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Enhancing Higher Education Teachers' AI Competencies:

Prelude to the Development of an
Inclusive Teachers' Professional
Development Model for Low-
Internet Regions

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Executive Summary

The emergence of Artificial intelligence in higher education (AIHE) has captured the attention of policymakers and major tech conglomerates, with various intergovernmental organisations and corporates rallying behind this technological wave. These entities have translated their advocacy into policies, shaping national agendas. While the potential of AIHE to enhance educational efficiency remains debatable, our focus shifts towards the pressing issue of insufficient awareness and competencies among higher education teachers, particularly those in remote and rural areas with low internet connectivity, to effectively integrate AI into their teaching methodologies.

It is noteworthy that despite deploying disruptive technologies, educating teachers on practical implementation strategies is central to its successful implementation in educational spaces. However, mainstream teaching and teachers receive more attention in this regard, leaving those in remote areas at the periphery, often ignoring their context, conditions, and requirements. In light of these challenges, we introduce a prelude for an inclusive specialised Teacher Professional Development (TPD) model tailored to the unique circumstances, needs, and expectations of teachers in remote and rural regions with low internet connectivity.

The prelude was developed based on the inputs from the teachers and key stakeholders from the remotest colleges in India, located in Ladakh. This study seeks to shed light on the necessity and potential efficacy of specialised TPD programs in empowering educators to leverage AIHE effectively. By understanding the ground realities and requirements of teachers in remote regions, this initiative aims to bridge the digital divide and foster inclusive, and equitable access to educational opportunities, ultimately contributing to the advancement of higher education in remote and rural areas and ensuring sustainability in higher education as espoused by the National Education Policy 2020 (NEP 2020).

This is the final report submitted to COL-CEMCA, summarising the following deliverables: (i) understanding of TPDs on AIHE in India, (ii) policy analysis for guidance on directives for TPD on AIHE, (iii) collation of best practices in TPDs on AIHE, especially for remote regions, and (iv) empirical insights on TPD for AIHE in Indian remote regions through the case of Ladakh. Finally, these study provides some suggestions as a prelude for grounding the AI-TPDs in the context of ruralness and remoteness. These recommendations will help in further development of AI-TPD models in such contexts, in synchronisation with the vision of NEP 2020 related to quality and inclusivity in teaching-learning through disruptive technologies.

1. Introduction

The Commonwealth of Learning Strategic Plan (2021-2027) emphasises the continuous professional development of teachers as one of the means towards sustainability. It is unquestionable that teachers' professional development cannot remain aloof from the ever-evolving education landscape, disrupted by innovations in the realm of artificial intelligence in higher education (AIHE). This is also reflected in one of the priority areas set by the Beijing consensus on AI and education, noting to “develop appropriate capacity-building programmes to prepare teachers to work effectively in AI-rich education settings” (UNESCO, 2019). However, it is concerning that the number of qualified teachers in higher education who employ AIHE in their teaching practices is disproportionately low compared to the rising demand for AI education (Ng et al., 2023). Moreover, uncertainties and institutional inertia flourish in the absence of a national policy in this direction in India.

While early attempts to develop AI-powered teachers' professional development (TPD) programs are seen in the home country, many of these actions lack the consideration of contextual features, and therefore, their applicability is restricted to mainstream higher education institutions (HEIs). In its light, the current study proposes a prelude to the tailored TPD conceptual model to enhance the AI competencies of Indian college teachers in remote regions with low internet connectivity. Artificial Intelligence (AI) has emerged as a prominent area of focus in the realm of digital technologies due to its ability to execute intricate tasks previously exclusive to human intelligence (Becker, 2017). Furthermore, AI, in addition to being ‘protean, opaque, and unstable’, is also ‘generative and social’ (Mishra et al., 2023). The applications of AI in higher education for teachers encompass but are not limited to (i) assisting teachers in making informed decisions and suggesting appropriate instructional methods, (ii) aiding teachers in creating new assignments, contents, and resources, and (iii) facilitating assessments that provide continuous feedback regarding the student's learning process, progress, and areas requiring support (Heffernan & Heffernan, 2014; Luckin, 2017; Mishra et al., 2023). Therefore, AI particularly offers an opportunity for teachers to augment their capacities and competencies.

