

ETHICAL CHALLENGES AND STRATEGIES IN AI-ENABLED PERSONALIZED LEARNING: A QUALITATIVE STUDY

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Abstract: With the rise of technological reform and AI-empowered educational transformation, novel means of personalized learning has been developing for customized needs of learners. Nevertheless, stakeholders in the educational sphere do worry about ethics, considering it as something uncertain and risky, at least to some degree, for humans' learning, development of critical thinking, creativity and emotional intelligence. This paper presents a study of ethical challenges and strategies in AI-enabled personalized learning context by firstly adopting a bibliometric approach to finding out gaps in previous literature, then following a qualitative interview methodology to ask for the real-world ethics violation problems from the learners and the teachers and lastly conducting a focus group interview to figure out strategies for the ethical challenges from the real world as stated by the students and teachers. A whole story of ethical challenges regarding AI-enabled personalized learning has been synthesized by the researchers based on interviews and proves to encompass the macro-level and micro-level ethical challenges, with the former further wound up by researchers from a PESTEL (Political, Economic, Social, Technological, Environmental and Legal) perspective and the latter broken down from six smaller perspectives. What's more, after focus group interview with experts and administrators in concern, practicable strategies for the ethical challenges and risks in the context of AI-enabled personalized learning are proposed.

Keywords: AI-enabled personalized learning; Macro- and micro- ethical challenges; Strategies for tackle the challenges; Qualitative study

1 INTRODUCTION

As a matter of essential urgency, learning in the AI context is mediated technologically pervasively in education. Knowing the challenges facing the ethical issues against the background of AI-empowered education sets the tone for tackling such potential challenges with technological advancements. All the factors shielding humans from the goal of being physically, mentally and emotionally healthy are deemed unethical [1-2]. Therefore, ethics challenges in AI-enabled education are the facets in learning and teaching that pose threats on the well-being of the stakeholders like teachers and learners.

However, there is a rich range of literature talking just generally about ethics issues or narrowly describing ethical challenges with students at a certain stage of schooling, thus making it necessary to discuss ethical challenges in AI-enabled personalized learning and find approaches to them.

Moreover, present researches focus on a deductive method or an inductive method to talk about ethics challenges in AI-enabled education, without researches centering on an abductive approach from an empirical viewpoint. As a consequence, the researchers aim to draw evidence from the true learning context about ethical risks by taking the learners at core and solicit practicable solutions to the risks.

2 LITERATURE REVIEW

2.1 Ethics

Ethics is a judgement about being right or wrong and a human ability to choose the right from the wrong [3]. Scholars have deepened it with the development of human society to refer to ethics as the sense of intuition and a sense of mission to do the right things [3]. Ethical judgements and behaviour are the results of exploiting intelligence, which incorporates human intelligence and artificial intelligence, thus making it worthwhile to consider ethical issues when AI engages in human teaching and learning [2]. This study defines ethics as a sense of intuition of telling right from wrong, the awareness and intelligence of doing right things and the literacy of reasoning out the philosophies behind behaving in the right way.

2.2 Ethical Theories Related to Education

Ethical theories vary, among which those theories concerning education are deontology [3-4], consequentialism [3], theory of justice and fairness [5], theory of autonomy and agency [6], utilitarianism [3, 7], virtue ethics [3, 8] and so on. None of those theories cover human education related ethical problems against the AI context [9-10], since deontology focuses on only the agent who takes action to judge it ethical or not, consequentialism on the results not process,

utilitarianism seeing ethics too utilitarianist-wise with the calculation of utility minus disutility done, virtue ethics on the formulation and reference to virtuous qualities and the other two theories overly incomplete. This research tends to employ human flourishing ethics as a theoretical basis, which entails a human state of prospering, thriving, fulfilment and living well [3, 11-12] and requires in educational settings a future-oriented and long-term view to power the holistic development and fulfilment of an individual's potential in the physical, mental, spiritual and emotional dimensions [3, 12].

2.3 AI-Enabled Education

AI-enabled education constitutes a metaverse-based education system to facilitate immersive learning experiences and promote learning efficiency [13-14]. Such teachings and learnings are designed to make education free from physical limitations and regional constraints and characteristic of multi-modes, multi-cultures, diversity, inclusivity, agreeability, enjoyment, sense-inspiring features and so on [15-16]. With all the ideals fulfilled, AI-enabled education would be all about benefits rather than disaster, yet here come the ethical challenges.

