they are allowed to reveal, or, conversely, whether or not they are restricted by an overly obtrusive external direction, such as narrow vocational aims. One's underlying beliefs regarding the aims of education are in this way the real determinants of the educative use of educational technologies, notwithstanding the claims of those who regard them as inherently good or bad, or those who argue that they are easily amenable to human control in whatever project may come along (Blacker, 1993, p. 193).

Here we can see, Dewey uses the instrumentalist account of technology to highlight the importance of committing to ideal educational aims and then manipulating the technology for those aims—if we can control the use of educational technology in whatever way we prefer, then what the functions of the specific technology are, fancy or not, matter less than what our educational aims are. As such, instrumentalists may welcome the incorporation of technology into the classroom because they believe in their own power to explore the possibilities within the technologies in a right way, but they do not attach too much importance to it—even when they have no sophisticated or advanced technologies in hand, they are still optimistic about their own power in terms of using what they have to achieve whatever educational aims they value and to overcome whatever negative impacts they try to avoid. In rebuttal to Robertson's (1998) concern that the use of technology at school such as the internet tends to prioritize the transfer and delivery of given information over critical classroom dialogue—thereby resulting in a crisis of critical and reflective thinking, Hyslop-Margison (2004), from a very instrumentalist perspective, argues that Robertson neglects the role educators could play in shaping possible learning outcomes and neglected the variety of internet-based learning strategies that still support the cultivation of critical thinking. Hyslop-Margison (2004) then concluded that "rather than condemning educational technology…democratic educators should appropriate classroom technologies and utilise them in ways to promote the critical consciousness of students" (p. 137). As we can see, both Dewey and Hyslop-Margison are optimistic that humans could eventually figure out how to overcome the negative impacts of technology. But, as I reiterate along the way, this optimism is based on the neutrality of technology, which is questionable. Maybe certain kinds of technology are simply not fit for cultivating critical thinking regardless of how hard humans try to make it work.

In sum, this is what technological instrumentalism tells us about technology's role in education: technology matters, but only instrumentally; what matters most is how humans take effort to use it right for right educational aims. This theory encourages us to explore the possible educational value within any given technology, but its accompanying emphasis on human responsibility and optimism towards human power are in many senses implausible. I highlight that that this implausibility stems from a possibility that technology might not be neutral. However, although most of my counterarguments against technological neutrality in this section highlights the inability of individuals to take control in front of the technology, some of them are still of great instrumentalist implications—they imply that human factors still matter and make a difference. For example, with respect to Borgmann's concern over the use of central-heating system which could possibly disengage family members, one might argue that, if the family members realize this potential problem and try to lead a lifestyle more connected with each other, then we should not worry about the use of central-heating system. In other words, the skepticism of technological neutrality I elaborate on in this section is not the strongest or hardest counterargument against technological instrumentalism. In the next section, I will explore another classic theoretical conception of technology— technological determinism—which is arguably the strongest criticism of the neutrality of technology and technological instrumentalism. This theory, in a categorical manner, denies any human power or agency in front of technology—it conceptualizes technology as an essentially independent force with its own purposes, fundamentally overturning the claim that technology is the neutral means that can be utilized for any human purposes. In other words, in technological determinism, the use of technology is synonymous with the total rule of technology—no human factor matters or makes a difference.

2.2. Technological Determinism

2.2.1. Conceptual Characteristics of Technological Determinism

In sharp contrast to technological instrumentalism, technological determinism considers technology to be an independent force with its own goals and agency rather than an instrument at the full disposal of human beings. In addition, the power relationship depicted in instrumentalism is completely reversed according to this view: this time, human power gives way to that of the technology which is believed to determine and drive profound and enormous changes in the human society. This school of thought is distinguished as *technological substantivism* or *technological determinism*[4]. Yet the latter name denotes the very nature of this view more explicitly: the term "determinism" refers to the thesis that "all things and events are caused by some previous things and events" (Scharff & Dusek, 2014, p. 427), implying that what will happen is already predetermined and beyond human control; by extension, technological determinism emphasized that humans' life and fate is out of their own control yet predetermined by technology[5]. Technological determinism, in a nutshell, views technology as "an independent power that unfolds according to its own logic and that holds society and culture firmly in its grasp" (Verbeek, 2005, p. 174).

Nevertheless, Feenberg (1999, 2003) notes a difference between substantivism and determinism, arguing that both substantivism and determinism suggest that technology is an independent or autonomous force though while substantivism is determinism plus "the additional

[4] Regarding the name of this view, Borgmann (1984) distinguishes this school of thought as *substantivism*, according to which, "technology appears as a force in its own right, one that shapes today's societies and values from the ground up and has no serious rivals" and "hence that view is sometimes called … 'technological value determinism'" (p. 9).

[5] Blacker (1994) also pinpoints that substantivism is "often called 'technological determinism,' in the sense that it is technology itself that does the determining of most, if not all, spheres of human activity" (p. 2).

assumption that technology is inherently biased toward domination [over humans]" (p. 3). It seems to me that Feenberg's differentiation is unnecessary because the defining characteristic of substantivism as he argues is technically a pessimistic attitude or negative reaction towards the world conceived by the determinists. Feenberg's substantivism is not a new disparate theory—it voices an intuitive concern about the daunting possibility of technological domination over humans, which might take place if technology indeed develops autonomously as technological determinism suggests. In other words, Feenberg's substantivism is a subset of determinism and even Feenberg (2003) himself indicates that most substantive theorists are determinists. Therefore, I choose to discuss substantivism and determinism under the same term "technological determinism".

The reason why technological determinism is also a classic and even common-sense view of technology is because it stems from a common intuition and fear that the development of advanced technology, especially characterized with automation, would end up beyond human control, reshaping the world humans live in and even dominating humans. As Wyatt (2008) notes, technological determinism "conforms with a huge majority of people's experiences that it remains the 'common sense' explanation" (p. 169) and "has been 'common sense' for so long that it has hardly needed a label" (p. 168). For example, technological determinism persists in our ethical concern that artificial intelligence would have its own volition and purposes running against those of humans; it is reflected in a considerable number of dystopian novels such as *Brave New World* by Aldous Huxley and *The Caves of Steel* by Isaac Asimov and in a bunch of sci-fi movies or television series including *The Terminator* and recently *Black Mirror*; it is even implicit in our practice of classifying the civilizations by the technological objects used during that historical period (Arendt, 1998), e.g., the practice of saying "stone age", "steam age" and

"computer age"; because by doing so, human beings are in practice acknowledging that what shapes human history is technology. Quite interestingly, earlier I mentioned that technological instrumentalism is also a 'common sense' explanation in the sense that both functionality and neutrality are what many people accept as the common characteristics of technology. It is not paradoxical to acknowledge that the two opposing views are both common-sense explanations because both instrumentalism and determinism are plausibly described as capturing different yet conflicting common-sense attitudes towards technology. And the philosophical analysis in this thesis seeks to clarify and, to certain degree, reconcile the tensions between these two common-sense views, particularly after all the three theories are explored, compared and synthesized.

2.2.1.1. Two Conceptual Components of Technological Determinism

Like technological instrumentalism, determinism can also be analyzed into two conceptual dimensions. MacKenzie and Wajcman (1985) define technological determinism as having two indispensable parts: the first part is the claim that technology develops independently of influences from human society; and the second part is that technology causes and determines social changes. Similarly, as Feenberg (1999) puts it, technological determinism is based on two premises which are "unilinear progress" and "determination by the base" (p. 77). The "unilinear progress" refers to a fixed track followed by technological progress which is independent of the pace of social development; "determination by the base" refers to the presumption that "social institutions must adapt to the 'imperatives' of the technological base" (p. 77), which means that society is changed by technology rather than the other way around. Verbeek (2005) also indicates that "substantivists attribute two properties to technology: first, they conceive of technological development as something autonomous…technology follows its own dynamic; second, substantivists ascribe to technology the ability to change culture" (p. 136). As we can see, all

these conceptualizations invariably indicate that the statement of technological determinism can be parsed into two conceptual dimensions: 1) the concept of technology as a self-dependent force, and 2) the perception that technology's independent development finally determines the direction of human society rather than the other way around. The first dimension implies that technology has its own intentions while the second one implies that technology could take intentional actions to exert impacts. Taking the two dimensions into account, technological determinism enables us to see how technology often functions or operates as if it possessed capacities of agency independent of its human users.

Nevertheless, these two conceptual dimensions are not accepted by everyone. For example, Smith and Marx (1994) reveal that technological determinism takes several forms, which can be described as occupying places along a spectrum between 'hard' and 'soft' extremes" (p. xii). Only at the hard extreme does technology have its own agency and are the above two conceptual dimensions valid:

> At the "hard" end of the spectrum, agency (the power to effect change) is imputed to technology itself, or to some of its intrinsic attributes; thus the advance of technology leads to a situation of inescapable necessity. In the hard determinists' vision of the future, we will have technologized our ways to the point where, for better or worse, our technologies permit few alternatives to their inherent dictates. (Smith & Marx, 1994, p. xii)

However, on the soft end of technological determinism, the first conceptual dimension that emphasizes the independent state of technology is rejected. As soft technological determinists put it, even if technology finally determines the development of human society, it

does not do it independently; instead, human beings are the real actors and decision-makers that enable technology to determine and delegate the power to technology:

> the "soft" determinists begin by reminding us that the history of technology is a history of human actions. To understand the origin of a particular kind of technological power, we must first learn about the actors…Thus agency, as conceived by 'soft' technological determinists, is deeply embedded in the larger social structure and culture so deeply, indeed, as to divest technology of its presumed power as an independent agent initiating change… [Technology's] power to effect change may be derived from certain specific socio-economic and cultural situations, but to say that is only to relocate the origin of that power…In that case "technological determinism" has been redefined; it now refers to the human tendency to create the kind of society that invests technologies with enough power to drive history. (Smith & Marx, 1994, pp. xiii-xiv)

In sum, soft determinism assumes that technology's determining power derives from humans' own tendency to let technology determine. But this is very similar to an instrumentalist view of technology which views technology just as a vehicle for humans to carry out their purposes. That is why Wyatt (2008) argues that "this soft determinism is vague and is not really determinism at all, as it returns us to the stuff of history, albeit a history in which technology is taken seriously" (p. 173). In other words, if soft determinism locates technology's agency within "a far more various and complex social, economic, political, and cultural matrix" as Smith & Marx, 1994 (p. xiii) describes, it is foregrounding human history and thus still acknowledging the human control over and the human responsibility for technological development, which does

not accept technology as an independent power. And this is what Wyatt finds to be confusing given that technological determinism is supposed to be a provocative view of technology standing in opposite to technological instrumentalism.

My purpose in this chapter is to emphasize the contrast between different philosophical conceptions of technology. For that reason, I choose to follow Wyatt's lead and to discuss technological determinism through the lens of the hard extreme only, acknowledging the independent power of technology. Otherwise, the determinist conception of technology's role in human life or in education can be confused with the instrumentalist account explored in the previous section. In the next subsection, I will elaborate on a few hard determinist illustrations of technology offered by eminent philosophers and thus analyze in-depth the logic and implications of technological determinism.

2.2.1.2. Salient Determinist Illustrations of Technology

French philosopher Jacques Ellul is commonly viewed as a representative proponent of technological determinism. According to Smith and Marx (1994)'s criteria, Ellul should fall under the category of hard determinist. This is because Ellul (1967, 1980) frames a system of thoughts to reveal what he called "technological phenomenon" (1980, p. 79) to back up his worries about a civilization increasingly dominated by technology, and as Ellul (1980) puts it, the phenomenon of technological development is impersonal and autonomous, following its own logic independent of humans:

> This means that technology ultimately depends only on itself, it maps its own route, it is a prime and not a secondary factor, it must be regarded as an "organism" tending toward closure and self-determination: it is an end in itself. Autonomy is the very condition of technological development…

> Each technological element is first adapted to the technological system, and it is in respect to this system that the element has its true functionality, far more so than in respect to a human need or a social order. (pp. 125-126)

Furthermore, according to Ellul, the technological phenomenon not only follows its own logic and develops independently, but also promotes, expands and naturalizes its own logic in virtually all domains of life. Technology renders its own logic the only norm and, inevitably, the unescapable goal of human society. This inner logic as suggested by Ellul is 'efficiency'. When technology provides a set of standardized means for attaining the ends in an efficient way, it commits to a mechanism and a new order that favor, reinforce and reproduce the culture and pursuit of efficiency in all areas of human life including economic development, political agenda and even people's rational mind. Even human reason would adapt itself to the technology's rule of efficiency:

> Reason…multiplies technical operations to a high degree of diversity. But it also operates in the opposite direction: it considers results and takes account of the fixed end of technique— efficiency. It notes what every means devised is capable of accomplishing and selects from the various means at its disposal with a view to securing the ones that are the most efficient, the best adapted to the desired end. Thus the multiplicity of means is reduced to one: the most efficient. And here reason appears clearly in the guise of technique. (Ellul, 1967, p. 21)

The culture and pursuit of efficiency narrows the range of what humans can choose for themselves. One may argue that it is up to humans to decide whether to follow an efficient way

of life. However, Ellul's technological determinism argues that human beings in reality are denied any alternative or the ability to seek one. This fixed track to efficiency is not entirely built by one or two specific technological devices but by the larger technological phenomenon.

To illustrate Ellul's point, I try to use the example of the microwave. The microwave oven mentioned previously does enable a convenient and efficient way of life, but people may find it a misleading exaggeration to say that this home appliance normalizes efficiency as the only theme of life without leaving other options. Ellul's point is that microwave epitomizes a larger technological phenomenon: a collective acquiescence to and crave for efficiency. People do not have to choose to heat frozen ready-made food in a microwave and eat it alone, but people are less and less surprised if someone does feed on ready-made microwave meals every day. Meanwhile, the dining industry and eating culture are greatly reshaped. Merchants constantly invent, optimize, and update their technology to make efficient dining experience to the utmost extent accessible, which includes not only providing an increasing variety of ready-made food choices that serve for more needs (e.g., healthy power bowls) but also providing a series of home appliances for efficient cooking and eating (e.g. the recently popular air fryers). Also, we are witnessing the emergence and popularity of meal-kit brands (e.g., HelloFresh, GoodFood and Chef's Plate) which produce and deliver meal kits (including the exactly right amount of ingredients and step-by-step cooking tips) to efficiently simplify cooking and save the time of grocery shopping. In fact, even some well- known restaurants during the COVID-19 pandemic now are selling meal-kits to enable people to eat their favorites without leaving home. As people gradually internalize and adapt themselves to this efficient way of eating and cooking, there may be fewer and fewer alternatives left for humans other than the efficient choices. In this way,

someday in the future the only decision regarding food which people could make perhaps is between different brands of ready-made meals.

