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Enhancing personalised learning with artificial intelligence - Implementation challenges from educators' perspective in vocational education and training

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Abstract

With the recent uptrend of personalised learning (PL) coinciding with the advancement of artificial intelligence (AI) technologies, Singapore has been encouraging the mainstream education to adopt PL by tapping on the AI's capabilities and potential. Although a Singapore's vocational education and training (VET) institution had planned to pluralise PL with AI, they recognised that staff might face potential challenges hindering its implementation. A qualitative case study was conducted to explore the feasibility of implementing PL across the institution from the perspective of VET staff. Semi-structured interviews were carried out on six experienced VET staff members from four different faculties to gain insight into their prior knowledge, existing experience and future perspective of PL with AI. Adopting Cultural-Historical Activity Theory (CHAT), the data were sorted based on themes that contradict the notion of pluralising PL with AI. Through abductive reasoning approach, the findings indicated that the division of labour, community and rules contradicted the mass consumption of PL due to the lack of PL pedagogical knowledge from VET staff and the complex setup of various diploma courses in the institution. Additionally, the usage of AI to support or enhance PL and the VET institution's direction to pluralise PL without thorough research and guidelines was further contradicted by the community and the division of labour. Therefore, this study recommends VET institutions not to pluralise AI PL too early. Instead, VET institutions are recommended to conduct small-scale AI PL to build up use cases and staff confidence prior to institutional wide adoption.

Keywords: Cultural-Historical Activity Theory, Technology enhanced learning, Personalised learning, Vocational education and training, Artificial intelligence



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Introduction

Singapore's education has been advancing in parallel with the latest technological trend. Minister Chan (MOE Singapore, 2024) highlighted the need to pluralise personalised learning (PL) in education to cater to the needs of individual learners and unlock their potential. This emphasis on PL is driven by its numerous benefits, including the provision of immediate feedback, support for different learning needs, and the generation of exam questions, among others (Isiaku et al., 2024; McCarthy & Schauer, 2017; Prain et al., 2013). Additionally, with the increasing usage of artificial intelligence (AI) in recent years, personalised learning experience becomes highly accessible to students through various Generative AI (GenAI) platforms (Isiaku et al., 2024; Pesovski et al., 2024). Some local primary and secondary schools in Singapore have embarked on trials to implement PL into the school system (Tushara, 2023). Minister Chan further encouraged teachers to leverage educational technology (EdTech) resources such as AI and Generative AI (GenAI) to address individual learning needs, thereby offloading teachers' workload and enabling more purposeful engagement with learners (Isiaku et al., 2024; Taylor et al. 2021).

Although significant research has been conducted on PL over the past two decades, its use cases have not been widely implemented in mainstream education (Fariani et al., 2022; O'Donnell et al., 2015). Most of the studies focused on exploring specific technology that support PL in classroom setting rather than its implementation as a systemic approach. Furthermore, there is a lack of research on PL studies in higher education (HE) or vocational education and training (VET) contexts, as existing studies primarily addressed PL in general education (Fariani et al., 2022; Lin, 2023; Tushara, 2023). This gap is likely due to the complex integration of technology, pedagogy and governance required for PL implementation in HE and VET (Lin, 2023; Muñoz et al., 2022; Rakshika, 2024). Therefore, it is crucial to identify and address these barriers to enable HE and VET to explore practical solutions.

Existing studies focus a lot on the benefits and approach to implement PL without discussing issues pertaining to teachers practising PL. Bernacki et al. (2021) highlighted the vagueness in defining PL boundaries and guidelines for educators who wish to implement PL approach. On the contrary, few books detailing PL approach in designing and planning have been published (Ferguson et al., 2001; Grant & Basye, 2014; Murphy et al., 2016). Additionally, studies have shown the use of AI and GenAI to efficiently offload educators' administrative tasks and effectively implementing PL (Castro et al., 2024; Isiaku et al., 2024). As such, the contradiction indicated that it is not the poor definition of PL nor the lack of scholarly studies in PL, instead the focus of pluralising PL should turn to factors limiting the use of AI in supporting PL implementation in vocational settings.

Furthermore, Murphy et al. (2016) encouraged various external stakeholders such as governments of the state or district to support schools with PL resources and training. Similarly, in McCarthy and Schauer (2017) implementation of PL on a school level, evaluation of the success and challenges considered the division of labour, including teachers, parents and EdTech administrators. Hence, to truly understand PL implementation barriers in HE and VET, teachers' inputs on their potential challenges are important considerations to provide school-wide practical implementation solutions. Therefore, this study aims to investigate the limiting use of AI which hinders the pluralising PL, focusing on the perspective of various department staff, with the following research questions:

RQ1. What concerns or challenges do VET academic staff foresee if the institution implements PL?

RQ2. How do VET academic staff perceive the use of AI in their job involvement with AI PL?

Theoretical framework

This study takes on a social pragmatism outlook to understand external influences that could potentially hinder the pluralisation of PL. Pragmatism views truth as an idea made possible by events (Koopman, 2006). While many PL studies have discussed the benefits of enhancing a learner's learning experience, PL has not been implemented across school levels. Thus, this has drawn attention towards putting PL into pragmatic practice in education (Fariani et al., 2022; O'Donnell et al., 2015). Additionally, since very few studies have explored the success of PL in VET and HE over the past two decades (Fariani et al, 2022; Lin, 2023; Tushara, 2023), social barriers could potentially hinder the adoption of PL at the school level. Therefore, by studying the practical challenges of PL implementation through a social perspective, future studies can then explore realistic solutions and provide appropriate support to encourage PL adoption at the school level of VET and HE.

From a social pragmatism perspective, this study adopts Cultural-Historical Activity Theory (CHAT) to examine the impasse of implementing PL at the school level. Further developed by Engeström (1987) from Activity Theory, CHAT can be used to examine social activities, ranging from learning to working, through a collective of cultural perspective (Holzman, 2006). Particularly for learning, Engeström (1987) concluded that learning activities that occur within schools are not limited to individual learners but are also influenced by social and cultural needs and policies (Bligh & Flood, 2017). As such, radical learning approaches such as PL are likely to be implicated by social and cultural boundaries. Therefore, referencing from CHAT, this current paper examines multiple

voices, such as teachers, managers and academic administrators who influence the implementation of PL activities at the school level (Engeström, 1987).

Based on CHAT, this study focuses on the distribution and exchange within the PL activities. Adapted from Engeström (1987/2015, p. 87), Figure 1 illustrates CHAT's structure of human activity, showing how a collective of interrelated activities within a society ultimately leads to the consumption of the product (Engeström, 1987/2015). The entire human activity system starts with the upper sub-triangle, where a valuable object is produced using an instrument to satisfy the subject's need. This study considers learners and teachers as the subject, who can utilise AI EdTech as the instrument to support and deliver PL as the object. The three entities thereby form the upper sub-triangle of the human activity that produced PL.

Since many studies have indicated the benefit of PL without achieving pluralisation (Fariani et al, 2022; Lin, 2023; Tushara, 2023), CHAT's model suggests that distribution and exchange of AI EdTech could potentially hinder the communities' consumption of PL. In Middleton's (2013) study, he highlighted that the rules within schools limited the resource allocation towards learning, which was influenced by local authorities. Eventually, these rules hindered the exchange of educational resources for learning consumption. Additionally, Mørch et al. (2013) emphasised that it was the congruity among various departments ameliorates a product holistically, as each process contributing to the distribution of the product can significantly affect the outcome for consumption. Hence, without a productive division of labour to utilise AI EdTech and distribute PL, or without proper guidelines to ensure the fair exchange of PL through AI EdTech, the community would not be able to access and consume PL effectively.