2.4 Ethical Challenges in AI-Enabled Education

External challenges concerning adoption of AI in educational environment come from the prerequisites and imperative supportive forces of it. First, it costs a lot to establish the AI supporting infrastructure, which harbours the potential to cause increasing digital divide and information disparity among differently developed regions [17-18]. Therefore, usability and accessibility to an AI-enabled educational world may naturally divide people. Second, it is limited by the lack of equally developed legislation to maintain observance of law in a digital world [19-20]. Third, cultural biases and prejudice may happen since economic disparity may alienate some culturally disadvantaged regions [3]. Fourth, perception deficiency means social views of the merits of the technology may not be so compatible with the technology itself, causing adaptation difficulty of AI [21-22]. Fifth, technical constraints like time limits, device inefficiency, unexpectedly poor device shutdown or low server resilience might also exacerbate the matter [23] since underlying ethical issues like misinformation, data and privacy leakage do happen [24].

Teaching and learning related internal challenges are: first, confidentiality concerns cause people to hold unhappy [25] since individual learning data (learning style, use of language, behavioural tendency or a learner's progressive paths, absence frequency, thinking flaws) are typically exposed to the digital world [26]. Second, though young people are less concerned about privacy issues, adults care much about related issues [27]. Third, psychological manipulation, cognitive discordance, digital illiteracy, privacy paradox are all factors leading to ethics worries [28]. Third, complete dependence on AI-based immersive learning is also problematic for a user's physical and mental well-being [29]. Person-to-person communication, real life engagement or formulation of a sense of belonging [30] might all find no way in an AI-interactive world, caused by a lack of humanistic features like courage, integrity, kindness etc, which is a source of dehumanizing experience, thus violating human ethics [31].

3 RESEARCH DESIGN AND METHODOLOGY

3.1 Data Collection

There are three steps. First, by exploiting related literature under the PRISMA Framework [32], the researchers explored the present research reality with regard to ethics, ethical theories, ethical challenges and ethical challenges in AI-enabled education. Second, a qualitative approach was undertaken to glean data, with online interviews carried out between one researcher and each of the ten students who have engaged themselves in AI-supported learning and with face-to-face interviews of three teachers whose students used AI in their after-school learning. A purposeful and targeted sampling principle was followed. Five students were from senior high and the rest were from college, each kind with AI-supported learning experiences. One teacher came from Junior High, one from Senior High and another from college, each of them showing concerns over AI-empowered students learning. Lastly, based on the ethical challenges and risks summarized from the previous step, two school administrators and two college experts devoted to AI study were invited, over a focus group interview, for recommendations for coping with the challenges, thus establishing a better ethically healthy AI ecosystem. It is noted that a focus group interview stands out when arguments and opinions about an issue are expected to facilitate strategies-proposal and decisions making [33]. All the interviewees involved in the research were given rewards for their care and attention.

3.2 Data Processing and Analysis

For the first step, a bibliometric approach was adopted to explore and refine the existing and possible ethical considerations of AI-aided education in literature to define key concepts and fit an ethics theory in with the study. Journal articles were retrieved in three major databases, Springer, ProQuest and Web of Science with the key words "ethics in AI-driven education personalization", "ethics in AI-aided learning", "Ethical challenges in AI-driven learning", "Ethical challenges in AI-enabled learning", "Ethical Challenges/Risks in AI-enabled learning and teaching", which produced a total of 2389 journal articles from 2019 to 2024.

Then, a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis, see Figure 1) framework [32] was applied to filter articles. 52 studies and reviews were selected for this study as shown in Figure 1. There are 2389 journal articles about ethical considerations concerning AI, yet after excluding irrelevant ones to educational sphere (but related to medicine, science, biomedicine etc.), ruling out ones focusing on topics unconnected with educational ethics, and filtering the remaining 294 by double-checking time limits, domain relevance and focusability, the eligible journal articles were chosen.

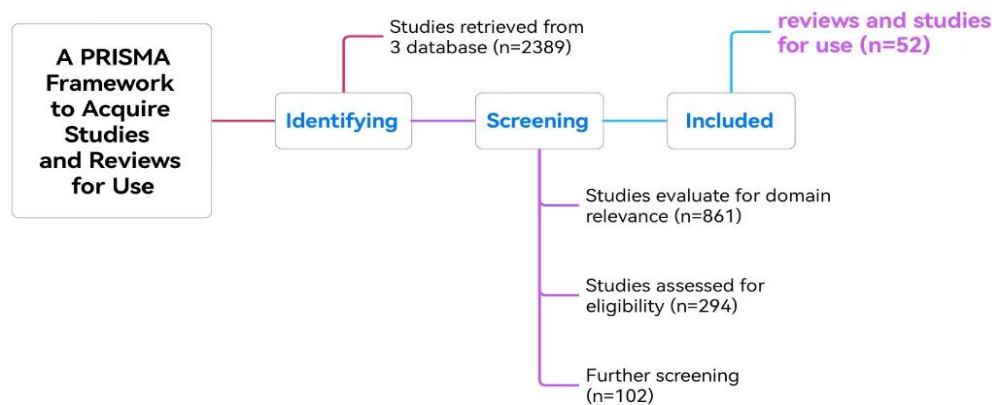


Figure 1 A PRISMA Framework Run to Select Studies and Reviews for Use [32]