Hard as it may be to envision the above scenario related to food choices, the unescapable choice of efficiency has already been true for many other fields such as, say, the cellphone industry. Since the popularization of cellphones, companies all over the world embark on the journey to explore new features to pursue more and more efficiency in different aspects. Ostensibly it is up to each company to decide its cellphone design and up to each individual to decide which type of cellphone to buy though. However, the majority of cellphones on the market now are smartphones which resemble each other and boast similar features in which the pursuit of efficiency is implicit (e.g., a large full touch screen supporting efficient browsing). In addition, it is difficult to escape the ubiquity of smartphones of such type: although, technically speaking, the choice not to own one smartphone exists, the social costs of such a choice become so extensive and significant that in practice it makes little sense to think of it as a genuine choice—the choice not to own a smartphone impacts everything: it restricts basic social networking, limits access to information, undermines the possibility of gaining or keeping employment and having an income and even prohibits the maintaining of a social identity in the contemporary world. The use of smartphone has been accepted as a normal part of human existence. In other words, technology is gradually reshaping and determining the texture of human society which leaves little freedom for humans to choose for themselves or allows humans to take a respite from it. We do not have a choice not to own a smartphone; we do not have a choice not to pursue a faster and more efficient 5G network after an already fast and efficient enough 4G one. By the same token, it might just be a matter of time before the technological mechanism of efficiency totally takes over dining culture or any aspect of life.

The pursuit of efficiency theorized by Ellul is just one of the many determinist interpretations of technology's own logic. For example, Ellul's predecessor, the well-known Martin Heidegger offers a much bolder, metaphysical explanation. For Heidegger (1977), technology exists essentially as a way to reveal the nature and reality of the world, but this revelation is not a human activity at all; instead, it all happens on a predestined track as a matter of fate, which is called "Geschick" by Heidegger (1977, p. 24), an unescapable fate for humans. Recondite as this may seem[6], its key idea is similar to that of Ellul's 'technological phenomenon'—both the two conceptions emphasize that technology has its own purposes and leaves humans with a predestined path or an unescapable choice. Here we can see, from the perspective of technological determinism, technology has the agency to determine humans' fate despite that human beings feel that they are the decision makers of the use of technology: humans seem to immediately choose and control what to do with technology by setting standardized devices into motion, but, at the end of the day, they are just the passive objects subordinate to and unaware of the larger and determining technological phenomenon. In light of this determinist account, even though people believe that they are using technology for the purposes they pursue, in fact, technology is the real determining force of the whole educational landscape—it replaces the humanistic value with its own purposes—be them efficiency or a predetermined mission. Education is no longer a human enterprise. It is technology-led and technology-centered. After all, the human-technology relation interpreted by technological determinism is a technology-centered one.

Of note is that technological determinism is still distinct from the previously discussed criticism of technological neutrality such as Borgmann's 'device paradigm' —technological

[6] For the in-depth exploration of Heidegger's view of technology, see Introna (2002) and Waddington (2005).

determinism is much more radical in terms of acknowledging the power of technology while denying humans' ability to have a say in the use of technology. Both 'device paradigm' and technological determinism dismiss the neutrality thesis of technological instrumentalism, but only the latter theory categorically portrays technology as an independent and determining power and, meanwhile, denies humans the opportunity to combat technological influences. In this sense, the more radical theory of technological determinism is expected to provoke more criticism.

2.2.2. Major Question Arising From Technological Determinism

The major question arising from the (hard) determinist account of technology is, in what sense can technology be understood as autonomous/independent from the purposes of human users? Many eminent determinists including Ellul and Heidegger as discussed above did try to provide their own explanations. However, the critics of technological determinism argue that even in these salient explanations it is still obscure and underexplained why technology is a self-sustaining force in its own right.

As discussed above, Ellul (1967, 1980) attributes technology's autonomous development to technology's predetermined goal of efficiency. However, Borgmann (1984) rebuts that efficiency cannot be the goals of technology—otherwise it would be paradoxical—because efficiency is meaningful only when it exists for the accomplishment of fixed goals, and, in this sense, efficiency is a problematic concept which must be preceded by other antecedental goals:

> The substantive view…seeks to give a comprehensive elucidation of our world by reducing its perplexing features and changes to one force or principle. That principle, technology, serves to explain everything, but it remains itself entirely unexplained and obscure. The most important

> example of this approach is given by Jacques Ellul… For efficiency to come into play, we need antecedently fixed goals on behalf of which values are minimized or maximized. Those goals remain in the dark. From the omnipotence of technique we can infer, however, that whatever the goals may be they cannot be forces in their own right which could give guidance to technical developments… Ellul's important and fruitful observations are then lost along with his pivotal concept. (pp. 9-10)

Heidegger's practice of stipulating technology's independence as a predestined fate is also problematic—his metaphysical claim can be neither proven nor disproven. Some will say that "Geschick"—along with a series of other esoteric terms coined by Heidegger in his theory—is ineffable, conceptual and arbitrary. Technology could stay as an independent force only when these concepts are valid, or in other words, when technology is indeed powered by the one and only predestined mechanism. But this condition stems from a subjective statement and are not backed up by other empirical evidence. Actually, as Verbeek (2005) suggests, empirical research into the development and use of technologies has revealed that Heidegger's approach "fails to match technological reality" because "the advance of technology does not follow a single dynamic but is rather the contingent outcome of a set of complex and interactive processes" (p. 100). In other words, technological determinism is often attacked for exaggerating the power of technology so radically that it distorts the reality and makes little practical sense. As Slack and Wise (2005) argue, "technological determinism is a belief that may feel true in our contemporary experience; but it is hardly fact" because "technologies do not, in and of themselves, determine effects" (p. 53). Instead, they still attribute the impacts of technology to human manipulation which is the origin of technology's power:

> People create and use technologies. Effects are not imposed on us by the technologies themselves. Automobiles did not drop from the sky and force people to drive them. Televisions did not simply appear and make people watch them. Microwaves do not force people to change their eating habits. Rather, technologies do require various forms of involvement or participation of people at various stages of their development and use. (Slack & Wise, 2005, p. 53)

As we can see, the concepts that undergird technological determinism are underexplained and subjective, and thus this theory often seems to be divorced from reality. Consequently, many in the academy even start to discount the value of technological determinism and regard it as "the variety of superstition" which is "demonstrably wrong-headed" (Smith, 1994, p. 39).

In sum, the major limitation of technological determinism lies in the obscurity of the concept of the autonomous state of technology. Despite this limitation, Wyatt (2008) stresses that it is still important to take technological determinism seriously. Because, according to Wyatt (2008), technological determinism can not only be used to describe and normalize a type of view of technology, but it is also useful and worth an exploration in at least two aspects: justificatory and methodological. To be more specific, according to Wyatt, the justificatory technological determinism implies that technological determinism could be used by decision-makers to justify and carry out their plans and strategies regarding technological influence. For example, technological determinism could help managers to persuade stakeholders to update the facilities or help the school board to justify and facilitate a program for improving digital literacy because technological determinism highlights the great differences that technology makes to human society. Likewise, the methodological type stressed that technological determinism could be

taken as a method to "understand the role of technology in history and contemporary social life" (Wyatt, 2008, p. 175).

In my opinion, Wyatt's defense does not mean to make the conceptual obscurity of technological determinism less problematic; instead, it just seeks to highlight its value—even though technological determinism is not an impregnable normative theory of technology, it provides an excellent heuristic—its radicalism provokes us to re-examine our relationship with and assumptions about technology and our choices of technology.

2.2.3. Implications of Technological Determinism for Education

In the educational context, the determinist account of technology encourages humans to see technology rather than themselves as the determining force of the whole educational landscape. In other words, according to technological determinism, the future of education is in the hands of technology, whose development is independent of human factors and whose purpose is enigmatic to humans. For determinists, using technology in the classroom is tantamount to permitting technology to take in charge of what and how the students will learn. And when humans feel that the use of educational technology threatens their own control of the future of education, naturally they would remain seriously concerned over and wary of any educative use of technology. Here I am not only talking about the dramatic and dystopian scenario in which the robots replace all the human teachers, giving orders to students and controlling their minds. The determinist conception of technology also raises our awareness of certain often-overlooked ways that technology shapes our education.

For example, as mentioned in the previous sections, many educators believe that the personalized learning (PL) system can improve the efficiency of education in the sense that it frees students from the standardized learning trajectory (Pane et al., 2015). In this case, with the

use of PL, it seems to be more likely for the students to determine what and how they learn. However, technological determinism offers an alternative interpretation. According to Ellul's 'technological phenomenon', the use of any technology—including PL—epitomizes the larger technological phenomenon in which efficiency is technology's very own purpose and is placed by technology at the center of human life. Humans may feel that they themselves choose to embrace the efficiency of PL and choose to gain more control of education with it. However, in a larger picture depicted by Ellul's determinist theory, the pursuit of efficiency is imposed by the use of PL and other technologies on humans rather than intended by humans themselves. This is because some important educational aims are, arguably, simply not capable of being so translated into terms of 'efficiency'. How, for example, would we 'efficiently' teach students the capacities required for reflective and independent thinking, which, as I will elaborate in the next chapter, is instrumental for the facilitation of human flourishing—a major aim of education—and is also an integral aspect of student agency. It is not clear that it is possible to do so because the training of reflective thinking requires students to be well-informed of a wide range of alternative ways of life or ideas apart from their own and then to evaluate them critically (Brighouse, 2006). In order to be exposed to so many alternative ideas, first, students must engage in social interaction with people from a diversity of backgrounds. Both the social engagement and reflective evaluation are time-consuming and, most importantly, can hardly be described as a clear and unilinear process measured in terms of efficiency. Second, as Schutz (2001) points out, students' participation in activities that they have not chosen for themselves is of great educative value in terms of expanding students' horizon, which indicates that the pursuit of efficiency or personalized learning itself is questionable. We want our students to make less mistakes in terms of choosing what they learn and how they learn, but how could they know what they really want to learn and

are good at learning if we do not let them experience a variety of them, and how could they reflect on and learn from their mistakes without making any? The 'trial and error' process might seem to be time-consuming and might end up with nothing rewarding from a utilitarian perspective and thus might be viewed as "inefficient", but it is definitely a crucial component of the cultivation of student agency. In other words, the languages of 'efficiency' or 'improving efficiency' are themselves an indication that technology has determined how we think about education and has produced certain miseducational consequences—it makes us normalize the improvement of efficiency as a desirable aim when perhaps it is not.

Technological determinism has significant implications for education—it provokes us to question any educative use of technology, and this skepticism makes it more likely for us to discern certain risks or miseducational impacts of technology which are otherwise often overlooked or taken for granted. Yet, as clarified earlier, this theoretical orientation has its own limitations which mainly lie in its failure to clearly explain how technology can stay completely autonomous and independent of humans. In this sense, the determinist account seems to overhype the power of technology while underestimating what is highlighted by the instrumentalist account—the power of humans. In the next section, I will further elaborate on the shared problems of these two classic theories and explore how their similar and problematic theoretical patterns are overcome by the third and last theoretical orientation—the postphenomenology of technology.

2.3. The Postphenomenology of Technology

The third philosophical conception of technology I discuss focusses on the postphenomenology of technology developed by Dutch philosopher Peter-Paul Verbeek. This theoretical orientation can be discussed in terms of two major dimensions. First, it is a critical

view of technology which bridges the two dichotomous views discussed above—technological instrumentalism and technological determinism—and overcomes their shared limitations. Second, it also provides a means of discerning, describing and analyzing the educational impacts of any specific technology. Each of the two following subsections will address one dimension.

2.3.1. The Critical Approach Beyond the Classic Dichotomy

To understand how the postphenomenological account of technology differs from the instrumentalist and determinist accounts and overcomes their limitations, we must review and summarize the shared problems of the two conflicting views of technology in the first place.

As the conceptual exploration of technological instrumentalism and technological determinism suggests, these two theoretical orientations are located at the two extreme ends of the same pole, the pole of human-technology relations. Technological instrumentalism is located at the end of humans, deeming technology as a neutral and passive instrument at the full disposal of human purposes; at the other end of human-technology relations is technological determinism which makes everything about technology and nothing about humans, deeming technology as an autonomous force achieving its own purposes through shaping and determining the development of human society. Instrumentalism underestimates technology's power, while technological determinism exaggerates it. In other words, despite their differences, both the two extreme approaches oversimplify this situation through the same lens: the lens of causality—both the two approaches interpret the human-technology relations as a simple causal correlation between humans and technology in which only a single dominant force is acknowledged: whether it is technological impacts caused by human direction (technological instrumentalism) or is social changes caused by technological development (technological determinism). According to Slack and Wise (2005), this causal approach is reductive—it reduces the multiple elements that matter

into a simple line of determination that holds "true" for all cases and thus neglects a much more dynamic and complex relationship between humans and technology in which more than one force is at play. Instrumentalism reduces the human-technology relations to humans' determination of the use of technology; determinism reduces the relationship to technology's determination of human world. Both of the two classic theories seek a categorical explanation of 'who definitely controls who'. In light of the categorical and reductive nature shared by this pair of classic views, philosophers of technology have been exploring a third way or a critical approach to capture the dynamic role of technology. The postphenomenology of technology is one of the many third ways, and, as the term 'post' in its name suggests, it is built upon a series of other third ways. In this sense, to gain a better understanding of the postphenomenology of technology, we should clarify the distinction between the critical approaches to human-technology relations of these third ways and the approaches of the two classic views.