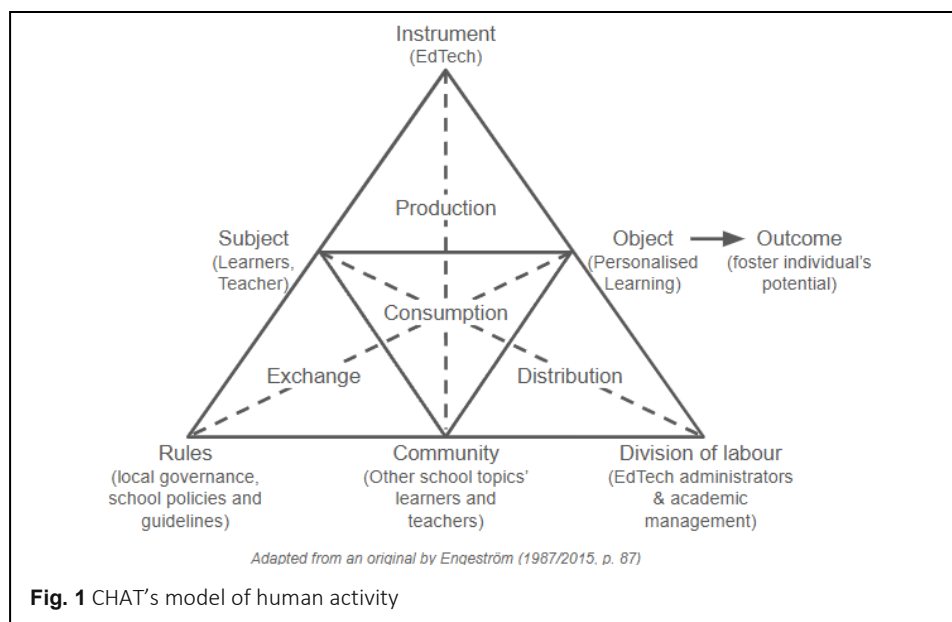


Fig. 1 CHAT's model of human activity

While distributing PL can be successful based on existing studies, the environment and setting for each school may differ and affect the implementation. Learning activities that take place in a specific setting are fundamentally shaped by the historical cultural practices (Engeström, 1987). In Warmington and Leadbetter (2013) study, the cultural learning practice across multi-agencies in the same country can vary. Although the schools are governed by a set of local authorities and policies, individual schools may have inherited a cultural teaching approach over time, which is often highly influenced by their labour force. As such, by understanding the contextualised cultural practice of a VET through CHAT, inherent issues within a specific school environment that restrict the implementation of PL can be identified. Thus, this study's result can provide insights towards implementing PL using AI EdTech within the context of VET.

Literature review

This narrative literature review examined the issues with pluralising PL based on cultural and historical challenges faced by existing PL studies. Google Scholar and the Scopus database were used to search for English-language, peer-reviewed journals, conference papers, and books published since 2000 within the subject areas of 'social science' and 'computer science.' Keywords used in the search included:

- 'personalised learning' AND
- 'history' or 'definition' OR
- 'technology enhanced' OR
- 'education' or 'higher education' or 'vocational education training'

From the results, PL articles that discussed on the following were excluded:

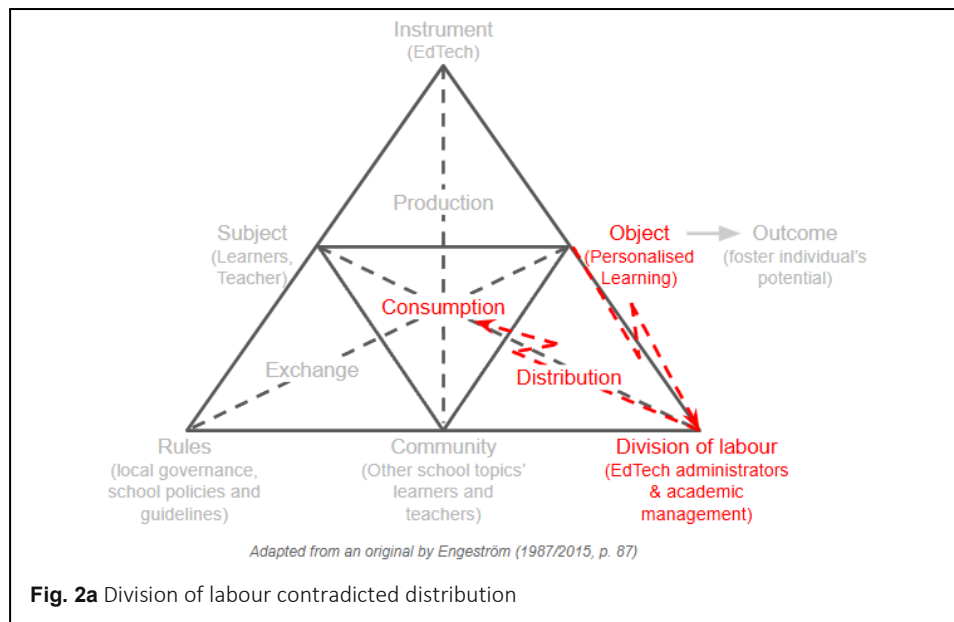
- EdTech technical issues, OR
- PL with innovative EdTech, OR
- kindergarten, pre-school, primary schools, secondary schools.

Discovered papers were briefly reviewed by examining their titles, abstracts, and, where necessary, skimming through sections to determine their relevance to contemporary or social issues arising from EdTech in PL. As a result, 19 out of 39 sources were selected for this literature review after filtering, forming three main discussion sections: evolving definitions, social restrictions, and the HE & VET environment. Finally, this extensive discussion identified the struggles faced by various academic staff within institutions, which guides the focus of this study's research.

Defining PL

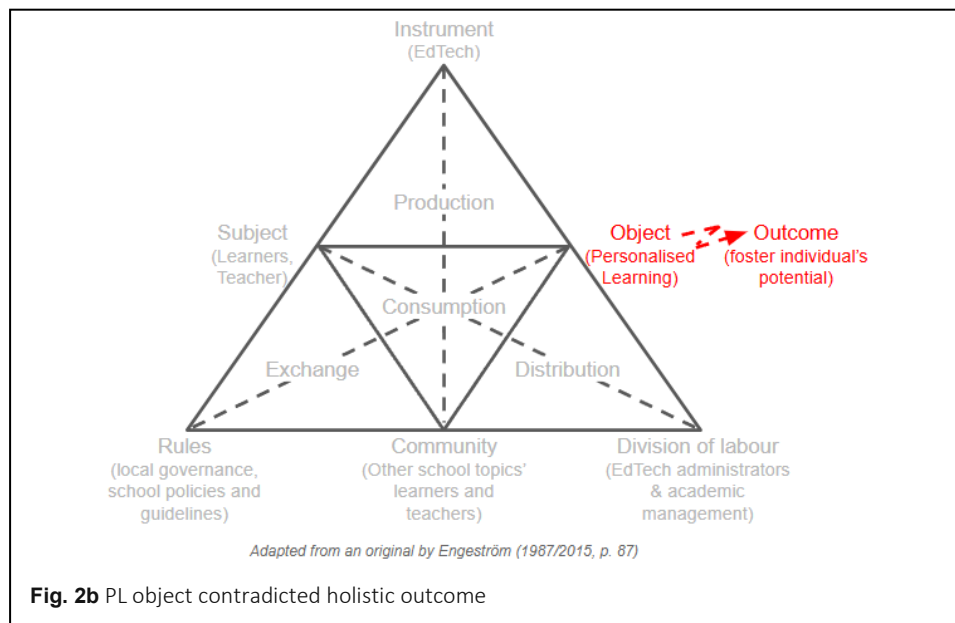
PL is a learner-centred learning approach that caters to an individual's learning needs. By allowing learners to direct their learning and adaptively supporting their learning process, their learning experience can be greatly enhanced (Grant & Spencer, 2003; Holmes et al.,

2018; McCarthy & Schauer, 2017; Prain et al., 2013; Redding, 2016). To start, when learners are given the autonomy to steer their choice of learning, it boosts their motivation, engagement, and satisfaction (Chatti & Muslim, 2019; Holmes et al., 2018; Redding, 2016). Next, learners need individualised support throughout their learning process by adapting to their learning pace and readiness, such as providing flexible alternatives to traditional fixed timetables and content (FitzGerald et al., 2018; Prain et al., 2013). Lastly, each learner must be able to monitor and evaluate their learning progress to close any gaps, which can be achieved through personalised feedback and assessment (Chatti & Muslim, 2019; Lin, 2023). In return, the PL approach can help realise an individual’s potential and meaningfully contribute to society (Ferguson et al., 2001; MOE Singapore, 2024; Prain et al., 2013). However, based on these existing studies, the process requires careful planning between learners and teachers so that the learning objectives and learners’ goals are aligned (Lin, 2023; Redding, 2016). Additionally, providing individual learning support and feedback demands significant teacher involvement (Holmes et al., 2018; McCarthy & Schauer, 2017). Although PL can enhance an individual’s learning experience, thorough planning and substantial resources are necessary for its implementation. As such, the division of labour may lack the necessary support to replicate PL at scale, which could eventually hinder its distribution (Figure 2a).