For the second step, semi-structural interviews with the ten students and three teachers were conducted respectively. The interview outlines are based on the essentials of human flourishing ethics, which, according to Kantar and Bynum [12] encompasses attainment of human autonomy, being a part of a group or community, access to all the resources, knowledge and opportunities, physical and mental security, and the maximization of equality of all those above in a justice-filled environment. By importing texts and audios to NVivo 14, data analysis was carried out by cleaning, coding, categorizing and analysing the data. According to the nodes created, the core categories, themes and sub-themes were shown (Figure 2). Similarly, raw data from teachers' interviews were dealt with, resulting in a categorization exhibit as presented in Figure 3. Comparing Figure 2 and Figure 3, the researchers found that, teachers, with their instructional thinking and logic as well as more holistic and systemic views, actually cross-check some opinions of the students, indicating a possibility to synthesize the reporting of ethics challenges under one theoretical framework [34] to facilitate strategies seeking.



Figure 2 Main Themes and Sub-Themes from Students-Related Data Analysis

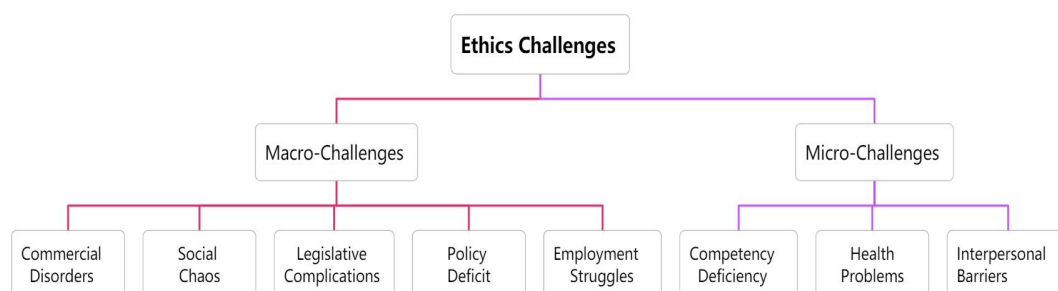


Figure 3 Main Themes and Sub-Themes from Teachers-Related Data Analysis

As for the last step, two school administrators and two experts studying AI were invited, over a focus group interview, for recommendations for coping with the challenges looming the educational context, thus making it possible to establish a better ethically healthy AI ecosystem for all the stakeholders. Notably, a focus group interview stands out when arguments and opinions about an issue are expected so as to facilitate strategies-proposal and decisions making [33].

3.3 Methods of Theory Construction

Here an abductive methodology of theory constructing was adopted. Abduction is neither deduction nor induction, it is based on the perspectives of some theory (in a deductive way) while complementing that, if possible, through empirical research (in an inductive way) [35]. The manifestation of abduction found its proof in phase two and three. For phase two, deduction appeared when interview questions related to ethics challenges in AI-enabled education were proposed on the basis of literature review about ethics theories; meanwhile, data analysis in step two was dependent on an inductive method, e.g., categorizations of students' and teachers' views of ethics challenges in concern are summarized and generalized upon the interview data [35]. Besides, in phase three, though data from group focus interview was organized to generalize recommendations for ethics risks in AI-enabled personalized learning in an inductive way, yet the analysis and presentation of the results were organized partially under PESTEL framework so as to make the suggestions clearer and more acceptable, which, anyhow, follows deduction.

4 RESULTS

4.1 Students' Views of Ethics Challenges in AI-Enabled Learning

As the data shows, students took delight in AI-enabled learning at first. For example, S3 (Student 3) described, *"I thought of it as a new friend, making me curious and full of expectations."* As time went by, some students found it tiresome to confront the device to either do *"repetitive practice"* (S1, S3, S8, S9, S10) online or *"attending online classes"* (S1, S2, S7, S9, S10). A further exploration of students views offered more information as follows.

4.1.1 Internal risks

Data analysis results fell into internal risks and external risks. There are five sub-themes for internal risks.