Albert Borgmann (1984) initially expects this third approach to take account of "the various evolving trends and complexities and of the many interacting forces" and situating technology in "the entire complex web of numerous countervailing forces" (p. 11), which is called pluralism. But later Borgmann points out that this pluralist approach still "fails reality" (p. 11) by attaching the same importance to all forces while the reality is that some of the forces are evidently more influential and determining than others. Therefore, Borgmann (1984) finally prescribes that his new theory should overcome the problems of instrumentalism, determinism and even pluralism and at the same time retain the virtues of the three:

> It should emulate the boldness and incisiveness of the substantive version without leaving the character of technology obscure. It should reflect our common intuitions and exhibit the lucidity of the

> instrumentalist theory while overcoming the latter's superficiality. And it should take account of the manifold empirical evidence that impresses the pluralist investigations and yet be able to uncover an underlying and orienting order in all that diversity. (pp. 11-12)

The new theory that meets all the criteria above in Borgmann's mind is his own 'device paradigm' which I introduced earlier while discussing the limitation of technological instrumentalism (see section 2.1.2). As per the device paradigm, "humans are not dominated by technology, as the substantivists would have it, and neither do they treat it as a mere means; they are implicated in it" (Verbeek, 2005, p. 179). They are implicated in a life paradigm contributed by modern technology, a life paradigm in which authentic engagement with other people and the world is replaced by the consumption of commodities.

A third way as envisioned by American philosopher Andrew Feenberg also embodies the virtues of the classic theories and overcomes their limitations simultaneously. Feenberg (1999) calls it "critical theory" when he presented and compared different theories of technology along two axes (see Figure 1).

Technology is:	Autonomous	Humanly Controlled
Neutral (complete separation of means and ends)	Determinism (e.g. traditional Marxism)	Instrumentalism (liberal faith in progress)
Value-laden (means form a way of life that includes ends)	Substantivism (means and ends linked in systems)	Critical Theory (choice of alternative means-ends systems)

Figure 1. The Varieties of Theories in Philosophy of Technology (Feenberg, 1999, p. 9)

As shown in Figure 1, technology is positioned in relation to the issue of neutrality on the vertical axis and to the issue of human control on the horizontal axis. These two axes help delineate the two classic views of technology and more. As discussed above, instrumentalism sees technology as the neutral and passive means for the realization of human ends, which means that technology does not have its own ends and is subject to human control. Therefore, instrumentalism is defined by the intersection of "neutral" and "humanly controlled". Also, it is noteworthy that determinism and substantivism are distinguished from each other by Feenberg in Figure 1. Previously (see section 2.2.1), I mentioned that Feenberg (1999)'s explanation for this distinction: both determinism and substantivism suggest that technology is an autonomous force while substantivism is determinism plus "the additional assumption that technology is inherently biased toward domination" (p. 3), and I argued that Feenberg's substantivism is technically a

negative reaction to determinism considering how daunting it sounds if technology develops independently rather than a disparate theory. Here, Figure 1, again, reveals the implausibility of Feenberg's differentiation: according to Figure 1, both of the determinism and substantivism deem technology as an autonomous force beyond human control while they seem to differ in whether technology is assumably neutral or value-laden. However, if technology is an autonomous force developing on its own in the first place, it must have its own ends and thus cannot be neutral. In this sense, it is meaningless and paradoxical to distinguish determinism from substantivism by the neutrality thesis.

Then the last box named "critical theory" is defined by the intersection of "humanly controlled" and "value-laden", which is also the type of 'third theory' Feenberg finally chooses to defend. "Critical theories…affirm human agency while rejecting the neutrality of technology" (Feenberg, 1999, p. 9). A critical theory, according to Feenberg (2003), agrees with instrumentalism that technology is in some sense controllable by human beings, and it agrees with substantivism that technology is embedded with its own values and ends. This is not paradoxical because here the purpose embedded within technology is not the narrow concept in its literal sense but a socially specific one. In other words, the idea is that the use of technology may cause society to develop towards a certain orientation or with certain characteristics, but human beings are still able to build a society they prefer by capitalizing on that orientation and those characteristics through specific practices. For example, if efficiency is technology's raison d'être, it does not mean that on the way to a more efficient society human beings are just the passive cogs incapable of making decisions for themselves; instead, they could find a way, for example through policy intervention, to make it easy for technology to pursue efficiency in the research and production of COVID-19 vaccines while make it hard for technology to pursue

efficiency in the development and manufacture of weapons of mass destruction. When realized in different areas, the same concept of efficiency leads to completely different worlds. A critical theory believes that human beings can make decisions about how efficiency is realized and which world they prefer to live in even if efficiency is the trend in this technological era.

As we can see, the third ways of understanding technology developed by philosophers such as Borgmann and Feenberg acknowledge the power of both human beings and technology and their influence on each other. As such, human beings are able to use technology for their purposes; and technology is able to impact human beings in a certain way. In short, according to the critical approach shared by the third ways, humans and technology are intertwined in a dynamic relationship in which they influence each other. This critical approach is distinct from the two classic views, The two classic views only get into the idea of 'who definitely controls who' and, consequently, both end up merely capturing one valuable aspect of human-technology relations while underestimating the value of the aspect captured by the other. Technological instrumentalism captures the agency and significant role of humans in the use of technology, which inspires educators to make best use of technology; however, it misses another important dimension—the inevitable changes brought by technology. Technological determinism captures the dimension of technological impacts—it emphasizes the changes brought by the use of technology, which reminds educators to critically assess their choices of technology; yet it misses the dimension of human power—humans are able to optimize the use and design of any technology constantly. The critical approaches of the third ways seem to combine the best elements of the two classic theories, encourage us to go beyond the 'who controls who' narratives and seek complex rather than simple answers.

This is also how the postphenomenology of technology as a third way differs from the classic views and overcomes their shared problems. However, I choose to focus on this theory rather than other third ways in this section because it is more than the aggregation of the two conflicting views. The postphenomenological account of technology also provides a conceptual framework for us to discern, describe and evaluate the educational impacts of specific technologies.

2.3.2. The Framework for Analyzing the Impacts of Specific Technologies

2.3.2.1. Background

As its name suggests, the postphenomenology of technology is built upon other theories in philosophy of technology including, apparently, phenomenology. A phenomenological account of human-technology relations holds that "human beings, their technologies, and the surrounding world form a structural whole, a being-in-the-world" (Scharff & Dusek, 2014, p. 507) and thus rejects the distinction of subjectivity (humans) from objectivity (world), which was founded by Edmund Husserl[7] and was intensively explored in Martin Heidegger's works including the well-known *Being and Time*. The postphenomenology can be described as phenomenology marked with an "empirical turn", or in other words, "can be characterized as a synthesis of both phenomenology and pragmatism" (Tripathi, 2015, p. 202), in the sense that it integrates the examination of humans' relations with "particular technological devices and experiences of technological practices" (Scharff & Dusek, 2014, p. 508) into the phenomenological approach. This postphenomenological approach was theorized by Don Ihde (1990) who identifies four major types of relations between human beings, technologies, and the world (see Table 1).

[7] See *The Crisis of European Sciences and Transcendental Phenomenology* (Husserl, 1970).

Table 1

Human–Technology–World Relations

Relation	Notation	Descriptions and Examples
Embodiment relation	(Human-technology) → world	Technology is united with human body; humans experience the world through the technology. (Example: we observe and perceive the miniscule objects in the world through the **microscope**)
Hermeneutic relation	Human → (technology-world)	Technology is united with world; humans experience the world interpreted/represented by technology. (Example: we experience the temperature of the world represented by the digits on the screen of the **digital thermometer**)
Alterity relation	Human → technology-(-world)	Humans directly interact with the technology as if technology is independent from the world and has quasi-human characters. (Example: we directly interact with **artificial intelligence-based robots/computers** and even **ATM machine**)
Background relation	Human (-technology/world)	Humans do not directly experience the technology; technology creates a context for human actions and experiences. (Example: we are used to living with **air conditioners** on and humming without even noticing it)

Note: These four relations were identified by Don Ihde (1979, p. 14, 1990, p. 107) and this table was made by the author of this thesis with a synthesis of descriptions and examples from the analysis by Verbeek (2005, pp. 125-128, 2008, p. 389) and Nørskov (2015, pp. 190-192).

Then, Ihde's postphenomenological approach is expanded and reinterpreted by contemporary Dutch philosopher of technology Peter Paul-Verbeek (2005, 2011) with an emphasis on the mutual constitution of humans and the world around them:

> In this perspective the relation between human beings and their world takes center stage, and are viewed as mutually constituting each other—human beings are what they are thanks to the ways in which they are present in their world, and their world is what it is thanks to how it appears to them. (Verbeek, 2005, p. 235)

Therefore, Verbeek's phenomenology of technology explored the role of technology against the backdrop of the close relations and mutual constitution of humans and the world. More specifically, it approaches technology as the mediator of human-technology-world relations, and thus is also called as the theory of technological mediation. Apparently, a mediator is a forcing factor but is far from a determining one. Technology is seen neither as a passive instrument under the total control of humans nor as a determining force having humans under its control. In this sense, the postphenomenological approach is positioned as a third way beyond the dichotomy between instrumentalism and determinism:

> The key concept of this approach is "mediation." This concept allows us to escape from two "common-sense" approaches to technology, which regularly frame the discussion…The first is the instrumentalist view that technology is a neutral means to achieve human goals be they good or evil; the second is the substantivist conception that technology is not neutral but a determining and controlling influence on society and culture. When technological artifacts are looked at in terms of mediation—how they mediate the relation between humans and their world, amongst human beings, and between humans and technology

> itself—technologies can no longer be pigeonholed simply as either neutral or determining. (Verbeek, 2005, p. 11)

Therefore, the human-technology relations depicted by Verbeek's postphenomenology is a much more complex and dynamic one. To be more specific, according to Verbeek's postphenomenological approach, on the one hand, technology reshapes the human experience of the world around them and human existence simultaneously[8]; on the other hand, humans provide the specific use contexts where technology gain its concrete identity. In this way, neither humans nor technology is dominant in their relationship; instead, they interact with and co-shape each other. I would like to elaborate these two dimensions in the following two subsections.

2.3.2.2. Technology Reshapes Human Experience and Human Existence

When it comes to technology's influence on humans, Verbeek (2005) argued that technology reshapes "[humans'] experience [of the world around them] and [humans'] existence" (p. 199). These two aspects are identified not only to reflect the phenomenological focus on the close relation between human and the world but also to respectively do justice to the hermeneutic and existential questions explored by Verbeek's predecessors in the field of philosophy of technology: it is the focus of a hermeneutic perspective of technological mediation to analyze the role technology plays in the way in which reality is interpreted, perceived and thus experienced by human beings because hermeneutics study how the world can be there for us or how we experience the world; it is the focus of an existential perspective of technological mediation to analyze the role technology plays in the way in which human existence takes shape because the existential philosophy studies how we can be there or how we are present in the

[8] It happens "simultaneously" because these two aspects also mutually constitute each other throughout technological mediation.

world. Drawing on a series of hermeneutic and existential discussions of technology[9], Verbeek synthesized his postphenomenological framework and established a set of "postphenomenological vocabulary" (see Table 2 on next page) to help systematically describe how the mediation takes place.

In sum, Verbeek's postphenomenological approach synthesizes a variety of philosophical views of technology, thereby providing a systematic and comprehensive framework against which the impacts of specific technologies can be analyzed:

> To be more specific, according to the hermeneutic perspective of mediation theory, technological artifacts mediate human experience by transforming perceptions and interpretive frameworks, helping to shape the way in which human beings encounter reality. The structure of this kind of mediation involves *amplification* and *reduction*; some interpretive possibilities are strengthened while others are weakened. From an existential perspective, artifacts mediate human existence by giving concrete shape to their behavior and the social context of their existence. This kind of mediation can be described in terms of translation, whose structure involves *invitation* and *inhibition*; some

[9] According to Verbeek (2005), the discussions on which he based his approach include, on the hermeneutic dimension, the Heideggerian view which holds that technology exists to reveal the meaning of the world around us (see section 2.2.1 and Heidegger, 1977); and on the existential dimension, Verbeek synthesized both Bruno Latour's Actor-Network Theory which structures how technological artifacts could also function as actors to translate human actions into new ones (see Latour, 1999) and Albert Borgmann's "device paradigm" which elaborates the specific consequences of changing human behavior including the above-mentioned disengaging effects (see Borgmann, 1984). Also, as we can see from Table 2, Verbeek directly used the human-technology-world relations identified by Don Ihde to help capture the technology's role from both hermeneutic and existential perspectives.

forms of involvement are fostered while others are discouraged.

(Verbeek, 2005, p. 195)

Table 2

The Postphenomenological Vocabulary

Perspectives	Hermeneutic (Human Experience)	Existential (Human Existence)
Questions	How reality appears to humans	How humans appear in their world
Main Concerns	Perception: humans' interpretation of the world	Action: humans' involvement with the world: —with the artifacts themselves —with the contexts of artifacts —with what artifacts make available
Forms of Technological Mediation	Transformation: Amplification Reduction	Translation: Invitation Inhibition
Most Relevant Human-Artifact Relations	embodiment relations hermeneutic relations	embodiment relations alterity relations
Points of Departure	—artifacts mediate perception and context of interpretation —experience takes shape as perception interpreted within a context of meaning	—artifacts mediate action and context of existence —existence takes shape as action involved in a context of existence

Note: This table is made by the author based on Verbeek's original version of "A Postphenomenological Vocabulary" (Verbeek, 2005, p. 196) and a simplified version from a conference paper (Ohlin & Olsson, 2015).

2.3.2.3. Humans Provide the Contexts and Identities for Technology

In brief, the postphenomenological account of technology encourages us to discern how technology amplifies/reduces humans' perception of the world around them and invites/inhibits certain human behavior. However, this claim is different from reducing human-technology

relationship to a single causal relation which only foregrounds the impacts of technology on humans. This is because Verbeek (2005) incorporates the concept of "multistability" originally proposed by Don Ihde (1993) into his postphenomenological approach. The concept of 'multistability" holds that technology per se is not an independent variable with intrinsic properties or essence; instead, technology has many identities at once and is "stable" in multiple ways. As Verbeek (2005) put it, according to Ihde's 'multistability', technology is context-dependent and cannot be separate from its use contexts. And this means that only in the specific human-technology relationship would technology's role in exerting impacts be meaningful:

> Artifacts can only be understood in terms of the relation that human beings have to them.…technologies always and only function in concrete, practical contexts and cannot be technologies apart from such contexts…they are what they are only in their use…They are only technologies in their concrete uses, and this means that one and the same artifact can have different identities in different use contexts. (Verbeek, 2005, pp. 117-118)

In other words, any analysis of how technology mediates human experience and human existence should be situated within the specific relationship formed by humans and the given technological artifact. Of note is that the specific relationship is dynamic and ever shifting. This is because once technology starts to reshape human experience and human existence, the relationship between humans and technology is also changing as a result. Therefore, in this human-technology relationship conceptualized from the perspective of mediation theory, neither humans nor technology is the determining force; instead, they interact with and co-shape each other. It is thus implied that any attempt to capture the impact of technology would be a complex

one and, in order to do so, a mediation analysis is always required to examine the specific technological artifact in use within the specific context.