Nevertheless, there are concerns surrounding the appropriate and ethical use, potential overdependence, and biases of AI, which have been discussed in the literature (Porayska-Pomsta & Rajendran, 2019). To comprehend the complexities of AIHE and effectively use it, educators must delve into the various applications of AI and incorporate them into their pedagogical practices

to foster innovation and enhance student engagement. At this juncture, it is noteworthy to mention that the success of AIHE closely depends on teachers' readiness (Ayanwale, 2022).

Teachers face challenges in updating their knowledge and keeping themselves abreast with the ever-changing and dynamic digital landscape (Albion et al., 2015). It could, to some extent, be attributed to the following two reasons. First, there is limited guidance for teachers as there is an absence of a national policy in this regard (Endris et al., 2024). Second, further erupting from the first limitation is the lack of appropriate TPDs in place in this regard, especially in the Indian context. Hence, teachers' unpreparedness poses a serious challenge (Kitcharoen et al., 2024) in implementing an AI-based curriculum, consequently hindering the production of an AI-literate workforce in higher education institutions (HEIs). Further, while early attempts to develop generic TPDs for mainstream colleges are seen, there is a dearth of work in developing specialised AI-TPDs crafted as per their local needs while taking cognisance of the global components to target college teachers from remote regions.

Remote colleges with low internet connectivity pose unique challenges because of differences in their socio-cultural and geographical features, which might significantly impact how teachers adjust to pedagogical changes driven by AI, thereby limiting the effectiveness of standard TPD models. Furthermore, while there is a growing acknowledgement of the need for personalised TPD programmes to develop AI skills, there is a significant lack of consideration for integrating teachers' experiences and perspectives into these TPD models. The unique insights obtained from teachers' practical experiences are essential for creating successful TPD programmes. Furthermore, there is limited study on the creation of TPD models for Humanities and Social Sciences (HSS) instructors in remote Indian HEIs, compared to the existing studies on TPD models for STEM teachers. An empirical study is needed to create and assess a TPD model tailored for HSS teachers in rural Indian colleges to improve their AI skills.

In its light, the study aims to develop a prelude for the theoretical TPD model for Indian college teachers that matches the local needs in remote regions and, in turn, helps teachers sustain their learning. The region selected for piloting the TPD model is one of the remotest areas of India (and Asia) in Ladakh. The study emphasises the potential for AIHE to improve teaching and learning in remote Indian colleges.

This is the final report, explained through the following eleven sections. After this introduction section, the second section explains the conceptualisation of AI-powered TPDs, and the third

section further locates this conceptualisation in Indian higher education. The fourth section highlights how policies have been thrusting upon AI-TPDs. Next, the fifth section helps in building the gap of AI-TPDs being less explored for HSS disciplines in contrast to STEM disciplines. The sixth section highlights the factors shaping AI-TPDs. The seventh section summarises some best practices for effective AI-TPDs in remote regions. The eighth section underlines the study's design, including sample and tool development. The ninth section underlines the empirical findings from Ladakh as a case in point. The tenth section highlights the study's recommendations as a prelude to AI-TPD, followed by concluding remarks in the eleventh section. This study offers merit to developing an AI-TPD for such contexts.

2. AI-powered Teachers Professional Development

In this section, we explain the conceptualisation of TPDs in the context of AIHE. However, before that, we briskly walk you through the core understanding of TPDs.