Physical harm

"Eyesight", "being sedentary", "burnout" are frequent words according to data. AI-supported tutoring, though seemingly freeing students from commuting pressure to meet tight schedules, was reported to deprive students of their right to walking for exercise and talking to real-life partners for emotional reassurance. S3 mentioned, *"Long time look at the screen to take online personalized exercises lowered my eyesight, and now I am wearing glasses of high degree."* *"From time to time I want to talk with my deskmate just like we did before"* (S7). Still, students' sedentary situations were worsened after long-day sitting in classrooms when they still had to be seated to learn under the guidance of AI-aided learning assistants. S10 mentioned, *"My back got broken after AI tutoring. I do not want to work like machines."* Therefore, physical harm on students' body worsens with the long-term use of virtual AI, which is different from traditional real learning experiences, the latter just being more physically-friendly.

Mental burden

"Burnout", "isolation", "addiction" are further themes under sub-theme *Mental burden*. "Addiction" is the word most frequently appearing in students' account, displaying that AI related devices risk being over-used or misused. S1 mentioned, *"I just secretly spared time during AI-enabled learning to play online games with my partner. We were even stuck."* Addiction to e-device caused students to be more exhausted physically and mentally. They found no way to level themselves out of that, though. Therefore, they became more isolated and more unwilling to talk with their peers, families or relatives. *"Caught by so-called online learning, I just took it as opportunities to look through short videos, shopping websites. My roommates asking me to go parties doesn't work."* stated S4.

Cognitive blockage

"Lower learning efficiency", "loss of judgement", "acting without deep thinking", "loss of self-discipline" are the most frequently-mentioned themes here under *cognitive blockage*. Some students thought of AI as "technology for good" only at times (S5, S8). Some worried their cognition had downgraded after a long period of adoption of AI-enabled learning (S2, S6). Still, others admitted their loss of quick and critical response to problems, a result of superficial repetitive exercise in certain subject, thus deteriorating their ability to act wisely (S9). What's more, some stated their self-discipline actually was not improved and they tended to delay what they were supposed to do earlier. S1 recalled, *"AI-enabled learning seems lucrative at first, yet it did not lure me naturally to study. I have a sense of being pushed."*

Intelligent Retrogress

"Memory" is the only frequent word in this sense. *"I used to have memory skills, but they are gone"* (S9). *"Memory is something you can train yourself to enhance. AI-aided personalized learning curbs the training of exploiting memory, so it is losing"* (S3). Memory loss constituted the most apparent facet of students' intelligence retrogress, which means over-dependence on AI device may claim human born abilities or at least deduce them.

Interpersonal Barriers

"Stay alone" and "social rejection" are most commonly shown themes here. Students who are accustomed to AI tutoring may find it natural to cut ties with humans and seek whatever they want in virtual space. Their interpersonal skills got rotten without talking, walking and hugging people. Proof came as S8 stated, *"I even feel alone when I am*

with my friends. Guess what, my bosom friend, who learns with AI, told me she had almost become a house cat with no social interactions.” That knowledge, ability and competency are better acquired when students exchange opinions with other people and when they find their practical application in life.

4.1.2 External risks

For external challenges, two sub-themes were detected.

Social distance

As students refuse to narrow social distance, their distancing way of learning will gradually take shape, so will that of the next generation. “All the community become quieter after school” S10 stated, “My aunt and uncle send the children to AI rooms, but they get seated with their phones” said S5. Without social interactions, students’ mental health problems will take roots and possibly become trickier to deal with. All these will haunt students’ learning effectiveness. “My teacher knows my shortcomings better and I just need her frown or smile to go further” (S1).

Over-competition

Students even worried about their future employment after graduation with AI-enabled learning deepened and advanced. Their thoughts were revealed through expressions like “rate race”, “fierce competition” to help develop the theme over-competition. S7 pointed out, “Price rat race has already on. Our very next anxiety is about whose AI device outperforms.”

4.2 Teachers’ Views of Ethics Challenges in AI-Enabled Learning

Analysis of teachers’ interviews was conducted to demonstrate the main themes and sub-themes as exhibited above. When the main themes go with *Macro-challenges* and *Micro-challenges*, the sub-themes of each go as follows.

4.2.1 Macro-challenges

At the macro-level, sub-themes and the results are below.

Commercial disorders

Teachers used expression like “buying rush” (T1, T2), “commercialization not education” and “pricing war” (T3) to surface the commercial disorders. Sales of AI learning related devices popularize, and since the providers do not know much about educating students and tutoring them on their study, they depend on promoting their products. “They would say, it is for tailored learning, so an iPad for each kid is necessary to talk parents into buying” (T1). Paying for their child to learn in self-learning care centre, parents may soon find their money not worth it or seek for better service, thus causing the business to crazily cater for market demand, blurring the meaning of education. According to T3, “college students skip physical classes with the hope of learning from online AI-supported courses before their finals, and such commercial courses and alternatives do exist, replacing students’ true experiences in learning.”