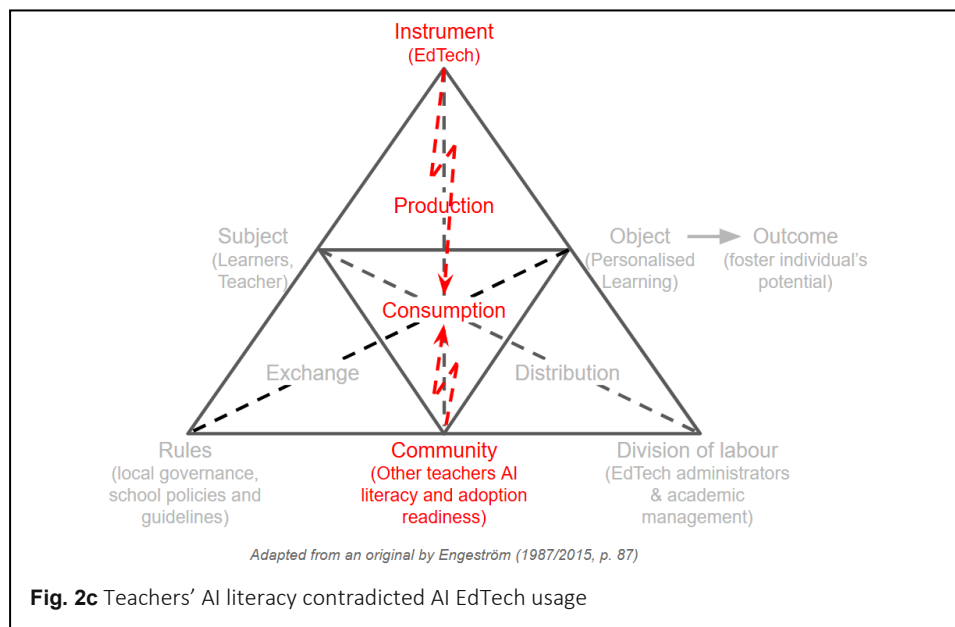
Evolving definition

To date, there is no PL-based theory, but several teaching approaches closely resemble PL. Research by Dubin and Traveggia in 1968 explored the Personalised System of Instruction (PSI), which provided ease in learning and reduced the need for teaching resources (Grant & Spencer, 2003). Additionally, this independent learning approach indicated that teaching methods did not significantly affect an individual’s learning capability. Further research in this field paved the way for distance learning by leveraging the internet, breaking the boundaries of time and place in learning (Grant & Spencer, 2003; Koyama et al., 2001; Sakai et al., 2004). However, PSI mirrors individualised or differentiated learning approaches, as newer EdTech tools were seen as capable of enhancing PSI rather than strengthening the pedagogical aspect. Hence, PL is commonly mistaken for differentiated or individualised learning, which fails to account for a learner’s aspiration to learn (FitzGerald et al., 2018; Holmes et al., 2018; Kerr, 2015). In contrast, PL evolved to include social learning, promoting cultural awareness and fostering a learner’s sense of self-worth and contribution to society (Holmes et al., 2018; Kaminskiene & DeUrza, 2020; Redding, 2016). Yet, the growing trends in PL research heavily focus on EdTech to address the resource-intensive nature of PL, rather than cultivating the social learning aspect of learners. Consequently, PL has lost focus on achieving its desirable outcome: the individual’s holistic personal development (Figure 2b).



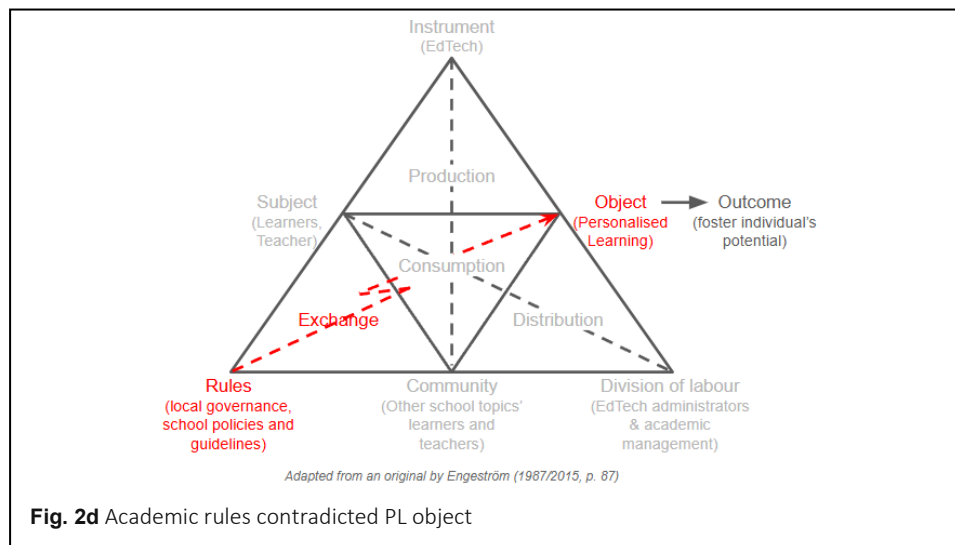
AI EdTech issues

Many studies have discussed PL using EdTech to create adaptive learning approaches that focus on differentiating learning pace and scaffolding content. Alenezi (2023) and Taylor et al. (2021) highlighted the use of EdTech to support PL by providing a flexible learning pace with tailored instructions (Alotaibi, 2024). AI EdTech’s adaptive evaluation features, such as multiple assessment attempts or immediate targeted feedback, can assist learners in promptly evaluating their learning progress (Alotaibi, 2024; Wangsa et al., 2024; Zhou et al., 2024). Consequently, teaching tasks can be readily offloaded with AI automated tasks and assessment, allowing teachers to focus on meaningful engagement with learners (Lin, 2023; Wangsa et al., 2024; Zhou et al., 2024). However, faculty members have concerns about data privacy and security on student’s personal data (Alotaibi, 2024; Zhou et al., 2024). Wangsa et al. (2024) stressed the lack of institutional ethical practice and standards for both students and teachers. For example, the use of AI must be clear to prevent assessment plagiarism by students, yet teachers were insufficiently trained on AI literacy to effectively detect students’ AI plagiarism (Zhou et al., 2024). These studies underscore the contradictions between AI EdTech to enhance PL while teachers within the community lacks the readiness and competency to adopt AI PL (Figure 2c).