With the changing educational landscape, teachers in higher education settings as seen as torchbearers, with the following two major responsibilities, apart from curriculum transaction and evaluation. First, teachers are expected to develop 21st-century competencies in their students, including decision-making, critical thinking, problem-solving, adaptability, and communication skills (Bear & Skorton, 2018). Second, the system demands teachers' responsiveness to the changing needs as classroom experiences present new challenges that cannot be fully anticipated or learned in advance (Asian Development Bank, 2021). For instance, as an unprecedented outcome of the pandemic, teachers are expected to integrate technology into their pedagogy to enhance digital literacy among learners (National Education Policy, NEP-2020, p. 58), including fostering a sense of its responsible and critical use (Asian Development Bank, 2021). Having said that, as the demands of the education system are getting higher and higher, it becomes necessary for teachers to acquire new skills, knowledge, aptitude etc. This is where TPDs come to the rescue by potentially catering for the needs outlined above (OECD, 2005).

In this light, NEP 2020 also advocates teachers requiring comprehensive training and professional development to effectively fulfill their roles as teachers in the contemporary landscape. Therefore, TPD can ensure teachers' continuous learning by equipping them with the new knowledge and skills required in their pedagogy, including innovative instructional methods, new assessment techniques, and strategies. This helps teachers cater to a diverse student body, thus fostering

inclusion, which directly has an impact on students' learning outcomes (Garcia and Weiss 2019; Asian Development Bank, 2021). It promotes a culture of continuous learning, challenging the traditional notion that once an individual becomes a teacher, they need not to learn further. In addition to the above-mentioned points which improve learners' outcomes, TPD serves as a platform for educators to advance in their careers through personal, academic and professional growth.

Therefore, the central idea of the TPDs is to train teachers on how students learn, resulting in informed curriculum and pedagogical practices (Kennedy, 2016). This training helps teachers deliver their expertise through the following five means- content focus, coherence, active learning, participation of pupil, and duration (Postholm, 2012). Today, with the advancements in technologies, particularly AI technologies, the understanding of TPDs is changing dramatically. The AI-powered TPDs emerge as a path for providing confidence to teachers to learn and develop their AI literacy and competencies (Brandão et al., 2024). It simply means how teachers can benefit from AIHE in their own work, broadly encompassing the following three categories, as explained by Luckin & Cukurova (2019). First, AI-powered TPDs imply solving educational crises through understanding the learning patterns of teachers and accordingly providing assistance in adapting content, feedback, and pedagogies. This potentially provides more time to teachers for active scaffolding. Second, "educating about AI" (Cukurova et al., 2024, p. 7) involves training teachers about responsible and ethical use of AI. This is not limited to honing teachers' foundational literacy about AI and its ethics, but also comprises pedagogical knowledge so that teachers can understand and adapt this knowledge as per their contexts to create employable students. Third, AI-powered TPDs encompass rethinking the educational landscape in the light of AI, with a focus on process over outcomes of learning. This not only incorporates training for a responsive curriculum but also highlights the need to train teachers in social skills, metacognition, and emotional intelligence. Having discussed the AI-powered TPDs, we now move to its state of the art in the context of Indian higher education.

3. AI-powered Teachers' Professional Development in Indian higher education

TPD in India has seen tremendous transformation, from traditional face to face programs to technology-driven and AI-powered approaches. Initially, teacher training in India was informal, but post-independence reforms led to the establishment of systematic programs. Early TPD efforts

were largely centralized and delivered through workshops, seminars, and in-service training programs. These programs were organized by institutions such as the National Council of Educational Research and Training (NCERT), State Councils of Educational Research and Training (SCERTs), and District Institutes of Education and Training (DIETs).

These traditional methods, while effective in theory, often suffered from logistical constraints, lack of contextual relevance, and limited scalability. Teachers in rural and remote areas faced challenges in accessing these programs due to infrastructural limitations, travel constraints, and inconsistent quality in training materials. In the 1990s and early 2000s, large-scale government initiatives such as Samagrah Shiksha Abhyan, which included Sarva Shiksha Abhiyan (SSA) and Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and Teacher Education (TE) emphasised regular teacher training. The introduction of digital platforms, particularly following the launch of Digital Infrastructure for Knowledge Sharing (DIKSHA) in 2017, signaled a trend towards technology-enhanced TPD. The portal was introduced as a national platform for teachers and provides training modules. It has now expanded to include ETB/s (Energized Textbooks) for students as well.