Social chaos

“Companion learning machines”, “fixed answering machines” and “cold talkers” were the labels the teachers given to some of their students’ problems and AI learning risks. Machines do not share human emotions, warmth, care and love; they do not learn with flexible methods, dynamic thinking and holistic considerations of the real need of a humankind. What’s more, AI-assisted learning facility usually catches students’ pursuit of curiosity about virtual world, thus exacerbating the problem of making students separated from real world life. “Phubbers now start very young. What lacks is the daily greetings in the lift to show kindness and warmth to community members” (T2). “Some of my students turned to me for encouragement and better, warmer remedy for their learning before and they paid it forward. However, AI-stuck learners do not.” (T1). Social competency should be cultivated when one is still young and get improved as he or she grows older, while AI based learning risks igniting such turbulence and chaos in society.

Legislative complications

More profound risks are posed upon the legislation to perfect the legal systems considering AI-enabled learning infrastructure, business, industry and education activities. Educational training organizations are trying to discover new opportunities, and violations in their business conducts may follow, thus making legislation more complicated. “Radical changes in legislation and legal execution are expected to follow suit to maintain better behaviour in AI-enabled learning context” according to T3. Students’ rights and duties in engaging in AI-backed learning should be maintained and made clear. “What students shall do and shan’t do is not sure” (T1). Legislative cooperation with technology service developers is expected to take place, making the scene more complex.

Policy deficit

Students’ learning burden has been a major concern of the educational sphere, with after-school homework and after-school learning service providers severely banned. However, the rise of AI-aided learning mode may just exacerbate anxiety and worries. “It all comes down to a pyramid-like design from top-down” (T3). Policies lead the educational sphere and related industries to go after certain trend and technology. “Is AI just a memory of intelligence or a real intelligent being? Or AI is just a paradox without a promising future for humans?” (T2). Only timely policy making and execution can curb problems radically, but policy making regarding AI-enabled learning is not yet so systemic and clear-cut.

Employment struggles

There are students who find employment in AI technology sector to better the reality and prospects of that, yet more frequently ordinary students find themselves disqualified in the market for their bad interpersonal skills, poor language expressions, inability to build business bonds, incompetency to solve problems and even deficit of viewing their profession in a reflectively critical way. “Do common students reap what they sow and pay?” (T1, T3) Unemployment

exists everywhere for people of various ages, AI personalized learning and tutoring should have done a lot to tackle the problems. *“It just caused concerns about losing jobs. We teachers sometimes worry about that”* (T2).

4.2.2 Micro-challenges

At the micro level, teachers take the challenges from the development of their students and the risks are sub-themed as *competency deficiency*, *health problems* and *interpersonal barriers*. The results are here.

Competency deficiency

Many aspects concerning students' full-fledged development may render stronger or much weaker with the application of AI-aided personalized learning. Students with clear learning literacy and objectives may develop better “learning autonomy”, “self-discipline”, “critical thinking”, “creativity”, “problems-solving abilities”, while most students are on the way to better their learning literacy, the introduction of AI tools risk being obstacles hindering their development with their lack of self-judgement and digital literacy. *“Technology is always double-edged, helping those take charge of it and taking control of those who lack competency. Consequently, those whose competency shortcomings will get enhanced”* (T3). The mindset of resolving learning obstacles by resorting to AI's repetitive cycles does harm to students' acquisition of various competencies, especially the ability to think creatively and critically. *“Students with high self-discipline are capable enough to promote their competencies. Those in the critical developing process will find the competencies hindered”* (T2).

Health problems

“Worse eyesight”, “tiredness”, “laziness”, “being sedentary”, “fatness”, “attention problems” are most commonly discussed health problems. According to T1, students in her classes become increasingly stuck to their seats not only in class but also at home. *“They surely take seats most of the time in school. Even after school, they lose access to running as their after-school time belongs to sitting with AI”* (T1). AI based learning style negatively affects students' attention since their thinking cycles are not scientifically identified and facilitated. *“Most of the time, AI assistants just give them exercises. No emotional care. No encouraging hug. No such things”* (T2). The paradox of AI-teaching is given full play, as *“Practice makes not only perfection but also problems. Basically, they are health problems. It's awful”* (T3). Students themselves report such risks, which really raises alarms for the society to work it out to protect students' right to physical well-being.

Interpersonal barriers

Students do have some interpersonal communication difficulties, which is why they are encouraged to take part in social activities. However, when schools strengthen the use of AI, students have to circle them in a closed and virtual space after school. As stated by T1, *“Students distance themselves with the communities, which are rich land for them to know about life.”* Not reaching out to life cause students to be less aware of empathy, compassion and reaching out to others when necessary. *“Even college students cage themselves at home during holidays. They claim there is no reason why they should get out with AI assistants”* (T3).