To navigate through the vocabulary and concepts in Verbeek's postphenomenology of technology, I would like to follow his approach and conduct a mediation analysis of the use of smartphones with a focus on its impacts on interpersonal relationship. To begin with, from the hermeneutic perspective, a smartphone interprets your friends, family or your loved ones as small icons or profile pages on the screen of a mobile device. In this way, the presence of these people in your life is amplified. However, at the same time, the smartphone reduces your attempt to keep in touch with them into a single tapping on the screen, or fingers scrolling up and down in their timeline, which are effortless. In this way, from the existential perspective, the smartphone translates your relationship with your contacts into both a much more intimate one in the sense that you can keep in touch at any time and a less intimate one in the sense that you dedicate less into the face-to-face communication. That is to say, the smartphone *invites* you to connect with each other while *inhibits* you from doing that at the same time. Taking all these possibilities into account, the dynamic of the interpersonal relationship of smartphone users is totally reshaped, yet it is difficult to conclude which impacts prevail because it all depends on the specific user contexts. Therefore, mediation theory points to the importance of the specific and in-depth analysis of the technological artifact in use. As Verbeek (2005) argues, the value of this postphenomenological approach to technology lies in the fact that "it makes possible a more careful and thorough investigation of specific technologies" and "its vocabulary makes it possible to describe technologies not simply in terms of their functionality but also as mediating the relation between human beings and their world" (p. 197).

In the educational context, the human-world relation becomes more specific—it mainly involves students themselves, their peers, their teachers and the world they are exposed to. Therefore, I argue that the postphenomenological account of technology's role in education is the mediator of student-teacher-world relations. And, according to the postphenomenology of technology, technology reshapes human experience and human existence, which means that, in the educational context, the use of technology reshapes the experience and existence of all the human subjects involved in the student-teacher-world relations. In this way, technology reshapes the education landscape on various levels and in a dynamic way, which cannot be captured with a determinate and uniform description like what the instrumentalism and determinism offer. Instead, an impact analysis of specific technology using the postphenomenological vocabulary is required. In chapter four, I will develop such a case analysis in which I use the postphenomenological vocabulary to examine the impacts of artificial intelligence in education (AIEd) on student agency.

Chapter Summary

In this chapter, I explored three philosophical conceptions of technology to highlight several different, potentially conflicting, ways of understanding technology's role in the educational context. Each of instrumentalism and determinism, respectively only capture a limited important dimension of human-technology relation while underestimate the value of the dimension capture by another. From the perspective of technological instrumentalism, human is the center of and stands in the foreground of the human-technology relations; technology is nothing more than the neutral educational means for educational aims pursued by humans; it matters only instrumentally and will not change the existing educational aims; this instrumentalist account encourages us to explore the possible educational value within any given

technology, yet its accompanying emphasis on human responsibility and optimism towards human power are in many senses implausible and even dangerous. From the perspective of technological determinism, technology is placed at the center of human-technology relations; technology is self-dependent with its own purposes, and it determines the development of human society based on its purposes; consequently, the whole educational landscape including the educational aims will be defined and determined by technology rather than humans; this determinist account provokes us to critically assess the choice of educational technology yet it overhypes the power of technology. The postphenomenology of technology, as a critical theory, overcomes the shared problems of the two conflicting views and interprets technology's role in education as the mediator of student-teacher-world relations; furthermore, it provides a conceptual framework for discerning, describing and analyzing the educational impacts of specific technologies. The discussion of the three philosophical views of technology along with the three assumed roles of technology in education addresses the conceptual complexities of technology and thus provides a theoretical foundation for our focused examination of how the use technology impacts student agency. In the next chapter, I grapple with the other key concept of my research question—student agency—through unraveling its conceptual components and its representation of and connection with major educational aims.

CHAPTER THREE: Demystifying the Concept of Student Agency

In the previous chapter, I reflected on the concept of technology by exploring its roles in education. And, to truly understand technology's impact on education, it is also necessary to clarify what are the valuable aims of education. In this thesis, I use the concept of student agency as the reference point for the interrogation of what valuable aims are. In the present chapter, I seek to conceptualize what is essential to student agency and how the concept of student agency is connected to broader educational aims.

However, conceptualizing and theorizing student agency can be complex and problematic in that "agency" is an equivocal concept, the scope of which is wide and developing (Donaldson & Kymlicka, 2016; Marín et al., 2020; Schlosser, 2019). Hence the discussion in this chapter can hardly be considered as an exhaustive investigation or a determinate definition of student agency, though I try to capture the conceptual debate and the multiple facets of student agency as much as possible. And in doing so, I resort to the broader philosophical conceptions of human agency as well as the multi-faceted conceptions of student agency developed by qualitative educational researchers. Through identifying a complex of aspects of student agency, we are enabled to take a closer look at the research question of how the use of technology impacts student agency and we are equipped with the conceptual resources to answer it—we are allowed to translate the research question into the focused discussion on how technology supports or problematizes the four key aspects of student agency.

I start with a review of the two major types of conceptions of agency in the philosophical works—the cognitively based conceptions and the more inclusive ones—which sketch a contour of the multiple dimensions of agency. Against this philosophical background, I identify four integral aspects of human agency—*action, intention, reflection and interaction*—which are

interrelated with each other. Then I point out that these four aspects also overlap with the recurring themes of two conceptual models of student agency grounded in psychological and sociological theories. In this light, these four integral aspects arguably constitute a defensible account of student agency. In the final section of this chapter, I argue that the four aspects are also closely related to important aims of education—the moral aim of promoting human flourishing and the ideal epistemic aims. This reference made to the broader educational aims not only validates the practice of defining student agency in relation to the four integral aspects, but also justifies this thesis' focus on student agency as the reference point for the reflection on the value of education: considering the close connection between the four aspects of student agency and the major educational aims, it is of great significance for both the research as well as the practice in the field of education to analyze the technological impacts student agency may be exposed to.

3.1. Philosophical Conceptions of Agency

Agency, in very general terms, denotes the manifestation of the capacity of being able to act or take actions, and anyone or anything who possesses this capacity is considered an agent (Schlosser, 2019). Therefore, agency is often discussed in philosophy of action and this discussion revolves largely around which mechanisms actually constitute or back up the actions taken by agents. There are a myriad number of specific interpretations of agency but in general they fall into two major categories: 1) cognitively based conceptions, and 2) inclusive conceptions. The cognitively based conceptions focus on human agents and what is distinctively human agency while the inclusive conceptions also study agents without a sophisticated cognitive system such as non-human subjects and humans with cognitive disabilities. Both the

two approaches help shed light on what is essential to the concept of human agency and can be applied to conceptualizing the agency of students in the educational context.

3.1.1. Cognitively Based Conceptions of Agency

Many philosophers insist that agency must be explained in terms of intentional actions based on the complex cognitive mechanisms involving desires, beliefs, rational reflection of and mental reactions to certain life events (see Anscombe, 1963; Bratman, 1987; Davidson, 2001; Frankfurt, 1971; Mele, 2003; Taylor, 1985). It is thus implied that the concept of action which is at the center of agency cannot dispense with intention and the reflection on intentions, the latter of which is supported by a sophisticated cognitive system. In fact, these two concepts have been emphasized so much that the cognitively based conceptions of agency are often exclusively focused on human agency given that the ability of reflective thinking is long viewed as distinctively human characteristics. A representative of such cognitively based approaches to the concept of agency is the influential framework constructed by Harry Frankfurt and Charles Taylor, which highlights the reflective evaluation of desires as the essential and distinctive features of human agency.

Frankfurt (1971) holds that both human beings and other agents take actions or exercise their agency out of desires, but only human beings are able to reflect on their desires, which distinguishes human agency from the agency of others. Frankfurt (1971) explains this through a hierarchy of two types of desires: first-order desires "which are simply desires to do or not to do one thing or another" (p. 7) and second-order desires or the higher-order desires, i.e., the desires about certain first-order desires rather than others after evaluating all of them, which entail "the capacity for reflective self-evaluation" (p. 7). According to Frankfurt (1971), first-order desires are pretty common among agents including most animals, but only human beings are able to

form the second-order desires. As Taylor (1985) puts it, the capacity to evaluate desires "is bound up with our power of self-evaluation, which in turn is an essential feature of the mode of agency we recognize as human" (p. 16).

To understand and compare the two types of desires, let me take myself as an example. At this point, I have got quite a number of desires: I desire to finish my thesis and pass my French proficiency test as soon as possible; I desire to sleep all day long without working on my thesis nor French test at all; I desire to travel to both Japan and Europe when the COVID-19 pandemic is over; and I desire not to experience another wave of COVID-19. These desires are what Frankfurt called as first-order desires which can be formed by any agents. Even my bunny could form certain first-order desires out of her contingent biological needs such as eating hay, drinking water and taking a nap—nonhuman animals have the first-order desires to "live, eat, play, etc." (Vezér, 2007, p. 3) However, only I, as a human being, am able to form second-order desires after evaluating all of my first-order desires. I regard sleeping all day without taking effort to accomplish my academic tasks as undesirable because no work and all sleep would not only cause serious academic and financial consequences for me but also turn me into an idler whom I hate to be. Also, I desire to work on the thesis writing more than to prepare for the French test considering that the former is more urgent. As for my travel destination, I could only choose one because my limited budget does not allow two and I actually prefer Japan to Europe because my current city Montreal resembles some European features. Finally, spending time thinking and whining about the COVID-19 situation is undesirable because it is beyond my control. In this manner, I reflect on and evaluate all my first-order desires prior to attaching different degrees of importance to each of them. From where Frankfurt stands, this reflection on

various desires or intentions belongs solely to humans and should be deemed as essential to human agency.

Charles Taylor took Frankfurt's framework to another level by further defining the evaluation process. Taylor (1985) categorizes the evaluation of desires into two types: the weak and the strong. Weak evaluation is the utilitarian or quantitative calculation of consequences considering the contingent or circumstantial conflict between different desires, while strong evaluation is the qualitative characterization of desires as "higher and lower, noble and base" (p. 23), or in other words, strong evaluation is based on value system and moral conviction.

For example, again, if I desire to work on my thesis rather than sleep simply because these two things cannot be done at the same time, then I am just conducting the weak evaluation in the sense that my decision to desire one thing rather than the other is a result of the contingent conflict between the two things. When I find studying to be more desirable than sleeping with the primary concern that idleness would result in the loss of a better career opportunity, I am still doing the weak evaluation since I am actually making a quantitative and utilitarian calculation of the consequences. However, if the reason why I choose to study is that I aspire to be a diligent and productive person, which does not allow the sluggish lifestyle such as sleeping all day, then I am making the strong evaluation because this time the evaluation involves the self-reflection with respect to what I value and believe as worthwhile or morally imperative. Likewise, my choice between travel destinations would also be a weak evaluation if I vote for Japan simply due to the limited budget, yet it will be counted as a strong evaluation if I argue that my preference for Japan represents my curiosity and passion to discover and explore a world I have never seen before. According to Taylor (1985), strong evaluation involves the reflection at a deeper level and is what is truly essential to human agency:

> Strong evaluation is not just a condition of articulacy about preferences, but also about the quality of life, the kind of beings we are or want to be. It is in this sense deeper…the capacity for strong evaluation in particular is essential to our notion of the human subject; that without it an agent would lack a kind of depth we consider essential to humanity. (pp. 25-28)

In sum, Frankfurt's first and second-order desires underline that the reflection on intentions is an integral and distinctive part of the concept of human agency; Taylor's weak and strong evaluation reinforces this viewpoint by interpreting the value-based in-depth reflection—namely the strong evaluation—as the essential feature of human agency. Their claim that reflection is distinctively human may be challenged by ethological studies or questioned by animal rights groups, but they emphasize and point to one thing: human agency is not only the ability of human actions; instead, it is centered around intentions and particularly the reflection on intentions. So far, the cognitively based approaches adopted by Frankfurt and Taylor indicate that there seem to be three integral aspects of human agency: action, intention and reflection.

3.1.2. Inclusive Conceptions of Agency

Critics of cognitively based approaches contend that agency cannot be reduced to the reactions out of reasons or desires or based on cognitive systems. They argue that agency also consists in unintentional actions where mental representations and human cognitive mechanisms are absent (see Ginet, 1990; Lowe, 2008) and widely consists in non-human beings including technological objects such as robots and artificial intelligence (see Brooks, 1991; Slack & Wise, 2005). As Donaldson and Kymlicka (2016) put it, "the scope for agency is always changing and developing" (p. 180). This type of approach is not framed by a definition of agency solely in

relation to cognitive abilities and seeks to take every potential source of agency and every potential agent seriously. Thus, I call it the inclusive conceptions of agency. As we can see, the implications of the inclusive conceptions of agency are twofold.

On the one hand, the inclusive conceptions of agency provoke us into reflecting on the social attitude towards those who do not have sophisticated cognitive systems including people with cognitive disabilities and children and provoke us into rethinking humans' relations with non-humans including animals and technology as well. This implication enables us to, for example, acknowledge and respect the importance of social causes such as the empowerment of the disabled and children and the welfare of animals; it also reminds us to take more seriously the impacts and changes technology exerts on us, which is also a major theme of this thesis. Actually, in chapter two's exploration of philosophy of technology and the roles of technology in education, as we have seen, agency is believed to reside in technology according to technological determinism and the postphenomenology of technology. In many senses, the inclusive conceptions of agency serve as a philosophical and sociological heuristic. In fact, expanding the scope of agency to include people with cognitive disabilities, children and even domesticated animals as acknowledged agents per se contributes to the commitment to social good in a democracy (Donaldson & Kymlicka, 2016).