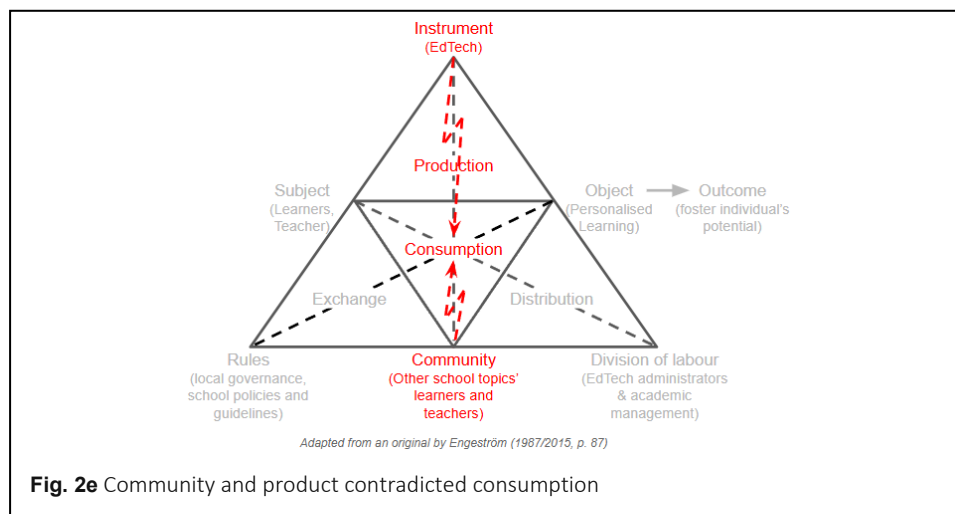
Academic restriction

AI EdTech has the capability to assist students to locate learning content based on their individual interest. Infusing AI analytics can profile a learner, search for, and recommend academic content for PL (Castro et al., 2024; Pesovski et al., 2024). Additionally, AI EdTech can efficiently gather student’s data based on their interaction behaviour and past search results to providing various learning pathway (Alenezi, 2023; Castro et al., 2024; Zhou et al., 2024). However, these studies provided predetermined learning content set by the institutions based on academic requirement, which fails to encourage personalisation of an individual’s goals and aspirations for learning. In addition, research by Solari et al. (2022) and FitzGerald et al. (2018) highlighted that the choice of subjects in school is restricted by societal norms and mainstream education, which revolves around mandatory subjects. Although recent studies mentioned the capability of AI EdTech to personalise an individual’s learning goals and adapt to their learning pace, it appears that schools may lack the autonomy to allow learners to choose their own learning goals. Governance regulations and cultural practices could potentially hinder the adoption and exchange of AI-driven PL in its entirety (Figure 2d).

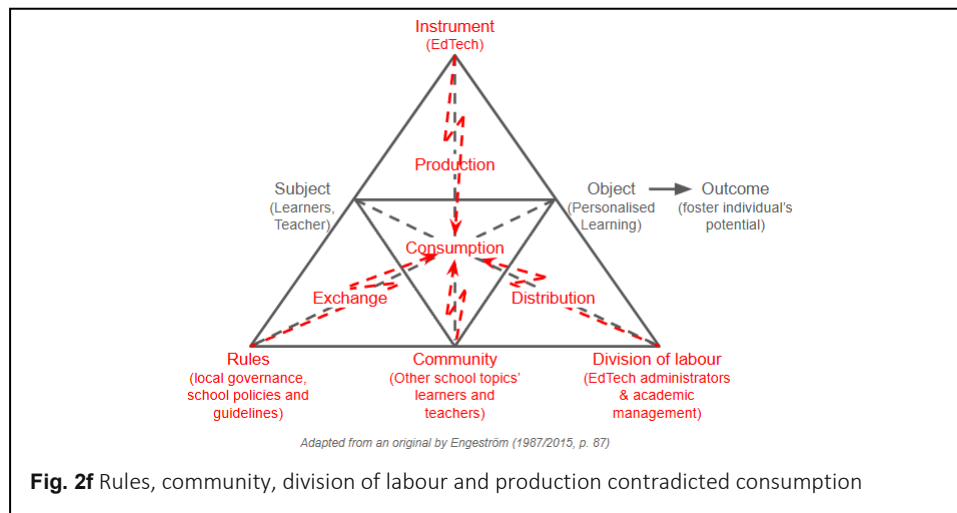


HE and VET environment

HE and VET face difficulties in designing a framework that could accommodate the myriads of subjects offered by institutions. Few studies have highlighted the need for PL to gain acceptance from various stakeholders in schools, as traditional curricula are still strictly controlled by schools, limiting learners’ choices of interests (FitzGerald et al., 2018; Holmes et al., 2018). However, Solari et al. (2022) found that learners’ interests can be cultivated within mandatory subjects by allowing learners to have a voice in applying the subject meaningfully to their social interests. Although this strategy is possible for HE or VET, experienced teachers are needed to facilitate subject learning around the learner’s interests. Additionally, EdTech must provide varied yet simple tools to support different learning approaches in PL, helping educators deploy PL effectively (FitzGerald et al., 2018; Holmes et al., 2018). While EdTech is highly functional in accommodating complex class profiles, not all teachers are tech-savvy enough to pick up an EdTech tool and use it effectively (Lin, 2023; McCarthy & Schauer, 2017). Therefore, if HE or VET intends to pluralise PL, educators would need to upskill both their pedagogy and EdTech literacy to effectively craft PL based on learners’ interests. This is especially challenging in VET, where knowledge is passed on through hands-on training. Matching a learner’s interests with the school’s academic position may be very challenging. Hence, the production of PL in the VET sector could face an internal contradiction in meeting the PL outcome (Figure 2e).



The aforementioned studies highlight several areas within a school’s activity system that could hinder the pluralisation of PL. A significant amount of planning and resources are required to implement PL, to provide both individualised and social learning for learners. As such, EdTech must be leveraged to support the complexity of PL implementation, nurturing a learner holistically. Currently, studies have shown the potential of AI EdTech in implementing PL comprehensively. However, due to various cultural practice constraints within each school, the mass deployment of PL appears to be challenging. This is particularly true in VET, where topics involve hands-on skill training. Each topic requires unique planning and execution of PL, which necessitates the division of labour to customise PL, further restricting its distribution. Additionally, teachers in the community need professional pedagogy training in PL and AI EdTech to support the delivery of their subjects. Figure 2f depicts the contradictions highlighted within the CHAT model, which are closely related to various departments within a school.



Methodology

This study adopted a case study approach to investigate this phenomenon, which can be highly influenced by its cultural and organisational background. Since current practices were shaped by the organisational culture over time, contemporary issues can be closely linked to contextual policies and local activities formed over time (Cohen et al., 2007). Additionally, the case study approach seeks to understand some behaviours within a social setting (Tight, 2017). With the social pragmatism outlook of this research, adopting a case study allowed a deeper exploration into a VET setting to identify possible operational hindrances to implementing AI PL. As illustrated earlier, the CHAT model depicted various departments within an organisation that may contradict the distribution of AI PL. Therefore, collecting various data sources from teachers, managers, and administrators in a VET institution would provide an authentic unit of analysis for the two research questions, which explain the actual challenges faced by the institution (Alpi & Evans, 2019; Cohen et al., 2007).

This case study collected data through semi-structured interviews with participants. In the studies by Karch et al. (2024) and Liaw et al. (2024), the data from semi-structured interviews were collected, coded, and categorised according to CHAT components for further analysis. In both studies, participants had either reviewed or participated in the activity under investigation prior to the interview. This approach captured the participants' current perspective on the activity, but the results were limited to their present knowledge and not their prior cultural experiences. In this case study, cultural practices over time are essential to identify the gap between the past, present, and future. Hence, to account for VET staff's prior knowledge and current practices on PL, the semi-structured interviews for this study included questions to collect:

- staff's prior and current experience with PL,
- current perspective of existing PL framework,
- perspective of future AI PL implementation.

Finally, as illustrated in Figure 3, this study employed the aforementioned research approach to sort the data and code it against various CHAT components in order to analyse possible contradictions between the past, present, and the perspective of future AI PL.