4.3 Ethical Challenges in AI-Enabled Personalized Learning

The reported challenges, from the students' experiences and teachers' perspectives, complement each other. By drawing on literature sources, the research found that external challenges (main themes in Figure 2 and Figure 3) can be wound up with a PESTEL model [36]. Meanwhile, the Micro-level ethics challenges are modelled as PEMISI with reference to both the ethics theory pre-defined in this study and the empirical evidence from students' and teachers' accounts. Consequently, the research synthesizes them under a framework demonstrated in Figure 4, with both sub-themes from both teachers' and students' interviews added up.

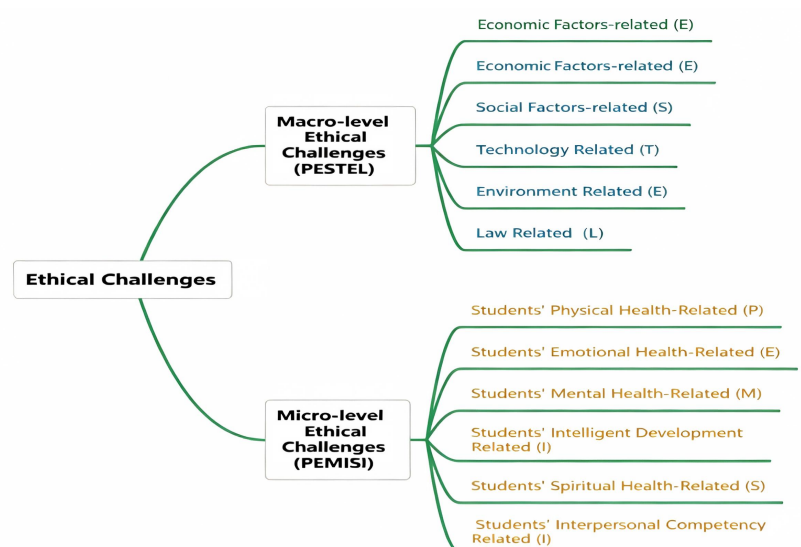


Figure 4 A New Theoretical Framework of Ethical Challenges in AI-Enabled Personalized Learning

4.4 Strategies to Tackle Ethics Risks Concerning AI-Enabled Learning

4.4.1 Strategies for macro-level ethical challenges

(1) Political strategies

On the one hand, governments should formulate governing responsiveness and resilience. Timely enlightened, reasoned, informed and well-versed policy-making and strategic planning for infrastructure are in urgent need. According to Ad2, *“Precise and considerate guidelines, dynamic regulations and financial investments are all in need, so governments have to make decisions by involving all possible stakeholders, schools and teachers, students and families, social groups or even international organizations.”* On the other hand, the government can implement AI-based holistic deployment and governance over educating all the citizens on AI literacy and road-mapping AI supportive networks in a balanced, eco-friendly, equitable and humanistic manner (Ad1 & Ex4).

Economic strategies

For-profit organizations should shoulder business responsibility for protecting personal data, conducting transparent deals and following the law of market (Ad1 & Ad2). Non-profit organizations can fundraise for channelling resources into human-friendly AI-based educational programs, *“General fundraising and virtuous commitment to AI-based learning conducts will need to go”* (Ex4). Trans-sector collaboration and best-practice exchanges between business organizations, technology developers and educational institutions are expected to grow out of nothing in deploying AI-enabled educational technology. *“Preventive actions are the cure”* (Ex3).

(2) Social strategies

First, social institutions' endeavour of educating teachers and students on privacy protection, data storage and improving their AI literacy is to be realized. *“Citizens' ethical thinking and ethics related digital literacy are of great importance”* (Ex4). Second, ethics education and training of community members in using and applying firewalls against ethical violations to combat the risks are to be done (Ex1&Ad1). Third, school, educational administrations and education related businesses are to maintain integrity in providing AI-based learning materials and resources. Fourth, family-centred community ethics supportive plans for an AI-empowered educational landscape should be initiated. *“Joint efforts are a must”* (Ex3). *“Mouth-to-mouth reminders of ethical risks help enhance joint efforts”* (Ad1).

(3) Technological strategies

Equitable access to networks and AI tools regardless of geographic disparities should be achieved through well-purposed development and improvement of AI and with tech companies' commitment to corporate responsibility and conscience (Ex3&Ex4). Besides, the tech side *“should enlarge its database, upgrade the algorithmic logic used for AI-enabled learning modelling and testing”* (Ex4). Tech giants are also supposed to design and provide joyful and satisfying experiences in AI personalized learning while curbing repetitive exercises. *“Too much repetition of previously done exercises helps nothing but stereotype”* (Ad2). Better still, tech companies or developers can reform expressions of AI-related algorithms to help learners deepen their understanding of AI logic and control their unethical behaviour. *“Firewalls, permission setting, de-identification or encryption of data are to be perfected to ensure due application of AI in promoting human competencies”* (Ex3).