On the other hand, the inclusive conceptions of agency also provide new insight into the concept of human agency per se by rejecting cognitive abilities as the only source. Instead, meaningful actions and choices are also believed to be "socially structured", especially through "socialization" (Donaldson & Kymlicka, 2016, pp. 185-186). It is thus implied that the promotion of agency should not be reduced to the support for intentional actions or reflective thinking of people with mature cognitive mechanisms. Agency is everywhere and the thing is to

supports agency wherever possible. Even people with profound cognitive disabilities can be supported to take meaningful actions through social interaction. Donaldson and Kymlicka (2016) use the term 'dependent agency' to illustrate this argument by saying that "on this view (of dependent agency), autonomy is understood as a relational accomplishment, not just a capacity of individuals" (p. 179). In this sense, the promotion of human agency also requires the creation of an engaging social environment where the actions of the human subjects are valued and supported as much as possible during their interaction with each other. Hence, the inclusive conceptions of agency indicate that the quality of interaction should also be considered as an integral part of human agency.

3.1.3. Four Integral Aspects of Human Agency

On balance, taking into account both the cognitively based and inclusive conceptions of agency discussed above, it can be argued that human agency can be conceptualized as the ability in four integral aspects: action, intention, reflection and interaction. Action is the central and most conspicuous aspect while it is connected with all the other three. More specifically, when it comes to assessing human agency, we cannot pay attention to the ability of taking actions alone. The intentions behind the actions also merit our attention and whether these intentions are reflected upon and evaluated is crucial to the quality of actions. In addition, meaningful actions are not fully dependent on individuals' reflected intentions; they can also be nurtured and supported by social interaction. In brief, the interconnection among the four integral aspects of human agency can be paraphrased as follows: actions are based on intentions, the reflection on intentions and/or meaningful social interaction. These four aspects are not identified to normalize the concept of human agency; I am not arguing that the lack of any one aspect of the four would result in poor or incomplete human agency. Instead, they serve as the conceptual methodology to

evaluate human agency: the point here is that any evaluation of human agency could be parsed into the evaluation of these four interconnected integral aspects.

Although it seems that these four aspects are derived from conceptions of agency in the general sense, they also provide a theoretical foundation for the specifical concept of student agency. This is not only because, obviously, students can be referred to as the human subjects within the educational context, but also because these four aspects overlap with the major themes of the conceptual models of student agency developed by qualitative educational researchers.

3.2. Conceptual Models of Student Agency

Both Klemenčič (2015) and Vaughn (2020) systematically identify what they considered to be the essential dimensions of student agency. They built their models upon a series of sociological and psychological especially cognitive theories without direct reference to philosophical theories, but many elements of their models overlap with the four aspects of human agency identified based on philosophical conceptions of agency.

3.2.1. 'Agentic Orientation' and 'Agentic Possibility'

Klemenčič (2015) conceptualizes student agency as the quality of students' self-reflective and intentional action and interaction with their environment which is measured by two variables: agentic orientation and agentic possibility. The agentic orientation refers to students' will to act, which lies in the way students make choices of action, interaction and self-reflection regarding what is desirable to achieve in a given situation; the agentic possibility refers to students' perceived power to achieve intended outcomes through particular action, interaction and self-reflection. Moreover, Klemenčič (2015) also highlights that student agency is characterized with temporal embeddedness and situatedness:

> The notions of agentic possibility and orientation are temporally embedded, implying that they are shaped through considerations of past habits of mind and action, present judgments of alternatives for action and projections of the future. They are also intrinsically relational and social, and situated in structural, cultural and socio-economic-political contexts of action (p. 13).

Even from the surface, we can see that Klemenčič's definition per se revolves around the keywords of 'action', 'intention (intentional action)', 'reflection (self-reflection)' and 'interaction', which are exactly the four integral aspects of human agency identified based on philosophical conceptions in the previous sections. However, Klemenčič's (2015) notes that her theoretical model of student agency is grounded on social psychology and sociology—the social cognitive theory formulated by Bandura (1986, 1999) and the sociological understanding of human agency offered by Emirbayer and Mische (1998)—rather than philosophical theories. Therefore, a review of Klemenčič's theoretical model of student agency could add psychological and sociological evidence to our philosophical reasoning and validate the practice of conceptualizing student agency based on the four of the four integral aspects.

According to social cognitive theory, human beings are neither autonomous agents nor simply subject to environmental influences (Bandura, 1986) and are self-reflecting (Bandura, 2006). In this sense, individuals are assumed to be able to control or influence their own life courses to certain extent, while the chance encounters that happen to individuals in different structural environments are also believed to often shape their life courses (Bandura, 1999). Both the power of human beings and that of external environment are acknowledged and the dynamic interaction between these two sources of power plays a role in the development of human

agency. Therefore, instead of being reduced to something students possess, student agency is defined as the quality of not only actions but also the self-reflection and the interactions with other people and the outside world as well (Biesta et al., 2011; Klemenčič, 2015) and thus is relational and contextual. In addition, this mechanism presented by social cognitive theory provides a crucial precondition for the notion of agentic possibility which renders individual's power a changing variable across different contexts. The concept of temporal embeddedness in Klemenčič's theoretical model is derived from Emirbayer and Mische's (1998) sociological understanding of human agency which argues that human agency is temporally constructed through the interplay of three dimensions: habit in the past, judgement at the present and imagination for the future. The dynamic interplay among these three dimensions also "varies within different structural contexts of action" (Emirbayer & Mische, 1998, p. 963), which again lays emphasis on the contextuality of student agency. In addition, Klemenčič's (2015) conceptualization of student agency as relational and social also draws on the argument from Emirbayer and Mische:

> We wish to stress that our conception of agency is intrinsically social and relational since it centers around the engagement (and disengagement) by actors of the different contextual environments that constitute their own structured yet flexible social universes… we highlight the importance of intersubjectivity, social interaction, and communication as critical components of agentic processes: agency is always a dialogical process by and through which actors immersed in temporal passage engage with others within collectively organized contexts of action. (Emirbayer & Mische, 1998, pp. 973-974)

Klemenčič's conceptualization of student agency revolves around two key concepts—agentic orientation and agentic possibility—and also highlights the dynamic and interactive relationship between students themselves and the structures, contexts and relations they are in. This conceptualization seems to encompass multiple theories, but all the major themes involved can interpreted in terms of the four integral aspects of human agency.

The concept of agentic orientation is characterized by students' decision making regarding what is desirable to achieve in a given situation, which clearly involves the evaluation of different desires and thus overlaps with what Frankfurt (1971) deems as the essential feature of human agency: the formation of second-order desires or the ability to evaluate desires through rational reflection. Here the aspects of 'intention' (desire) and 'reflection' are represented. In addition, Klemenčič (2015) does not simply equate student agency to a cognitively based quality; instead, she adopted a dynamic approach, situating student agency contextually, temporally and relationally. Therefore, both the agentic orientation and agentic possibility would change as students build different kinds of interactive relations with the people and the outside world across time and contexts. We could use simpler words to connect Klemenčič's theory with the four integral aspects of human agency. It seems to me that Klemenčič's concepts of agentic orientation and agentic possibility could be explained in terms of chess playing: the agentic orientation is like the direction to which we choose to move the queen while the agentic possibility determines how many squares we can move it. Or in terms of the geometric object of a Euclidean vector, agentic orientation is the direction and agentic possibility is the magnitude or length. We choose to face a certain direction and the magnitude decides how far we could go in that direction. In this sense, agentic orientation can be understood as the intention which is made based on reflection and interaction while agentic possibility can be understood as the power of

actions. Now we can clearly see how the four integral aspects synthesize all the major themes of Klemenčič's theoretical model of student agency. Yet Klemenčič's conceptualization does provide new and noteworthy insight into how student agency can be impacted: it introduces a concept of temporal embeddedness which emphasizes that student agency is constructed through past habits, present judgments and projections of the future, which merits our attention when we try to analyze technology's impacts on student agency.

3.2.2. Dispositional, Motivational and Positional Dimensions of Student Agency

Based on sociological and educational theories, Vaughn (2020) also identifies three key dimensions of student agency: dispositional, motivational and positional (see Figure 2). This theoretical model is quite similar to that of Klemenčič's and its key ideas also overlap with the four integral aspects of human agency.

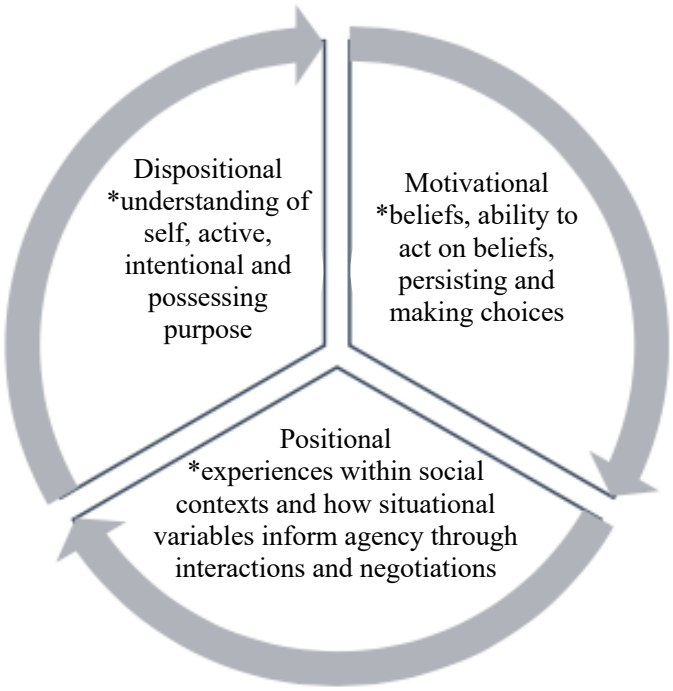

Figure 2. A Model of Student Agency with Three Key Dimensions (Vaughn, 2020, p. 113)

As we can see, most of the conceptions of agency we discussed above are in some way represented and covered by Vaughn's theoretical model. On the dispositional dimension, "developing a sense of agency has to do with having intentions and purpose" (Vaughn, 2020, p. 111). This is where the aspect of intention is manifested. On the motivational dimension, "agency has to do with persisting and choice-making as individuals learn how to make decisions and choices to complete tasks and to act on opportunities even when obstacles are presented" which involves "the ability to regulate their actions and ideas, and to reflect on their own skills" (p. 111). Arguably, this motivational dimension involves two major themes—reflective choice-making and the ability to act through, say, persisting—which integrate the aspect of reflection and that of action. When it comes to the positional dimension, Vaughn (2020) notes that "agency is not solely developed by an individual but is co-created with other individuals such as peers and teachers and across a variety of social interactions and contexts. Agency in this realm has to do with interactions and negotiations as individuals decide to take [or not take] action to exert their influence" (p. 112). In this dimension, agency is not entirely cognitively based but is structured through social relations and interactions.

The above review of the two theoretical models of student agency again confirms that student agency can be explained in terms of four integral aspects—action (on intentions), intention, reflection (on intentions) and interaction (with people and external environment across time and context). Therefore, these four dimensions are not only derived from philosophical conceptions but also evidenced by psychological and sociological theories. We can then argue that to promote student agency is thus to support the four key aspects as much as possible. More specifically, if students are enabled to establish life or learning goals, facilitated to reflect deeply on those goals, empowered to act on the goals and engaged in meaningful social interaction, we

can be profoundly confident that student agency will be significantly promoted. Then, when it comes to the investigation of how the use of technology impacts the student agency, the analysis should be focused on how technology makes a difference to the four integral aspects—whether it supports or problematizes students' establishment of goals, reflection on the goals, action to achieve the goals and interaction with people around them and the external environment.

3.3. Student Agency and Crucial Educational Aims

The previous sections grapple with a series of conceptual and theoretical issues in an attempt to provide a defensible account of student agency consisting of four integral aspects. However, this attempt is meaningful only if the exploration of the concept of student agency is worthwhile and significant for the interrogation of the value of education. The above theories which try to capture the conceptual issues of student agency already presume student agency to be an important concept that merits our attention. Indeed, we could immediately invoke certain formal remarks to confirm student agency as an important attribute in the educational context like, for example, that student agency is associated with desirable educational and career outcomes (National Research Council, 2012), or student agency is positioned as one of the seven elements of the learning compass for the future, one of the "point of orientations" that "help navigate towards the future we want" (p. 24) and "an invaluable skill that they (students) can and will use throughout their lives" (p. 32) in a recent OECD report on the "future of education and skills 2030" (OECD, 2019). However, these arguments are by nature external to the concept of student agency itself without justifying why student agency is inherently worth exploring and why it could serve well as an entry point for the analysis of technological impacts facing today's education. Therefore, in an effort to examine the educational significance of student agency, in the following two subsections, I argue that the four integral aspects of student agency are closely

related to major educational aims or principles—the fundamental moral aim of promoting human flourishing as well as the ideal epistemic aims of education.

3.3.1. Student Agency and the Moral Aim of Promoting Human Flourishing

What kind of education is morally desirable and worthwhile? Harry Brighouse (2006) offers a systematic account, in which he observes that, enabling humans to lead flourishing lives should be positioned as the fundamental moral aim of education and schooling. It is also the guiding principle of specific educational aims. Educators may aim to instill in their students a variety of attributes or rather educational goods such as knowledge, skills, dispositions and attitudes, but all these educational goods are developed to ultimately contribute "to their (students') own prospects for flourishing and to their ability to contribute to the flourishing of others." (Brighouse et al., 2018, p. 19). In this sense, the aim of human flourishing represents the moral promises of both personal development and public good, and thus it is "the fundamental value that underlies our discussion of educational goods" (Brighouse et al., 2018, p. 21).