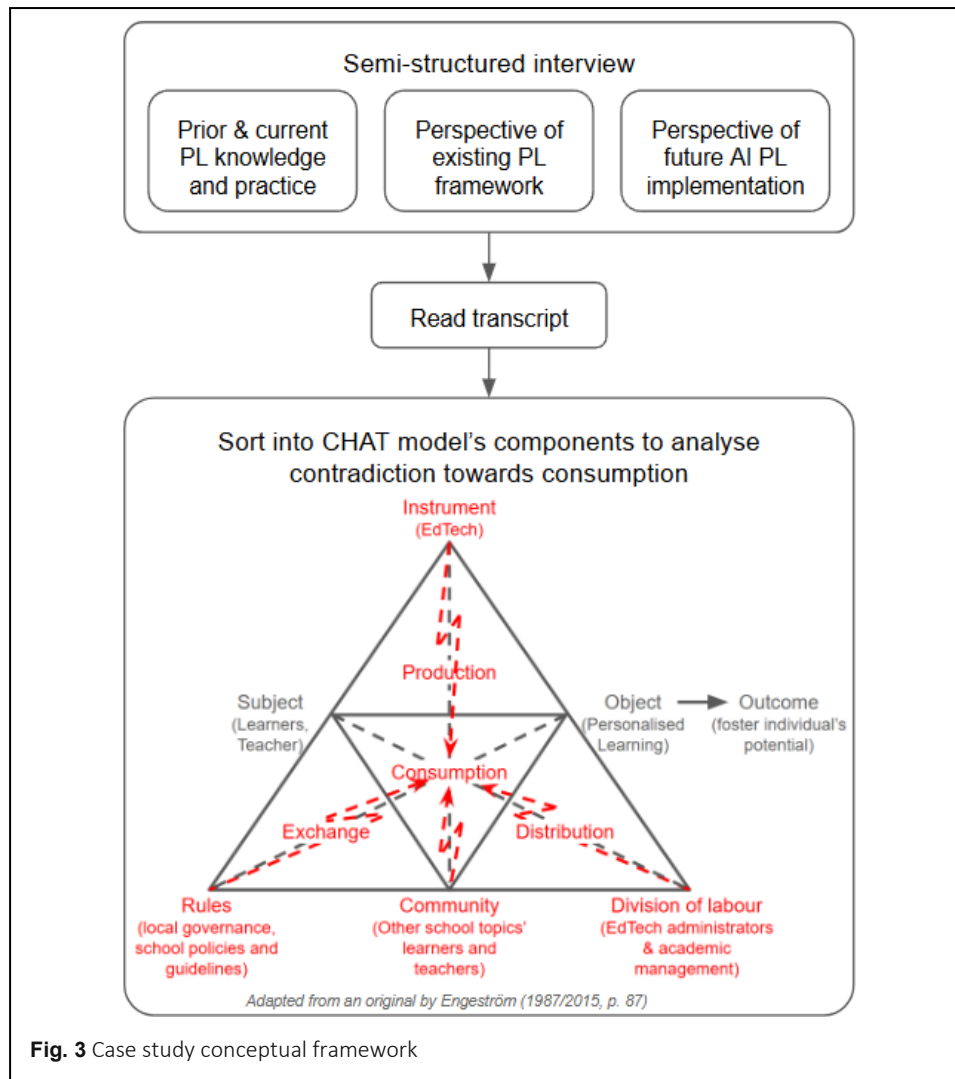


Fig. 3 Case study conceptual framework

Context

This case study was conducted at a VET institution in Singapore, which was planning to implement AI PL for its students. The institution, which provides education for diploma-level certification, consists of six different schools that train students in a wide range of industry-relevant skills for employability. As a result, the teachers come from various industry backgrounds to conduct both theory- and skill-based subjects to meet the respective diploma requirements. Within each diploma course, the department includes a course chair, managers, and teachers, with additional support from academic and technology administrators.

Sampling

An institution-wide email was sent to all staff across the six different faculties of schools to call for participation. Six participants volunteered for the study with their roles, years of experience in their role and the faculty they belong (Table 1). There were representatives from four out of the six faculties. Their job roles were either as teachers, managers, or administrators within their respective schools, and they would be directly or indirectly involved if the institution implements AI PL. With the years of experience in their role, the participants provided valuable insights based on their cultural understanding of the institution and the potential of the institution implementing AI PL in near future.

Table 1 Participants' background

	Role	Years in role	Faculty
Participant 1	Teacher A	10-15	Humanity & Social Science
Participant 2	Administrator	10-15	Engineer
Participant 3	Teacher B	10-15	Humanity & Social Science
Participant 4	Teacher C	5-10	Informatics & IT
Participant 5	Manager A	10-15	Engineer
Participant 6	Manager B	5-10	Design

Data collection

Semi-structured interviews were conducted in English with the participants to gather their perspectives on AI PL within a one-hour duration. This method naturally extracts qualitative data based on the participants' job experience, the school's cultural practices, and the potential implications for their roles (Yamagata-Lynch, 2010). Additionally, semi-structured interviews allow the interviewer to explore themes that were not initially planned but are crucial for gaining deeper insights into the study (Cohen et al., 2007). Therefore, the data collected through these interviews provided richer findings based on the VET staff's working experience.

Data analysis

The interview transcripts were reviewed and coded according to the components of the CHAT model, focusing on rules, community, and division of labour that could potentially hinder the distribution of AI PL. Abductive reasoning was used to derive the most logical explanations and conclusions based on the empirical evidence collected (Pratt, 2016). While the data, drawn from participants' perspectives, does not provide definitive answers, abductive interpretation enabled a deeper understanding of these challenges, particularly from cultural and social standpoints. Consequently, each component was analysed using abductive reasoning to identify common challenges or concerns faced by VET staff. Under a pragmatic lens, the analysis aimed to assess the plausibility of VET staff effectively distributing AI PL in the future (Kivunja & Kuyini, 2017).

Ethics

Approval for the study was granted by the institution's ethics committee before research commenced. Participants were informed about the purpose of the study and that the interviews would be recorded for transcription purposes. The recordings were only accessible to the investigator and were deleted after transcription. Participants were assured of confidentiality and anonymity, and their consent was obtained prior to the interview. Ensuring confidentiality and anonymity is crucial to allow participants to provide honest and genuine data without concern for potential consequences to their livelihoods (BERA, 2024).

Findings

The six interview transcripts were coded and organised into three main themes: participants' prior knowledge of PL, their current perspective on PL, and their future perspective on AI PL. Further analysis revealed sub-themes related to components of the CHAT model

(Instrument, Object, Rules, Community, Division of Labour). The findings were then presented narratively to describe the insights drawn from the data.

Prior PL knowledge

Definition (Object)

Every participant seemed to understand only a small part of personalised learning, with descriptions focusing on goals, execution, or evaluation, but not the entire framework. Four participants highlighted students' autonomy to choose their subjects based on their interests or diploma goals. The administrator mentioned,

“According to their interest, student can choose the subjects they wish to learn over the 3 years, rather than a general pathway. But in Singapore, I normally do not see such arrangement in polytechnics and even universities.”

Two participants emphasised the flexibility of students' learning pace and study load, providing examples of students learning at a slower pace and being allowed more time to study. Four participants indicated that they did not see PL implemented within their school, while two reported seeing it implemented in small-scale or with minimal impact on student's learning experience. One example involved a subject using AI chatbots to provide learning feedback and ideation. The second example described an institution-wide system that allows students to reduce their study load by taking one fewer subject during the semesters, which in turn extends their years of study.

Envision (Division of labour, Community)

All participants highlighted the labour-intensive challenge of implementing PL to meet individual students' needs, an area in which they had no prior experience and which they often perceived as potentially chaotic. Manager B noted that significant effort and organisation were required simply to cater to a single student's subject needs. Participants also raised several concerns related to resource planning, including the preparation of materials, scheduling timetables, and the increased demand for teacher-student interaction and regular check-ins. Additionally, three participants expressed concern about the impact of PL implementation on other subjects. They were unsure how to standardise the expectations for student assessments, as different diploma skill-based subjects have different setups.

Existing PL framework

Resource (Division of labour)

Based on the existing PL framework, participants felt it would be challenging to implement it across the institution without standardisation. As a VET institution, the polytechnic offers a wide range of skill-based subjects, each conducted with varying delivery methods. Therefore, to provide a variety of learning content, a significant amount of resources will be required to curate and validate the materials. Not only will venue resources need to be adjusted to match the delivery modes, but balancing class sizes will also be a major concern for years to come.