(4) Environmental strategies

Approach to environment related ethics challenges should take into account the physical and the cultural environments (Ad1&Ex4). The one thing is to curb waste of infrastructure, device substitution and over-consumption of AI-supportive learning devices so as to free schools and families from the burden of purchasing. *“It's interesting that many families are AI-rubbish-rich. There should be sharing economy here.”* (Ad1). The other thing is related to standardization of the cultural norms prevailing in the virtual learning space, pedagogical disparities, delivery of values, degree of interaction and the awareness of all the instructional culture. *“AI-enabled personalized learning has different modes, values and styles, leading to different instructional culture and different students' experiences”* (Ex3).

(5) Legal strategies

The basic thinking is that law establishment should function as a supplement to possible ethical violations. *“Ethics and laws are intrinsically different ways of restraining misbehaviour, with the former individuals-dependent and the latter compulsorily executed. If there are no ethical problems with AI-based education, there is no need for law and regulations”* (Ex4). First, the right for each student to get access to equally qualified digital devices for learning should be secured instead of “bringing your own device” policy (Ad1&Ex3). Second, law should be made and enforced to differ the work of digital beings or AI devices from that of human teachers. *“If teachers' values are fully realized, learners will resort to human approaches more willingly”* (Ad2). Third, the standards and principles for punishing unethical behaviour should be different from those in the real educational settings. *“Punishments related to virtual learning violations can be stricter”* (Ex4) and *“Rewards for AI ethics protection can be used”* (Ad2). Fourth, the overlapping areas among legislative measures, social moralization and technical constraints on possible violations of ethics in AI-assisted learning shall be defined or joint efforts, enforced. *“Either legislative blank or over-legislation does harm”* (Ex3).

4.4.2 Strategies for micro-level ethical challenges

Following the principle of MECE, mutually exclusive, collectively exhaustive, the researchers omit overlapping strategies. Besides, summarising outcomes of focus group interview, the researchers put the strategies related to students emotional, mental and spiritual health together since the issues related are hard to get separated.

(1) Strategies for ethical risks in students' physical health

The best ethical remedy is not to cut the tie with AI-enabled learning tools since their mighty power can be leveraged to humans' advantage. The key is for the learners to willingly, voluntarily and timely draw back from the addiction. *"More breaks and time-outs are expected during the use of AI tools"* (Ad2). Students can thus rest their eyes, their back, their neck. *"The harmony is formed through striking the balance, not through getting AI out once and for all"* (Ex1). *"Standing up or walking out is better than sitting always"* (Ad1). More is expected from human teachers to guide students in the exploitation of AI personalized learning.

(2) Strategies for ethical risks in students' emotional, mental and spiritual health

Apart from building technological safeguards, students should raise awareness of AI-enabled learning literacy. First, AI-guided learning is only a supplementary approach when the human teachers are not available, and learners should not see it as a replacement. (Ex3, Ex4, Ad2). *"Clear recognition of AI-supported personalized learning helps students avoid super-high expectation, which allows learners to know the boundaries between their real teachers and AI tools"* (Ad1). Second, learners' mindfulness of the possible merits and demerits reminds them of data privacy protection, elusion of misinformation and withdrawal from spreading misinformation, and ensures that they have wonderful personalized learning without teachers' or parents' presence. *"Appropriate use of data helps learners improves their satisfaction with AI"* (Ex4). More importantly, *"The ability to control its use strengthens students' continuous satisfaction with AI learning, and their mental state will be bettered, which helps reduce the possibility for obsession. A virtuous circle will be developed"* (Ex1). Third, mental isolation or spiritual separation with the use of AI tools should be alerted and eschewed. *"It is on the learners themselves to seek human talk, a big smile or a warm hug."* (Ad 2) Turning to human teachers for emotional resonance, spiritual assurance and mental relaxation work better than relying on AI, which is the key starting point of exploiting AI for learning (Ad 1&Ex 1). *"Remembering there is always a human being behind you to support you works"* (Ad2).

(3) Strategies for ethical risks in students' intelligence development

Deliberate training and exercise of human brain and intelligence should be maintained. Instead of resorting to AI-enabled learning for all daily intellectual activities like counting, memorizing or thinking, students should emphasize the beauty of utilizing their born intelligence to calculate, to speak, to memorize and to talk to others. *"Intelligence rises when you subjectively want it to."* (Ad2) Besides, human flourishing objectives require the development of daily intelligence of mankind and a display of higher-order intelligence like critical thinking, reflexive thinking, problems-solving intelligence and so on. *"Problems-solving is a long-term training result. One cannot acquire it by shielding himself or herself from the chance to do it"* (Ex2). It is also true for some more highly-demanding intelligence like cultural intelligence or adversity intelligence, which can only develop through human endeavour (Ex4 & Ad1).