For humans to lead flourishing lives, Brighouse (2006) argues that there are two prerequisites: the life they choose to lead must be objectively good, and they must identify with and endorse that life from inside. To ensure that both these two prerequisites are in place, students should "possess reliable ways of evaluating different ways of life" (Brighouse, 2006, p. 17). Apparently, in a democratic society, no one, be it parents or governmental authority, is supposed to impose a normative standard of good life on the students or to coerce them to identify with it. Instead, students should be allowed and supported to "live well by their own judgement" (Brighouse, 2006, p. 18). Accordingly, students should be provided the information, resources, liberties and justice which enable them to "live well"; and, more importantly, according to Brighouse (2006), they should also be equipped with the skills which enable them

to make good and independent judgements about what kind of life is worth living. Here, education should play a significant role—it should facilitate the autonomy of students and instill in students the autonomy-related skills of "rational reflection and comparison" (Brighouse, 2006, p. 19), which are crucial for judgements and decision-making regarding how to live well:

> But the basic methods of rational evaluation are reliable aids to uncovering how to live well, and they are the only such aids that can be identified and taught… children will be much better placed to enter alternative good ways of life if they are well informed about alternatives and are able rationally to compare them…Rational reflection can help us to detect inconsistencies and fallacious argumentation, and to uncover misuse of evidence. It helps us to see whether a choice coheres with our given judgements, including our judgements about what kind of person we ought to be. (Brighouse, 2006, p. 18-19)

Through reflecting on their own life in light of a wide range of alternatives, students "make and act on well-informed and well-thought out judgments about how to live their own lives" (Brighouse, 2006, p. 14). In addition, Brighouse (2006) emphasizes that social interaction is also required for autonomy facilitation and human flourishing:

> …most children need to interact with a reasonably wide variety of people in a formal and paternalistic setting in order to develop into autonomous persons and cooperative citizens. (p. 7)
>
> Autonomy has a deeply social aspect, not least because human beings are deeply social beings. Individuals do not flourish separately from others;

> their interests are bound up with those of other people, and their reflection takes place within a given social context. (pp. 19-20)

Social interaction has twofold implications—both for individual development and communal attainment. On the one hand, it is through the exposure to and interaction with peers, teachers and any adults from a diverse background that individual students "learn more about alternative ways of living and new perspectives" and "reflect critically on opinions and values received from their families and from the mainstream culture" (p. 22). In this sense, education and schooling are expected to provide the opportunity for students to be engaged in meaningful social interaction with a diversity of people to cultivate autonomy-related skills, which are conducive to individual flourishing. On the other hand, we should always keep in mind that the educational aim of human flourishing does not only position individual at the center of the narrative but also includes the collective prospect as well, and it is argued that individual development cannot dispense with collective attainment. Therefore, Brighouse (2006) stresses that, besides the cultivation of autonomy-related skills of reflection, students "need far more" (p. 25). More specifically, apart from "the capacity for personal autonomy", there are also five capacities that "everyone should have in modern societies and which, when deployed effectively in appropriate circumstances, will tend to support the flourishing of both the educated person and others" (Brighouse et al., 2018, p. 22)—the capacities for economic productivity, democratic competence, healthy personal relationships, treating others as equals and personal fulfilment. Expanding the discussion of each one of them is an unmanageable task for this thesis, but we can see that four of those five conspicuously require students to be participants in the given type of social interaction, be it economic, political or interpersonal. Arguably, it is through the economic and political participation and social relationships that individuals contribute to the flourishing of

other peoples' life. In short, there are a wide range of required capacities which are instrumental to the human flourishing individually and communally, and many of these capacities cannot be developed without meaningful social interaction.

In a nutshell, for the sake of flourishing lives, students ought to make their own evaluations and judgements on what kind of life is subjectively good as well as worth living. However, students also ought to develop the autonomy-related skills to reflect on a wide range of alternatives of life and to interact with a variety of people to ensure that their judgements are well-informed and well-thought out. Then they need to act on their judgements so as to truly live well, and through social interaction, extend the flourishing from themselves to a wider group of people. At this point, we may find many elements and concepts recurring in the reasoning about how to promote human flourishing to be pretty familiar. This is because the four integral aspects of student agency identified in the previous sections—which are action, intention, reflection, and interaction—are all manifested in the educational aim of promoting human flourishing in a rather explicit manner: the aspect of *intention* is manifested in students' judgments regarding what kind of life they intend to lead; the autonomy-related skills and well-informed judgements require the *reflection* on different ways of life and the *interaction* with other people; *interaction* is also essential to communal flourishing in addition to individual development; to live well, finally, students need to take *action* based on their judgements. Hence, each of the four integral aspects of student agency plays a part in undergirding the educational aim of human flourishing. The ability to act on intentions, reflect on intentions, and the quality of social interaction are all the valuable attributes which could contribute to the realization of human flourishing. The promotion of student agency can thus be considered morally and educationally important given its

significance for human flourishing. Apart from the moral aim of human flourishing, the four integral aspects of student agency are also related to the ideal epistemic aims of education.

3.3.2. Student Agency and the Ideal Epistemic Aims of Education

Epistemic aims of education are the aims concerned with knowledge. The distribution of knowledge is widely seen as a salient dimension of the education which most people understand, and thus relating student agency to the epistemic aims of education could help capture the educational significance of student agency as a quality.

As Robertson (2009) summarizes, epistemic aims of education do not refer to the acquisition of knowledge content required by the learning objectives of specific curricular subjects; instead, they are the aims guided by the understanding of what is the nature of knowledge and what kind of knowledge is worth teaching. According to Robertson (2009), the epistemic aims of education generally fall into two categories—the aims related to the acquisition of propositional knowledge and the aims concerning the organized knowledge which "contribute[s] to perspective and understanding in orienting thought and action" (p. 14) including, for example, the overall and in-depth understanding of knowledge, the cognitive skills for evaluating knowledge, the epistemic virtues which guide students to use their knowledge and skills in the right way. Propositional knowledge refers to the information required for knowing something is so, which is characterized binarily as true or false, while the second type of knowledge is centered around perceptive and cognitive attributes which cannot be measured binarily. For example, the understanding of knowledge requires the holistic grasp of the larger picture of the significance and the interconnection of the individual propositional knowledge and its adequacy comes in degrees: say, if we are asked to play a specific note using the piano, the propositional knowledge of the piano keyboard is sufficient, and the audience could easily find

out whether we play the right note with the right key; yet only with the wholistic understanding of the instrument could we play a full melody, and the audience are likely to have a variety of opinions about the melody.

Among certain philosophers of education, there seems to be an attitudinal pattern regarding what are important epistemic aims of education—they attach more importance to the perceptive and cognitive qualities than the mastery of propositional knowledge. For example, Elgin (1996, 2007) argues that understanding rather than propositional knowledge is the goal of education. However, Robertson's (2009) discussion of these two categories of epistemic goals implies that they are not incompatible and they are closely connected to each other. And, most importantly, the concept of student agency is implicit in what connects these two.

To be more specific, according to Robertson (2009), the aims related to propositional knowledge have two accompanying and indispensable epistemic goals—truth and justification—because beliefs must be true and justified to count as meaningful knowledge. What is justification? As suggested by Scheffler (1965), justification is a process in which students bring about true belief "through the exercise of free rational judgment by the student" (p. 11), which is as valuable as the acquisition of true belief per se. Similarly, As Robertson (2009) puts it, the justification of knowledge requires that "educators should seek not merely to transmit knowledge but also to put students into a position where they can, to some extent, decide for themselves what to believe" (p. 17). Justification is what connects the aims regarding propositional knowledge and the aims concerning perceptive and cognitive skills and is where the concept of student agency is implicit. On the one hand, justification serves as an instrument for the pursuit of propositional knowledge or truth because "a student who has learned to reason well is more likely to arrive at true beliefs in the future than one who has made a lucky guess or gullibly takes

the word of another" (Robertson, 2009, p. 18). On the other hand, the justification of truth entails the more intangible perceptive and cognitive skills including making rational judgement and reflective evaluation on what is true or not, making intentional decisions regarding what to believe and what is virtually good to believe and disseminate. As we can see, at least two key aspects of student agency—intention and reflection—are implicit in the perceptive and cognitive skills and are instrumental to the justification of propositional knowledge[10]. In addition, as Robertson (2009) argues, between subjective justification and objective justification, educators should aim more at the latter, which requires the knowledge to be judged and examined not only by the students themselves but also by the wider relevant intellectual community. In this sense, another aspect of student agency—interaction—plays a crucial role in the pursuit of objectively justified truth by exposing students to the alternative opinions of other people. In fact, if students could critically reflect on other people's perspectives, the social influence would contribute to epistemic independence rather than infringe on it. In Coady's (1994) words, "[T]he independent thinker is not someone who works everything out for herself, even in principle, but one who exercises a controlling intelligence over the input she receives from the normal sources of information whether their basis be individual or communal" (p. 248). In other words, there is a social dimension "to becoming an independent thinker" (Robertson, 2009, p. 29). And if students could exercise their agency to interact with others and reflect on their views, this social dimension is greatly in their advantage.

[10] The aspect of action is not explicitly discussed here but is arguably implied. As previously discussed, action is the central aspect of student agency accompanying the other three aspects. After all, students must act on their intention and reflection to really acquire the true beliefs so as to fully accomplish the epistemic aim.

Chapter Summary

In this chapter, student agency is conceptualized in order to show how the concept of student agency embodies a range of valuable general aims of education. Based on the philosophical conceptions of agency, I identified four key aspects of student agency which are intention, action, reflection and interaction. These four aspects are also confirmed with the conceptual models developed by qualitative educational researchers based on psychological and sociological theories. Also, I pointed out that each of these four key aspects plays a significant role in the pursuit of broader educational aims, including the moral aim of promoting human flourishing as well as the epistemic aims concerning propositional knowledge and perceptive and cognitive skills. The multifaceted nature of the concept of student agency suggests that the concept of 'student agency' or educational aims by which we evaluate the 'educational impacts' of certain technology ought to include a host of aspects and not merely those that are popularly thought or assumed to be indicative of educational excellence—at least, we ought to know about how the given technology shapes learning in social and relational ways considering that interaction is a key aspect of student agency. As such, an impact analysis of how technology interacts with the four key aspects of student agency could shed light on technology's impacts on the education landscape in a broader sense. This impact analysis will be conducted in the next chapter of this thesis, with a closer look at the relation between technology's role in education and the conceptual aspects of student agency.

CHAPTER FOUR: A Case Analysis: Examining the Impacts of Artificial Intelligence in Education (AIEd) on Student Agency

To understand how the use of technology impacts student agency, the previous two chapters unravelled a complex of ideas regarding the two central concepts involved—'technology' and 'student agency'—respectively. Chapter two explored three philosophical perspectives of technology, which help to elucidate different conceptual and normative assumptions that can be brought to bear when interpreting the roles and impacts of technology in the educational context. Chapter three identified four integral aspects of 'student agency' and their connections with the broader educational aims, which highlight the significance of selecting the concept of 'student agency' as the point of reference for the reflection on the technological impacts facing today's educational landscape— 'student agency' is focused enough for us to capture the specific technological impacts and is multifaceted enough to embody various educational aims. This chapter seeks to develop a concrete case analysis which brings these ideas and conceptual issues together in order to demonstrate how they can serve as the theoretical resources for the analysis of a specific case of technology's impacts on student agency. While this chapter focusses specifically on the case of the impact of artificial intelligence in education (AIEd), the analysis that follows is meant to illustrate the value of the conceptual framework provided in previous chapters for addressing a wide range of issues related to technology's application in educational contexts.

I choose to use AIEd as the example because artificial intelligence (AI) is the most significant, influential and thus much-discussed technology of today, the use of which "could affect every aspect of work, play, and learning." (Volti, 2014, p. 403). As Holmes et al. (2019) put it, AI is "arguably the driving technological force of the first half of this century, and will

transform virtually every industry, if not human endeavors at large" (p. 1), and the possibilities AI brings to education "are profound yet, for the time being, overhyped as well" (p. 1). People's concerns over the use of technology lie more in such prominent, sophisticated and controversial technology as AI rather than the low-profile and quotidian ones such as a projector which comes with few concerns though its presence in the classroom is pervasive. In this sense, in addition to exemplifying the philosophical analysis of technology's impacts on student agency, the case analysis of AIEd also does justice to the common concern over the educative use of pioneering technologies and addresses the conflict between the significant technological changes and the humanistic values in the conventional education.

So, how might the use of AIEd impact student agency? First, the answer to this question depends on which philosophical perspectives we adopt to interpret the roles and impacts of technology in educational contexts. Second, the answer to the research question also depends on which aspect of human agency we are talking about. In addition, the knowledge of the features of AIEd is also required for us to understand specifically what kind of technological impacts AIEd might bring, and which aspect of student agency might be influenced. Therefore, in the next two section, I start with introducing what AIEd is and what AIEd is expected to deliver, especially as viewed from the perspective of its educational proponents; then, I analyze more critically how the use of AIEd impacts student agency based on the three philosophical perspectives of technology explored in chapter two and the four aspects of student agency identified in chapter three.

4.1. Overview of Artificial Intelligence in Education (AIEd)

Artificial intelligence (AI) literally denotes the intelligence demonstrated by man-made machines, as opposed to what is naturally demonstrated by intelligent beings such as humans and

animals. The term AI now often refers to computers or computer systems that have been programmed to interact with the world in ways normally requiring advanced intellectual characteristics of human beings, such as the ability to reason, to discover meaning, to generalize, or to learn from past experience (Copeland, 2020; Luckin et al., 2016). Regardless of its specific abilities, the functioning of any AI "depends both on knowledge about the world, and algorithms to intelligently process that knowledge" (Luckin et al., 2016, p. 18).

When the intelligent algorithms are brought together with knowledge in learning science-relevant disciplines including education, psychology, neuroscience, linguistics, sociology, and anthropology, there emerge a series of AI applications which could change how and what humans learn or teach, in some cases revolutionarily. Such applications are called AIEd (Holmes et al., 2019; Luckin et al., 2016). As Luckin et al. (2016) point out, AIEd could not only serve as the engines behind the educational technologies which offer "the possibility of learning that is more personalised, flexible, inclusive, and engaging" (p. 11); furthermore, it could also empower us with the "deeper, and more fine-grained understandings of how learning actually happens" (p. 11) which, in turn, inform the optimization of learning and teaching approaches or the redesign of the educational technologies per se. For example, through gathering and analyzing knowledge or data regarding pedagogical strategies (how to teach), student behavior (what the given student is like) and subject content (what to teach) using its algorithms, AIEd could build an adaptive learning environment in which it "select[s] the most appropriate content to be delivered to the learner, according to their individual capabilities and needs" (Luckin et al., 2016, p. 20). And, in the meantime, the ever-incremental data of learners' reactions to and interactions with what is delivered to them could then be computed and analyzed again to update and improve the existing knowledge of pedagogy, student behavior and the subject content and thus to constantly enhance

this adaptive learning environment. In other words, AIEd's collection and analysis of big data help "inform new ways to provide more efficient, personalised, and contextualised support, while also testing and refining our understanding of the processes of teaching and learning" (Luckin et al., 2016, p. 20). Such adaptive learning environment can be applied to a wide range of AIEd applications—for example, the Intelligent Tutoring System (ITS) which provides advanced personalized learning for students.