Suitability (Community)

As students have the freedom to choose their learning goals, teachers will need to focus on or upskill in the subjects that students wish to learn. Manager A highlighted,

“How many of them (students) really know the objective, what they want to learn? At this age, many students are still unsure of their interest to even decide on a pathway that leads to their career. Without knowing the benefits, providing the students the freedom to choose would add unnecessary resource to teachers and the school. On the teacher’s side, it will be very hard to manage them (students) if the teachers don’t know the student’s assessment (approach). Say I am a tutor of 25 students who have different objective, how do I write an assessment rubric to cater for all of them? It will be very hard to manage, and tutor don’t know how to manage assessment.”

Teacher B suggested that PL would be more suitable for mature students or adult learners, as they would be better equipped to judge suitable content for their learning. Similarly, Manager B indicated that PL pedagogy training would be necessary for adjunct lecturers who support the school in teaching subjects on an on-demand basis.

Guidelines (Rules)

Three participants highlighted the need for the VET institution to provide school-level guidelines so that both students and teachers can be aligned. This includes setting a standard for learning outcomes that is fair yet reliable, ensuring that students’ performance can be differentiated. This is especially necessary for students who wish to pursue a degree program, as their grades will be considered for university applications. Manager B emphasised,

“The school or tutor can’t have same expectation of the students learning standard due to individual student’s goal. When tutors were to teach a subject with 20 to 25 students having personalised learning, it will impact the way they teach and handle the class. If school is conducting PL in classes, the expectations from students must be same

for each subject to ensure fairness. Otherwise, students will raise concerned if the assessment is fair when they see some students doing less yet scoring higher.”

However, PL was observed in an example where subject assessment was limited to pass or fail, without grading. This allowed students to choose subjects based on their interests without the concern of poor grades affecting their future studies. Hence, such subject arrangement without grading system would encourage students to set goals based on their individual aspirations.

Perspective of AI PL

AI EdTech unification (Instrument, Division of labour, Community)

Teacher C highlighted the overwhelming number of AI EdTech tools, making learning cumbersome. He added that the abundance of AI tools discouraged both teachers and students from using them, creating inconveniences for teaching and learning. He emphasised the need to unify existing and future AI tools, so that teachers and students would not have to navigate multiple platforms for their learning needs. Moreover, Manager A pointed out that with every new AI tool introduced, both teachers and students are faced with learning a new interface before they can begin using it. Lastly, Administrator added that if AI tools keep updating and changing, a lot of time will be spending on training and updating instead of doing the necessary works.

AI limitation (Instrument, Division of labour, Community)

Although participants acknowledged the usefulness of AI in increasing productivity, they identified areas where AI cannot fully assist. Administrator provided examples such as complex timetable scheduling and validating student answers, which still require staff involvement to ensure credibility and validity. The administrator stressed that,

“(Timetabling) still requires manual checking of restrictions and constraints because it affects the whole school of a thousand students. I cannot rely on AI too much because if there is a mistake it will affect not just my faculty but the entire polytechnic’s reputation. That will be very serious!”

Similarly, Teacher B highlighted in vocational training context, the credibility AI providing students with information is questionable. He further explained that certain information such as industrial experience and insights should be provided by the lecturers, who are the experts themselves. This ensures the quality of polytechnic’s teaching quality and not over reliant of AI as the teacher.

Additionally, in VET, a student’s learning outcome could be a physical object or demonstration. Manager B, who had teaching experience prior to the managerial role, emphasised that there were no use cases where AI could provide an accurate and valid

interpretation of these outcomes. In Manager B's context where students create artwork installations or artefacts, AI EdTech could not contribute much towards managing or assessing the physical objects.

AI acceptance (Instrument, Community, Rules)

Two participants, Teacher A and Manager A, emphasised the need to review the purpose of AI to gain staff buy-in for its implementation. Given the rising trend of AI, the participants were concerned that the institution might be adopting AI simply to follow the trend, without thoroughly considering its impact. Manager A stressed that as an institution, educators should do things with purpose and that are useful for students, not just because of chasing AI trend. Additionally, Manager B express his concern that the management do not fully understand the operational challenges and providing the necessary resource support for staff to adopt AI. In his example, AI training provided by the institution were mainly scratching the surface of the AI EdTech while implementation AI into the operation is a different spectrum of challenges faced by staff.

Furthermore, concerns about privacy and data security were raised, particularly regarding how data would be used by AI platforms, with potential unknown future implications for teachers, students, and the institution. Manager B underscore the need for students to understand how their data were used through AI tools. Especially where design work consists of intellectual property (IP), it is important for students and their industry collaborators to have guidelines in safeguarding their IP while using AI tools. As a result, four participants expressed a desire to see successful examples or trials of AI PL before it is implemented institution wide.

Based on the above findings, various CHAT model's components identified contradictions within the production of PL that exist within a VET context. Although the findings may not provide generalisation of VET challenges to implement AI PL, the following discussion could provide an abductive reasoning to answer the two research questions posed in this study.

Discussion

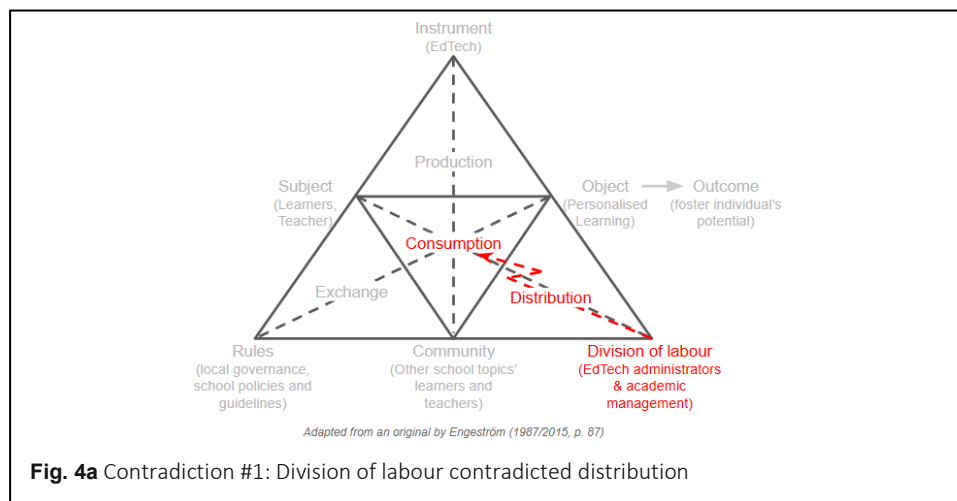
This paper examined existing literature that identified hindrances to the consumption of PL within the activity system, primarily due to contradictions related to the object, division of labour, community, rules, and instruments. The findings of this study revealed how input from various VET department staff highlighted contradictions closely aligned with those identified in the literature. This section will build upon the backdrop of current scholarship by discussing the two research questions in depth. This will be achieved through triangulation of the findings, the literature review, and the components of the CHAT

framework, providing insights into the feasibility and barriers to implementing AI-based PL based on the contradictions identified.

RQ1. What concerns or challenges do VET academic staff foresee if the institution implements PL?