(4) Strategies for ethical risks in students' interpersonal communication ability

The first step is to put down your AI devices and find someone. *"Listening, talking or having a look are basics of human nature, without which there will be no warmth"* (Ex 1). The second step is to cull some interpersonal skills mindfully. Listening carefully, responding timely and reaching out warmly makes the one who seeks for human help feel more worthwhile staying with their peers (Ex1&Ex2). The third step is to spread the belief that AI-enabled learning machines are just tools not the trump card of humans. *"Our mankind trump card is our creativity and compassion in showing care about others"* (Ad2).

5 DISCUSSION

The three-phase research concludes from the empirical evidence the ethical challenges, puts them under two dimensions (macro and micro) with PESTEL or PEMISI models respectively, and sums up corresponding strategies under the two models in accordance with experts' views.

During the first phase, a PRISMA framework [32] was adopted to search, examine, filter and refine the data obtained from journal articles. As a result, the existent ethics considerations in literature have been clarified and so have the definitions regarding ethics, ethical theories related to education, AI-enabled education and ethical challenges in AI-enabled education. Here in this research, ethics are defined as a sense of intuition of telling right from wrong, the awareness and intelligence of doing the right things and the literacy of telling the reasons for behaving in the right way. Ethical theory in education is defined human flourishing [3, 12] related, i.e., a future-led and long-term view to facilitate the all-round and comprehensive development and fulfilment of an individual's potential in the physical, mental, spiritual and emotional dimensions. AI-enabled education refers to teaching or learning with the use of AI device or agents while ethical challenges in AI-enabled learning are multi-faceted, encompassing external factors and internal ones. Compared to previous research, the definitions of key concepts in this research are both theoretical and empirical, with the definitions extended with the interviews in phase two.

Phase two of the research demonstrates a holistic view of the ethical challenges framework in AI-enabled personalized learning by using abductive modelling method. The research reveals that, on the macro level, ethical challenges existent can be modelled on the PESTEL [36-39], considering political, economic, social, technological, environmental and legal factors; on the micro level, ethical risks can be broken down as learners' physical, emotional, mental and spiritual health, learners' intelligent development and their interpersonal communicative skills. In comparison with previous study, the researchers here meticulously summed up the perspectives to be included in evaluating ethics risks in a visualized framework, making future ethical considerations of challenges clearer and more time-efficient. The researchers also extended macro environmental factors to include the physical environment and the cultural

environment, which is essential in light of over-consumption of natural resources to unethically produce more devices or underestimation of culture due to lack of embodied cultural experiences.

During phase three, experts' recommendations on approaches and strategies are proposed. On the macro-level, important ethical issues are concerned with timely and informed decision-making and far-sighted deployment and governance (P), efforts from for-profit and non-profit organizations as well as their collaboration (E), enlightenment of AI literacy of all community members and family-based community ethics education campaign (S), equal access to networks and AI products, transparency of algorithms and readability of AI logic (T), de-reliance on AI products and de-differentiation from instructional and pedagogical culture (E) and law establishment and enforcement of ethical behaviour (L). On the micro-level, time-outs, breaks and mindful protection of physical well-being (P) are essential, so are frequent human interactions to tackle emotional (E), mental (M) and spiritual aspects related ethics challenges. Besides, exploitation of human intelligence (I) such as memory and counting benefits ethical use of AI. Better still, the tendency to turning to human beings helps maintain close tie with social beings (S), thus developing all-round human competency in social interactions (I), which is more ethical.

6 CONCLUSION

Despite the comparable smaller size of the samples, it is concluded that, given the wide range of problems concerning ethics, which are evidently multi-faceted and cross-sectors in education, AI-enabled learning poses broader external challenges and wider individual-bound risks, which are later considered and targeted under the ethical theory of human flourishing to solicit recommended strategies for challenges resolution. The result is that political decision-making and deployment with governance, economic collaboration among all kinds of organizations, technological transparency, equity of access to networking infrastructure and algorithm availability, environmental awareness as well as legislative establishments and law enforcements are of crucial significance on the macro-level to tackle ethical challenges and risks in AI-supported customized learning; meanwhile, on the internal micro-level, ethical challenges can be addressed through dynamic co-functioning and synergia of one's physical, mental, spiritual and emotional health, development of one's intelligence and attention paid to enhance a learner's interpersonal communication skills. With the strategies proposed, it is expected that potential ethical challenges in the AI-enabled personalized learning context can be pre-tackled.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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