It is obvious yet still noteworthy that AIEd is not a single monolithic system; instead, it refers to the technological infrastructure which is composed of a wide and constantly expanding range of concrete applications with multiple intellectual capabilities to conduct various domain-specific tasks. According to Holmes et al. (2019), all the existing AIEd applications could be understood in terms of the SAMR model developed by Puentedura (2013) in which the functions of most educational technologies are categorized into four themes: *substitution, augmentation, modification and redefinition*. The definitions of these four thematic categories and the corresponding AIEd examples are illustrated in Table 3.

Table 3

AIEds and the SAMR Model

Components of SAMR Model	**Educational Technologies at Large**	**AIEds in Particular**
Substitution	Technology acts as a direct tool substitute, no functional change.	Not applicable (as of this writing)
Augmentation	Technology acts as a direct tool substitute, with functional improvement.	●Intelligent Tutoring Systems (ITS) ● Dialogue-Based Tutoring Systems (DBTS) ● Exploratory Learning Environments ● Automatic Writing Evaluation

		● ITS+[11] ● Language Learning ● Chatbots ● Collaborative Learning support ● Student forum monitoring
Modification	Technology allows for significant task redesign.	● Augmented Reality (AR) and Virtual Reality (VR) learning experiences ● AI Learning Companions ● AI Teaching Assistants ● AI as a Learning Sciences research tool.
Redefinition	Technology allows for the creation of new tasks, previously inconceivable.	● AI removing the need for stop-and-test examinations (i.e., by providing continuous highly adaptive assessments).

Note: This table is made by Holmes et al. (2019, p. 168) but the author adds some annotations with respect to the abbreviations in the right column.

As we can see from Table 3, no existing AIEd serves as the pure substitution without functional change, which implies that the use of AIEd makes a difference to education. The right column lists a variety of concrete AIEd applications, the terms of which generally introduce what these changes are. Luckin et al. (2016) explain more specifically what AIEd applications could offer for education at present as well as what the future possibilities of AIEd would be: currently, AIEd mainly supports teaching and learning in three major areas: 1) providing an intelligent, personal tutor for every learner; 2) providing intelligent support for collaborative learning through building an engaging learning community; 3) supporting learning in authentic environments through intelligent virtual reality; however, in the future, AIEd is expected to make advances in another four major areas: 1) helping learners gain important skills by using big data

[11] By ITS+ Holmes et al. (2019) mean "approaches that augment or extend standard ITS functionalities, that perhaps expand the reach of an ITS or add another layer" (p. 137).

to better measuring the characteristics of these skills—especially some currently difficult to assess ones such as creativity and curiosity—and by better understanding the most effective teaching approaches and the learning contexts that allow these skills to be developed; 2) reforming the assessment system to better shape the learning progress; 3) embodying new insights from the learning sciences to better predict and influence educational outcomes; 4) giving people lifelong learning partners.

Of note is that although the above functions demonstrated and/or promised by AIEd, in both its current and next phases, are varied in terms of their specific focuses, they all point to one explicit thing: the implementation of these AIEds requires and normalizes the intensive interactions between human subjects in the educational context (students/teachers/educators) and non-human computers or computer systems, and the use of those AIEds is expected to bring significant changes to the whole education landscape. In the following section, I analyze in more details the impacts of such influential and ostensibly promising educational technology as AIEd on student agency based on the philosophical perspectives explored in previous chapters.

4.2. Philosophical Analysis of AIEd's Impacts on Student Agency

I divide this case analysis of AIEd into three parts, each of which addresses one single theoretical account of how AIEd impacts the four aspects of student agency.

4.2.1. The Instrumentalist Account

According to instrumentalism, human is placed at the center of the human-technology relation, and technology is nothing more than the neutral educational means at the full disposal of humans. This instrumentalist account, as elaborated in chapter two, invites little reflection on the technology in use; instead, it places an emphasis on human responsibility and encourages an inflated sense of optimism towards human power—it celebrates humans' absolute dominance

and control over technology. As such, whatever outcomes or problems accrue from the use of AIEd must, according to the instrumentalist view, be viewed as the products of human intention and choice. This instrumentalist account of technology implies a categorical presupposition regarding how AIEd impacts student agency—AIEd can only impact student agency in a way that humans want or allow student agency to be impacted, and it can be a positive or negative way.

To illustrate this point, let us think about certain use scenarios of Intelligent Tutoring System (ITS), one of the AIEds which have been widely used. ITS can arguably impact student agency positively and negatively. The ITS could intellectually 'personalizes' a desirable learning goal for an individual student based on what it 'knows' about her and 'offers' her customized learning resources, immediate feedback and clear guidance which the student needs to achieve this goal. ITS is very much like the personalized learning (PL) system I mentioned several times previously, yet powered by AI, it can be much more intelligent and powerful in the sense that it can learn constantly from the behavioral patterns and changes and feedback of the students and accordingly change the learning content it 'recommends' for her; it can perform a wider range of sophisticated tutoring functions such as the instant grading of the student's essays with comments. As we can see, these functions of ITS can arguably promote student agency in certain ways since it helps the student clarify their *intentions* and support her to take *actions* to realize them. However, on the other hand, ITS might also 'embed' a set of beliefs, ideologies or misinformation into the student's mind through the intensive interaction given that it gathers a large quantity of data of the student and 'knows' clearly how to possibly change what the student believes and behaves. In this case, ITS becomes a vehicle of indoctrination rather than education. Returning to the four aspects of student agency and their interconnections with each other

enables a finely grained analysis of how student agency can be negatively impacted in this scenario—the powerful algorithms of ITS makes it difficult for the student to make well-thought out decisions (through reflection) and well-informed decisions (through interaction) about what she learns (intention) and how she learns (action). How might technological instrumentalism interpret such these positive and negative impacts of ITS on student agency?

Technological instrumentalism directs our attention to the purposes, strategies and efforts on the human side. It gives the credit for the positive impacts of ITS to the human stakeholders who design, develop, market, employ the ITS—the educational possibilities within ITS and the realization of them are exactly the kinds of purposes emphasized and pursued by these humans. Instrumentalists do not believe that technology can function without human efforts. And, when the indoctrination problem arises from the use of ITS, instrumentalism encourages us to explain it as the fault of the non-democratic states or private companies which attempt to sponsor or propagate certain ideologies or misinformation via the use of ITS, or as the fault of the human developers of ITS who translate the content for indoctrination into terms of algorithms and fail to design the ITS in a way that enables the student to have a say in what she learns.

As we can see, in these instrumentalist interpretations, humans are held solely responsible for whatever the ITS offers, good or bad. It then follows that if they do it right, they can always use ITS to positively impact student agency in terms of every aspect—they believe they can use it to assist students to reflect on their educational goals (intentions), to engage students in meaningful interactions and to empower students to act on the goals. This is the inflated sense of optimism towards human power encouraged by instrumentalism. With such optimism, despite the possibilities of humans' misuse of ITS, there is a strong likelihood that the incorporation of

ITS into the classroom or other domains for teaching and learning is generally approved and encouraged by the instrumentalist account of technology.

It is noteworthy that, from the instrumentalist perspective, for technology to positively impact student agency, humans must make every effort to use the technology right and, furthermore, use it right for every one of the four aspects of student agency—otherwise we cannot guarantee a positive impact on student agency or education, which, after all, is multifaceted. This instrumentalist vision represents humans' confidence in capitalizing on the potential of any given technology and their determination to take full responsibility for whatever follows, the spirit of which should be appreciated. That said, this vision only captures one valuable dimension of human-technology relations— the agency and significant role of humans in the use of technology. However, it misses another important dimension—the inevitable changes brought by technology, which is a dimension strongly emphasized and even overhyped by technological determinism.

4.2.2. The Determinist Account

Technological determinism does not encourage us to focus on the role and power of humans. Instead, it reminds us of the vulnerability of humans in front of technology—technology is viewed as a totally independent force following its own logic and determines not only the educational outcomes but also how we think about education or student agency.

From the determinist perspective, humans cannot control ITS to impact student agency in any ways they desire or plan. Instead, determinists believe that ITS, or any AIEd, or any educational technology impacts student agency in a way that we humans cannot control and sometimes even cannot anticipate or understand. Occasionally there are human factors involved in the difficulty which individual users have in controlling or determining what and how they

learn with the use of ITS. According to Holmes et al. (2019), some critics of ITS argue that the mechanism of ITS itself "reduces student agency" because "it is generally the ITS (its algorithms and student models) and, at a higher level, the ITS designers, that determine what should be learned, in what order and how; while the student is given little choice but to follow the ITS-determined individual pathway" (pp. 171-172). Although this claim highlights the inability of students to make decisions for themselves in front of ITS, it is still of great instrumentalist implications—it points out that the real decision-makers are the human designers of ITS "at a higher level" who control the student models and algorithms. However, hard determinists interpret the use of ITS as the total rule or domination of ITS in which no human factor matters or makes a difference. According to O'Neil (2016), the neutral network of AI can lead to decision making for which the rationalization is hidden, unknowable, un-inspectable and possibly unjust. As Holmes et al. (2019) put it, "[i]t isn't possible (or at the very least it isn't easy) to interrogate an artificial neural network to find out how it came up with its solution" (p. 221). Humans may find the way AIEd selects and delivers the educational content to be unfathomable as well as uncontrollable. This has an important implication for student agency. As I mentioned earlier, ITS might indoctrinate students with ideologies or misinformation sponsored by non-democratic or private agencies. In that case, it is still possible for humans to identify the problems and solve them by, for example, introducing certain policy intervention. However, if the internal workings of ITS are secretly or non-transparently determining certain fundamental ideological beliefs which are unknown to humans, then it seems like student agency is profoundly undermined, not only because the beliefs themselves might be false or morally corrupt, but also because they are immune to critical scrutiny and human interrogation. In addition, if AIEd is so un-inspectable, erratic and influential, can we trust it to identify the

multiple layers of student agency and then address each of them to help us promote student agency? What the determinists highlight is that the general human agency is in danger in front of technology, let alone the specific aspects of student agency. Even if we think we take advantage of the power of AIEd to develop certain aspect of student agency, determinist will not view that agency as the true agency—they believe technology is the real decision-maker that controls every detail of contemporary human life. This concern over the inconceivable internal mechanism of ITS can be used to explain why instrumentalism is limited. Instrumentalists expect ITS to serve for their intended educational goals, but from the determinist perspective, and taking the sophisticated 'intelligence' of ITS or other AIEds, there is a strong likelihood that such pioneering educational technologies function on their own goals and humans can hardly know what these goals are and how they are going to achieve them.

As such, humans are no longer the real decision-makers of the AIEd-based education, which is disquieting, and consequently, a series of collateral concerns would arise. People might worry that AIEd does not share the humanistic attitudes, values and goals or learn from the worst ones. For example, Douglas (2017) argues that AI is not only learning humans' biases but also amplifying them. If the AIEd learns from certain data shows that women account for a much lower percentage of the workforce in the field of computer science, how would AIEd interpret and response to this data? Would AIEd view it as a result of employment discrimination, or would AIEd explain it as a phenomenon that women have less aptitude for computer science and thus should mainly be offered elementary-level knowledge in that field? We do not know. It is unlikely that people will refrain completely from using technology in educational contexts due to these concerns, yet they will probably be more wary of the potential impacts within any

emerging educational technology and be reminded of the importance of critically assessing their choices of technology.

Some people would argue that humans are still able to influence how AIEd works by optimizing its algorithms and training its neutral network to better serve for human purposes. They can probably optimize the use and design of any technology constantly. At least, there are always people who try to unpack and clarify the impacts of using technology, like me in this thesis. Also, even the leading advocates of AI would admit that the singularity—the point at which AI becomes too powerful and capable of improving itself or designing other AI more advanced than itself— "appears to be due to arrive at some ever-receding future date" (Luckin et al., 2016, p. 15). In this sense, technological determinism seems to overhype the power of AIEd and its grip on human society. Or in other words, like instrumentalism, determinism also ends up capturing only one dimension of human-technology relations—the dimension of inevitable technological changes, while it misses the dimension of human agency—humans are probably not denied the ability to escape from a destiny completely determined by technology.

As we can see, both the instrumentalist account and the determinist account are caught in the idea of 'who controls who' when it comes to humans and technology and fail to capture the important dimension of human-technology relations emphasized by the other.

4.2.3. The Postphenomenological Account

By approaching technology from a postphenomenological perspective and viewing technology as the mediator of student-teacher-world relations, we seek out complex rather than categorical and simple answers to the question of how technology impacts student agency. This postphenomenological approach does not simply combine or aggregate the two opposite and incompatible classic views together into a third hybrid category—it also provides a means of

discerning, describing and analyzing the educational impacts of specific technologies on different aspects of student agency—the postphenomenological vocabulary (see Table 2 on p. 61). Compared with the two classic views, the postphenomenological account is more analytical than conceptual—it is no longer caught in the search for a 'who controls who' explanation; instead, it highlights the dynamic nature of human-technology relations—thus, it enables us to focus and reflect on the more subtle and detailed interactions between technology and human endeavors across contexts and time.

In the following paragraphs, I seek to conduct a postphenomenological analysis of ITS. My analysis can by no means cover all the possible impacts ITS has on student agency but at least it provides some illustrations that enable us to see how postphenomenology helps us move beyond the analyses made available by the aggregation of instrumentalism and determinism.

To begin with, let us first identify certain changes brought by ITS based on postphenomenological vocabulary (which will be italicized). The use of postphenomenological vocabulary enables us to discern and describe how ITS reshapes the experience and existence of the students, their peers as well as teachers in the given educational context or world; thus, we are allowed to further analyze how student agency is affected as a result of the changes in experience and existence. From the *hermeneutic perspective*, ITS *transforms* how students and teachers *experience* and *perceive* the educational environment and the world they are in. To name a few, for students, what should be learned is *interpreted* by ITS as what it presents its screen—knowledge and learning resources come in the form of texts, images and hyperlinks which ITS personalizes for the individual students; when it comes to the interpersonal relationship in the learning environment, students' peers might be *interpreted* as small icons or profile pages on the screen; furthermore, what changes the most is the teacher figure—human teachers are no longer

foregrounded as the one who do the lecturing or tutoring; instead, they are now only in charge of supervising the functioning of ITS and observing the student data generated by ITS. So, for the human teachers, students and their performance are converted into data and statistics. As we can see, what is *amplified* is the information on the screen—be it the learning content or the profile pages of students; what is *reduced* is the face-to-face communication among students, their peers and human teachers—it is *reduced* to chat bubbles with emojis. From the *existential perspective*, ITS reshapes how all the stakeholders in the educational environment *exist* and *act*—it gives concrete shape to the behavior of students and teachers and the social context of their *existence*. ITS *invites* students and teachers to memorize and internalize the information on the screen, click the mouse and type on the keyboard to accomplish their learning or teaching tasks while at the same time *inhibits* or at the very least discourages them from other types of activities such as handwriting, public speaking, directly observing and chatting with other people around them, etc.