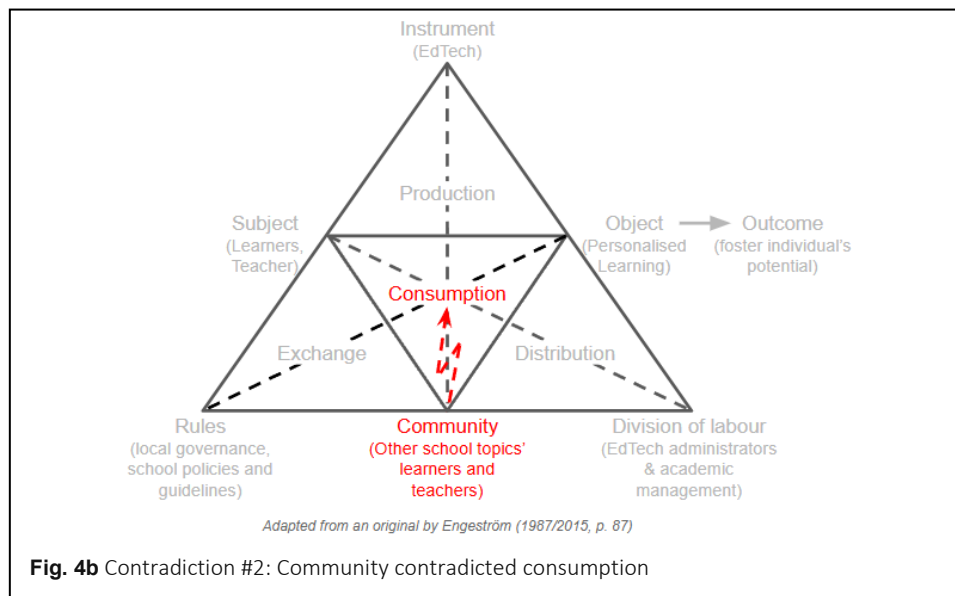
Contradiction #1: Division of labour

Through the findings, it became evident that VET staff have limited knowledge of PL; each staff member could only explain certain aspects of PL, and only a few had experimented with it in their teaching. Without prior experience and sufficient knowledge, VET staff expressed concerns about the high resource requirements for implementing PL. This created a contradiction, as VET staff lacked both the knowledge and confidence to distribute PL effectively (Figure 4a). This aligns with the literature, which emphasises the need for detailed planning and preparation when implementing PL (Lin, 2023; Redding, 2016), a process that could challenge the institution's division of labour. Furthermore, after being exposed to the PL framework during the interview, the VET staff reiterated their concerns about the resource-intensive nature of PL implementation, particularly regarding class arrangements, content preparation, and assessment design. Only a small minority of staff with prior PL experience felt more prepared to implement it. Therefore, as shown in Figure 4a, for PL to effectively encourage both individual and social learning (Holmes et al., 2018; Kaminskiene & DeUrza, 2020; Redding, 2016), VET staff must undergo adequate training in PL pedagogy before its implementation.



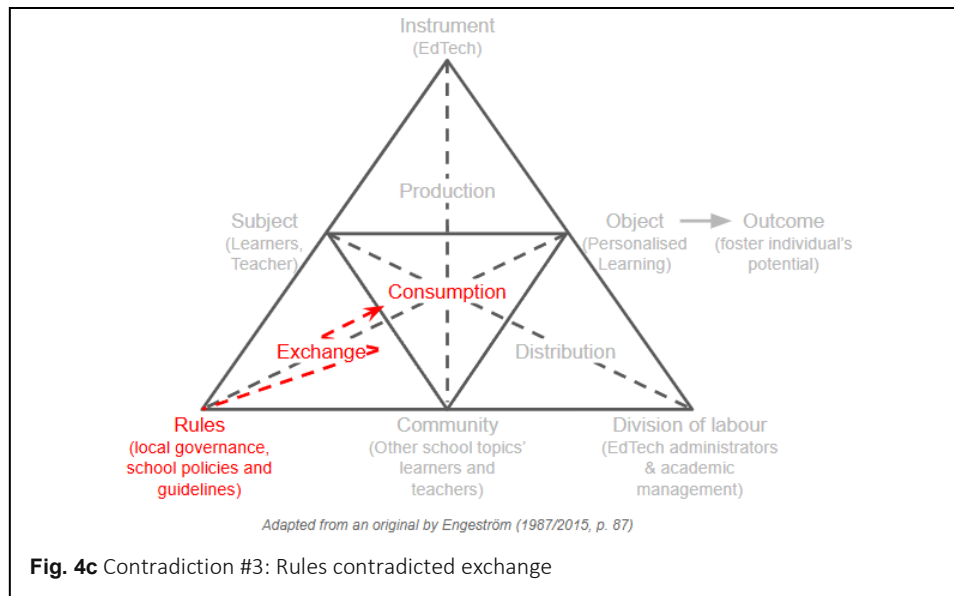
Contradiction #2: Community

VET staff highlighted that different diplomas come with varying subject expectations, alongside limited equipment and facilities. As a result, personalising lessons and content becomes challenging if class sizes are not optimally organised. This issue aligns with the literature on adapting students’ learning pace (FitzGerald et al., 2018; Prain et al., 2013), as resource limitations in VET pose a significant barrier if students are unable to access the necessary facilities to learn at their own pace. Furthermore, after being introduced to the PL framework, some VET staff questioned whether PL would be suitable for diploma students due to concerns about their maturity. With the autonomy to choose their learning path, VET students may not always select subjects that are academically beneficial. While literature has highlighted the importance of learner choice for motivation (Chatti & Muslim, 2019; Holmes et al., 2018; Redding, 2016), VET staff feared that allowing students to explore their personal interests might affect the relevance of their skillsets for industry needs. Therefore, as illustrated in Figure 4b, the diverse needs of each diploma program, which are designed to equip students for future employability, create a contradiction for the institution, limiting students’ freedom to choose their learning subjects (FitzGerald et al., 2018; Solari et al., 2022). This suggests that institutions should review each diploma program’s subjects to offer broader learning content that addresses both industry needs and students’ interests. This process can be expedited through the use of AI analytical tools to align students’ preferences with industry objectives (Wong et al., 2022).



Contradiction #3: Rules

VET staff emphasised the need for the institution to establish clear guidelines for PL assessment. In addition to preparing students for employment upon graduation, some students wish to pursue further studies, such as degree programs. For these students, subject grades are essential for university admissions. Based on some participants' experiences, PL was tested on non-graded subjects, which highlighted a contradiction within the education system regarding the outcomes of PL. Therefore, without a defined grading system for PL, its implementation across the institution would be difficult. As an alternative, drawing from Solari et al. (2022) in the literature, a modified version of PL could potentially be implemented by allowing students to apply subject knowledge meaningfully to their areas of interest. This approach could preserve the integrity of the subject and its assessment while accommodating students' learning interests. Ultimately, VET institutions are obligated to train students according to industry needs, as shown in Figure 4c. This creates a contradiction, preventing the adoption of an ideal PL framework based on learners' interests (Chatti & Muslim, 2019; Holmes et al., 2018; Redding, 2016).



RQ2. How do VET academic staff perceive the use of AI in their job involvement with AI PL?

Contradiction #4: Instrument contradicted division of labour and community

VET staff emphasised that the vast availability of AI tools complicates both the learning and operational processes. With the constant need for VET staff and students to learn new tools, less time is available for acquiring the intended subject knowledge. Moreover, learning new tools and integrating AI within the subjects puts on heavier workload for inexperienced teachers. This aligns with the literature on EdTech capabilities, which highlights that VET staff struggle to fully harness the potential of these tools due to the constant need to adapt to new technologies (FitzGerald et al., 2018; Holmes et al., 2018). This reflects a contradiction between the tools (instruments), division of labour, and community within the VET context (Figure 4d). Therefore, if VET staff are encouraged to use AI for learning or improving productivity, the solutions should be evaluated and provided prior to implementation. This reduced the need for staff to research and experiment on AI tools above their existing job scope.