How would each aspect of student agency be impacted by this host of changes? Let us focus on a specific scenario in which the ITS provides the feedback on a student's essay writing. ITS is able to offer the feedback and comments immediately after the student submits her essay. And the feedback is generated based on a large amount of data in the corpus. In this case, most of the grammatical and lexical mistakes in the essay can be instantly detected and modification suggestions can be provided simultaneously. As such, the student can quickly realize where she made an error and how to revise it; her student agency in terms of 'intention' and 'action' is arguably supported in this sense. Nevertheless, the ITS might also recommend some books or online courses on writing for her to further improve writing, which might be generated only in the interest of the developers of the ITS and hot hers—perhaps following the instructions of ITS is a waste of time for her. In this case, it seems that ITS does not always support meaningful

intention or action. This concern is not unreasonable because the development of personalized learning-related technologies is often pushed by those who want to profit from the educational technology market (Roberts-Mahoney et al., 2016), and the infrastructure of AIEd is expected to "resemble the marketplace that has developed for smartphone apps" (Luckin et al., 2016, p. 12). As such, the information generated by ITS might not be determined by the students themselves, nor the educators, but by the for-profit actors. How can we be reassured if we let the profit-seeking AIEd companies or organizations tell students what to learn and how to learn and let them collect the data of a large body of students? Even when our ITS developers are the ones of integrity, AIEd's very own algorithms and artificial neural networks, as introduced previously, can also lead to unconceivable and unjust decisions.

This concern over the information provided by ITS also brings us to the discussion of the other two aspects of student agency, i.e., "reflection" and "interaction". When ITS and its instructions have been *amplified* in the student's learning as, respectively, the teacher and the single source of information, the student is invited to view what is shown on the screen of ITS for granted with little skepticism, especially when the AI-powered ITS attempts to do so—in that case all the pieces of information disseminated by the ITS would conspire to reinforce what it wants the student to believe. If so, students' ability of critical reflection is alarmingly debilitated, which means that they are less likely to critically process the information delivered by ITS and are more susceptible to its influences. In addition, when human-computer interaction becomes ever more pervasive, face-to-face interaction is becoming ever more marginalized and the student learns and benefits less from it. However, face-to-face interactions and debates among students, their peers and teachers are arguably much more conducive to the cultivation of reflective thinking and the facilitation of autonomy than computer-based discussions. This is

because, for a student to truly gain autonomy in terms of thinking independently, critically and freely, she must be exposed to the "serious advocacy" (Brighouse, 2006, p. 25) for alternative views, or in Mill's (Mill, 1975) terms, she must "hear them from persons who actually believe them; who defend them in earnest and do their very utmost for them" (p. 36). In other words, students need to attentively listen, observe, think and feel while others are expressing their views in the face-to-face interaction so that they could better relate to or critically understand alternative views.

The technological impacts facing interaction could also be analyzed in-depth in terms of the student-teacher relationship in the use of AIEd. Grading essay is more than an intelligent task of identifying grammatical and lexical mistakes which can be properly replaced by AIEd; instead, it is also an emotionally exhausting task involving affective labour such as caring, listening, reassuring, comforting, supporting. For example, an affectionate human tutor can see a larger picture from a student's essay. If she reads between the lines and senses depressive and even suicidal emotions, she can perform affective labour to try to walk the student through her difficulty. But if this essay grading job is fully offloaded to AIEd, will the computer system identify the painful experiences of this student and offer her support? Maybe theoretically and technologically it is possible. Yet the premise is that humans must ensure that they fully understand the neural network of AI and try to humanize it, which, as previously mentioned, is difficult. Otherwise, there might be some counterproductive outcomes. As Watters (2015) suggests, the use of AIEd would possibly remove care from education and leads to unimaginable consequences or a "black box society" based on a decision-making process of AIEd hidden from us. For example, AIEd might possibly misconceive the student's depression as a source of poetic writing—which it values—and thus it deliberately provokes more negative emotions of the

student for more ‘beautiful’ sentences. Yet without the emotionally supportive interaction for the student, her agency is not enabled to flourish. Furthermore, grading is not merely emotionally exhausting but intrinsically educational. It seems unlikely, to put it mildly, that ITS in education could provide anything but a pale and inadequate facsimile of the real human thing, due to the finely grained emotional, cognitive and relational requirements of educationally worthwhile grading practices. For example, it seems highly implausible that even a sophisticated AI machine could provide the kind of finely grained, philosophically informed feedback my supervisor is providing for my thesis, formulated in a tone that takes into account his knowledge of me as a person and my educational capabilities and objectives as a student. In other words, the intellectual, cultural and emotional capital needed for human teachers to grade an essay or engage students in a meaningful interaction with them seem to remain substantially beyond the what the capacities or mechanism of AIEd can offer. Therefore, the use of AIEd in education might impact the meaningful interaction between students and teachers and thus the development of student agency or other educational aims we value in the humanistic education.

On the other hand, from the perspective of human teachers, when students together with their information and performances are converted into measurable data, teachers and educators tend to rely on these data to know and connect with their students. This prioritization of data analysis over direct communication, observation and understanding might not be conducive in forming the emotional bond between teachers and students or creating opportunities for students and teachers to better learn from and get inspired by each other. For both students and teachers, poor quality of interaction would lead to poorly informed reflective thinking and intentional actions and hence would not be in favor of the development of student agency. After all, these four aspects of student agency are not isolated yet interconnected.

Some may argue that AIEd could also provide novel opportunities for establishing an ever more engaging collaborative learning environment through providing "adaptive group formation, expert facilitation, virtual agents, and intelligent moderation" (Luckin et al., 2016, p. 26). I hope and I do believe that such promise is true. After all, one major distinction between the postphenomenology of technology and technological determinism is that the former trusts in humans' ability to influence where the technology leads—humans can provide the contexts and identities for the technology. Optimizing the features of AIEd and granting its new identities such as virtual agents for the sake of interaction facilitation is highly promising and technologically feasible. Yet still, the use of any emerging or optimized AIEd is very likely to have multiple new and different impacts on student agency, maybe some of which cannot be easily optimized this time. Yet the postphenomenology of technology is still an indispensable conceptual tool for educators to understand the ways in which AIEd transforms how students experience the classroom and exist in it in educationally beneficial ways—it suggests that we are to capitalize on this potential while keeping a close eye on the factors that might undermine the positive transformative potential.

Chapter Summary

Through the case analysis of AIEd based on the conceptual framework of 'technology' and 'student agency', we realize that a wide range of complex factors bear on any attempt to understand how technology impacts student agency—the power of humans emphasized by instrumentalism, the inevitable technological changes highlighted by determinism, the ever-shifting existence and experience of students and teachers depicted by the postphenomenology of technology, and the different interpretations of what the value of education is. These factors are also and of course what bear on any attempt to 'optimize' the use of technology for educational

good as much as possible. It seems that instrumentalism and determinism only capture a few, while the postphenomenology of technology captures most of them—specifically, it counterbalances the tendency in determinism to focus on technology's power to overwhelm human purposes; at the same time, postphenomenology avoids the overly optimistic tendencies of instrumentalism. In addition, it provides a framework by which we can identify ways in which technology interacts with each aspect of student agency and serves a range of worthwhile educational aims. The multifaceted conception of student agency allows us to analyze and reflect on the technological impacts on education in a nuanced, in-depth and comprehensive manner—for example, we keep in mind that the interaction between students and teachers reshaped by AIEd is an equally, if not more, significant indicator of the real educational impacts of AIEd compared to educational efficiency.

CHAPTER FIVE: Conclusion

5.1. Summary and Implications

This thesis set out to seek answers to the question of the how the use of technology impacts student agency. I adopted a two-layered philosophical approach to unravel the two key concepts at issue— 'technology' and 'student agency'—prior to discussing them together in a concrete impact analysis of artificial intelligence in education (AIEd). As I explored these two concepts one by one, or more accurately, chapter by chapter, I realized and also sought to highlight that the attempt to seek simple answers to my research question is becoming increasingly difficult.

First, the answer to this question depends on which philosophical perspectives we adopt to interpret the roles and impacts of technology in educational contexts. I examined three philosophical theories of technology and their normative assumptions about the role of technology in education.

Technological instrumentalism depicts technology as a functional and neutral instrument at the full disposal of humans, and thus it places an emphasis on human responsibility and encourages an optimistic attitude towards human power over technology. If we follow this instrumentalist account of technology, we are inclined to see ourselves or the human users of technology as the source of any impacts and problems of the technology in use—we feel that if we intend or design the technology to serve for certain educational aims, it will do so and only do so. In this case, the answer to my research question is clear: technology can only impact student agency in a way that humans want or allow student agency to be impacted. Although as I emphasized, this instrumentalist account oversimplifies the power of technology, I also argued that it inspires humans to explore and capitalize on every potential educative value which

consists in the available technologies. In other words, instrumentalists may welcome the incorporation of technology into the classroom since they believe in their own power to take advantage of the technology in a right way, but they do not attach too much importance to it—even when they have no sophisticated or advanced technologies in hand, they are still optimistic about their own power in terms of using what they have to achieve whatever educational aims they value and, of course, of using what they can to overcome whatever negative impacts they try to avoid.

Technological determinism encourages us to answer the research question in a diametrically different way—according to the determinist account, technology impacts student agency in a way that we humans cannot control and sometimes even cannot anticipate or understand. This is because determinists depict technology as a totally independent force following its own logic and determines not only the educational outcomes but also how we think about education or student agency. For example, according to Ellul's determinist theory of 'technological phenomenon', when we start to value efficiency and efficiency-related educational aims, we are already at the mercy of the technology we use. Technological determinism is criticized for its overhyping of the power of technology and underestimation of human power, but this theory provokes us to rethink and reassess our choices of technology in educational contexts, which suggests us raise our awareness of the potential impacts that technology might bring, particularly the negative ones.

The postphenomenology of technology's answer to the research question is relatively flexible in comparison with the other two theories—according to this theory, the impacts of technology on student agency depend on how the specific technology reshape how the specific users experience the world they are in and how they behave in this world. And to better

understand how these two aspects are reshaped, we need to resort to the postphenomenological vocabulary and conduct a specific impact analysis. In other words, the postphenomenological account itself encourages us to seek complex rather than simple answers to the research question.

Second, the answer to the research question also depends on which aspect of human agency we are talking about. If we only focus on 'intention' and 'action', there is a strong likelihood that we find student agency to be enabled by the use of many technologies—educational technologies tend to make it more convenient and efficient for students to be informed of what they should learn and what resources they could use for learning. However, once we consider student agency as a multifaceted concept involving a complex of aspects including 'reflection' and 'interaction' which cannot be easily measured in terms of what is typically indicative of technological advantages such as efficiency and convenience, we will have to base our evaluation of the impacts of technology on the conceptual complexities of student agency. It is also noteworthy that intention and action are not isolated aspect, they are connected to reflection and interaction; in this sense, it might take a fairly elaborate analysis and justification before we can answer the question of how the specific technology impacts student agency.

Finally, after my brief analysis of AIEd's impacts on student agency, particularly from the postphenomenological perspective, the difficulty and complexity of answering the research question was again highlighted. How does the use of technology impact student agency? Even in the specific case of AIEd it is still difficult to answer because, as we can see, AIEd mediates the experience and existence of humans on so many levels while any mediated perception or action is intertwined with and influential for multiple interconnected aspects of student agency. Even the same change could result in different impacts on different aspects of student agency

simultaneously, and the nature of these impacts—be them positive, negative or mixed—highly depends on which aspect of student agency we are talking about and from what angle. Moreover, it is also challenging to quickly point out which impact prevails and which pales because it all depends on the specific user contexts which are ever shifting. Maybe in the very near future, certain algorithms could prove to decentralize the decision-making of AIEd and thus combat any attempt to use it as a propaganda machine.

No one can know with certainty the answer to that question. But such complexity of technological impacts points to one thing that we do know and ought to keep in mind—the use of any educational technology deserves a constant and critical analysis rather than any presupposed conceptual judgement and categorical conclusion, like what the two classical views suggest. Maybe it is neither possible nor desirable to discern every possible difference or impacts of technology—after all, it could take an enormous amount of time, energy and resources to do so and some of the differences anticipated could end up being quite minor and insignificant from an educational perspective. Still, the value of the postphenomenology of technology is that it captures a wide range of complex factors that bear on any attempt to "optimize" AIEd. We should also keep in mind what we could learn from the two classic views—to always capitalize on the potential educative value of any given technology regardless of how quotidian it is, and to always be wary of the potential negative impacts of any technology regardless of how promising they say it is. All these implications could help navigate us through the contemporary educational landscape in which technology has undertaken an increasingly prevalent and influential role, particularly in this post-pandemic era.

5.2. Limitations and Future Possibilities

Even though I tried to provide some evocative insights and to highlight important points regarding technology's application in education, this thesis is not exempt from drawbacks and limitations. For example, although the three philosophical conceptions of technology are among the most prominent and widely acknowledged theories of technology, they do not dominate the literature of philosophy of technology and do not obviously cover all the theoretical understanding of technology. There might exist some solid theories that challenge or complement the ones I discussed yet missed in the discussion. In addition, in the thesis, most of my discussions and examples are developed based on normative assumptions derived from a complex of theories and my own logical reasoning, which is also the reason why I cannot provide a specific answer to the research question, even in the case analysis. In order to further test or reinforce my conceptual framework, future work is expected to involve empirical evidence from a broad range of educational studies including cognitive science, psychology, sociology etc. For example, to examine the actual impacts of the Intelligent Tutoring System (ITS) on different aspects of student agency, there is a need for empirical studies including quantitative analysis of student's reading speed as well as accuracy of reading comprehension with the use of ITS, cognitive experiments, and qualitative interviews to record student' feedback, etc. The empirical studies might also help further clarify the relations among the different aspects of student agency.

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