Additionally, if AI were used to implement PL, VET staff foresaw that certain areas, such as classroom management and content validation, could not yet be fully replaced by AI. Given their limited prior experience with AI and PL, staff lacked confidence in AI's ability to enhance operational productivity or effectively support the distribution of PL at the institutional level. This contradiction between the AI tools and the division of labour highlights an academic operational challenge that was not addressed in the literature. In the context of VET, managing diverse subjects and diplomas is complex and difficult to

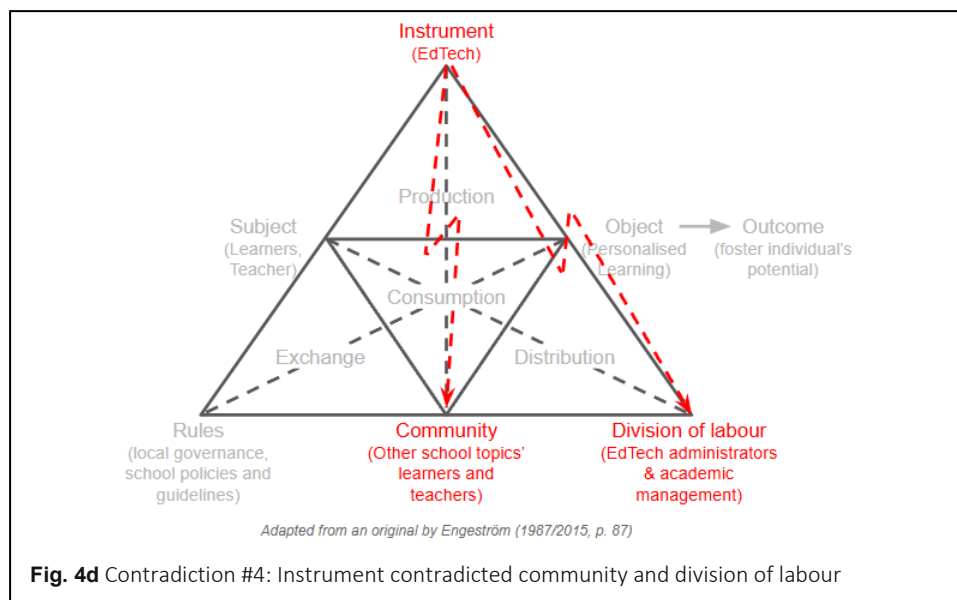


Fig. 4d Contradiction #4: Instrument contradicted community and division of labour

standardise across the institution. Therefore, this advocates for further and broader exploration of AI implementation through collaboration with designers and consultants who can provide practical solutions tailored to the specific needs of each diploma program (Solari et al., 2022; Wong et al., 2022).

Contradiction #5: Community and division of labour contradicted rules

Lastly, a VET staff member expressed concern about the institution's decision to adopt AI at such an early stage due to its novelty. Without a deeper understanding and experience with AI as an EdTech tool, staff felt that any potential issues could negatively impact student learning. Examples of issues raised were ethical use of student's data and unforeseen operational issues. As shown in Figure 4e, this highlighted a contradiction between the division of labour and the community, in relation to the rules set by the institution to adopt AI PL without thorough research. Similar to the literature on teachers' adaptability to new EdTech (Lin, 2023; McCarthy & Schauer, 2017), VET staff need to develop AI EdTech literacy to confidently understand the capability and boundaries for AI-based PL. Furthermore, they need existing AI use cases as references to effectively implement AI into their work.

Through this discussion, the consumption of PL revealed distinct contradictions across the division of labour, community, rules, and instruments. Given the complex structure of various schools within a VET institution and the intertwined operations of diploma courses and their subjects, implementing PL would be a challenging task. While AI is recognised as a powerful tool in contemporary education, VET staff have yet to fully perceive its practical application in supporting the distribution of PL. The findings highlighted several contradictions and challenges in using AI for this purpose. Therefore, before PL

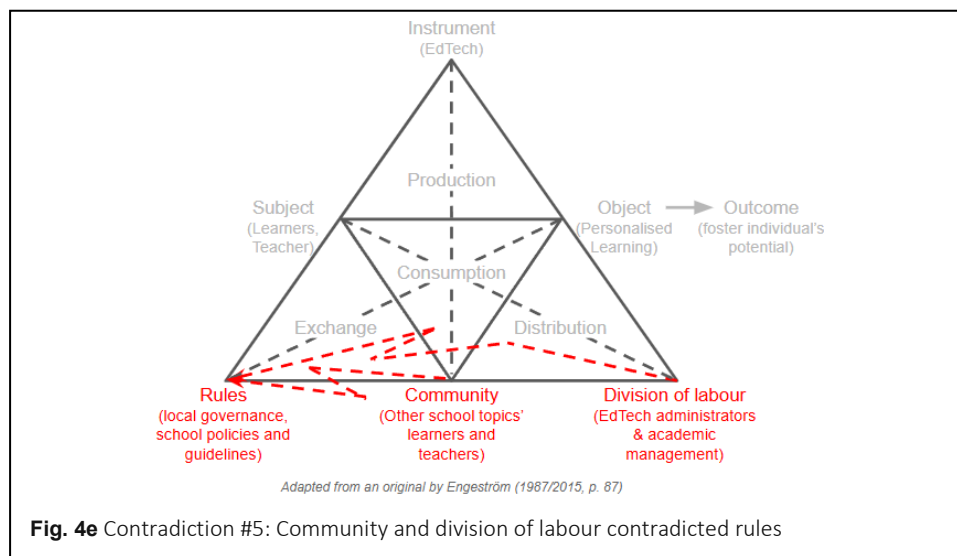


Fig. 4e Contradiction #5: Community and division of labour contradicted rules

can be implemented across a VET institution, it is essential for various stakeholders to discuss and clearly define the direction and guidelines for PL to enhance the student learning experience. Once a clear framework is in place, AI can then be introduced to optimise the labour-intensive distribution and exchange process, enabling effective PL delivery across multiple schools and diploma courses.

Conclusion

Implementing PL in VET institutions is a challenging endeavour, and it is crucial to understand these challenges from a social pragmatic standpoint in order to develop practical solutions. This case study utilised the CHAT framework because it breaks down the complex institutional system, allowing an examination of potential obstacles from various social aspects within the VET context. By conducting qualitative interviews with VET staff from different departments, the study captured insights into the feasibility of PL implementation and the role of AI in enhancing institutional operations. The findings revealed that the limited prior knowledge and experience of VET staff emerged as a significant hindrance to pluralising PL within the institution. Additionally, the absence of clear guidelines and direction for PL further restrained staff from adopting a PL approach within their schools.

As a result, the direction for PL within the institution requires a comprehensive review and thoughtful implementation plan before it can be integrated across the curriculum. While AI EdTech holds significant potential, VET staff perceived it as a complicated tool. If the institution cannot decide on a clear PL framework, adding AI into the activity system will further contradict the outcome of PL. Therefore, given the current early stage of exposure and limited accessibility to AI EdTech tools, this indicates that VET institutions should refrain from adopting AI for PL at the institutional level for now. Instead, to leverage AI effectively, institution should collect inputs from staff to clarify on their goals for the PL approach, which in turns set the direction to enable staff to harness AI's capabilities. Piloting small scale AI EdTech implementation into lesson could provide future references to deliver personalised learning efficiently and effectively.

Recommendation

To further explore the implementation of PL in VET, a case study could focus on a PL pilot trial, particularly for subjects that are considered challenging to execute. This study could assess the effectiveness of PL across different subject areas with varying needs. The results could offer valuable insights for refining the institution's PL framework, making it more adaptable for other subjects. Such a pilot would also allow the institution to identify areas where AI could optimise operational processes or enhance the student learning experience. The lessons learned from these pilot trial and subsequent refinements would serve as

critical references for other diploma programs, potentially leading to the pluralisation of PL with AI across the entire institution. Alternatively, further research could explore the necessity of allowing VET students to choose their learning goals within the PL framework. While the framework suggests that learners set their own goals, this study has raised questions about the applicability of this approach for VET students. Understanding how VET students would personalise their learning could provide deeper insights and reinforce the framework's effectiveness for this specific learner group.

Limitation

Through this case study, only qualitative data was used to investigate the VET staff's perspective, which was insufficient to conclusively generalise the findings for broader research (Cohen et al., 2007; Kivunja & Kuyini, 2017). While this case study provided critical insights, the perspectives of staff from other departments should be considered to increase the reliability of the results. Therefore, to strengthen the trustworthiness of this case study's findings (Tight, 2017), further research could be conducted to collect quantitative data from a larger sample of VET staff.

Abbreviations

PL: personalised learning; AI: artificial intelligence; VET: vocational education and training; CHAT: Cultural-Historical Activity Theory; GenAI: Generative AI; EdTech: educational technology; HE: higher education; PSI: Personalised System of Instruction; IP: intellectual property.

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Author's contributions

The author is responsible for the whole manuscript. The author read and approved the final manuscript.

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Availability of data and materials

The data can be made available upon reasonable request and with the permission of the institution.

Declarations

Competing interests

The author has no competing interests to declare that are relevant to the content of this article.

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