The COVID-19 pandemic further accelerated this transformation, making online platforms like SWAYAM and NISHTHA essential for teacher training. Currently, the DIKSHA platform has been used 4.94 billion times for learning activities with 5.74 billion minutes of usage time (Gupta et al., 2022). The National Education Policy (NEP) 2020 reinforced the role of digital learning in teacher training, promoting blended and personalised learning approaches. Today, AI-powered TPD is emerging as the next frontier, offering personalized learning paths, AI-driven chatbots for 24/7 pedagogical support, automated feedback systems, and content creation tools that assist teachers in lesson planning (Gupta et al., 2022). Virtual reality (VR) and augmented reality (AR) are also being integrated into teacher training for immersive learning experiences. Key AI-driven initiatives include DIKSHA's adaptive learning modules, CBSE's collaboration with Microsoft for AI-powered digital pedagogy, and NGOs leveraging AI to provide personalized insights. However, challenges such as the digital divide, teacher readiness, data privacy, and the need for scalable AI models remain.

Despite its relevance, the NITI aayog highlights the scarcity of technologically enabled TPD's in India. In the context of the northeastern state of Assam, Charania et al. (2024) noted in their study

that the adoption of online platforms for teacher professional development (TPD) has not been uniform across rural, urban, and remote areas. This is because these regions grapple with inherent problems such as difficult terrain and insufficient infrastructure to name a few. Additionally, social life is frequently disrupted by ethnic conflicts and border disputes. There is also a significant imbalance between demand and supply in areas like education, employment, skilled teachers, innovation, research, and funding (Konwar & Chakraborty, 2013). Other regions of North India, such as Uttarakhand, Punjab, Himachal Pradesh, Jammu & Kashmir, and Ladakh, often face challenges in accessing higher education due to their distance from major educational hubs and the difficult terrain. Areas like Ladakh also experience extreme weather conditions and a lack of basic infrastructure, which hampers access to technology-based learning.

On a perceptual level, remote and rural areas teachers face greater barriers due to issues of digital illiteracy and distrust towards technology (Jaiswal & Arun, 2021). Even though there have been few collaborated initiatives for TPD at the level of school teachers, such as the, TESS-India initiative, which comprises of a toolkit of 200 freely available Open Education Resources (OER) in multiple languages, and CLIX platform by Tata Institute of Social sciences, efforts particularly targeting higher education teachers are scarce. Thus, ensuring equitable access to AI-powered TPD, particularly for teachers in higher education institutions in remote areas, is critical for educational equity. As India continues to embrace AI in education, strategic policy implementation, digital infrastructure expansion, and teacher capacity-building is essential to harness the full potential of AI-powered professional development.

4. Policy thrust on AI-Powered Teachers' Professional Development

After having discussed the trajectory of AI-powered TPDs in Indian higher education, we unbox the policy imperatives in this direction. The TPD policies vary across countries but harmoniously focus on teachers' continuous learning and skills enhancement. We first zoom in on two international policies that discuss teachers' competencies and then underline the national context. First, the European Union (2017) presented a "European framework for the digital competence of educators (DigCompEdu)" belonging to all levels of education. The DigCompEdu presents 22 competencies spanning six areas, which could be classified into three broad categories: professional, pedagogic, and facilitating learners' competencies. The teachers' professional

competencies include the first area, i.e., professional engagement, directed towards teachers' professional interaction with peers, parents, community, and other third parties to ensure self-growth and the organisation's growth. The teachers' pedagogic competencies span the next four areas. First, it includes competencies to responsibly select, create, and disseminate digital resources. Second, it is concerned with carefully orchestrating technologies for successful teaching-learning. Third, it concentrates on using digital resources to enhance the assessments. Fourth, it capitalises on learner-centred teaching by ensuring accessibility, inclusion, personalisation, and engagement. Facilitating learners' competencies includes the last area, which thrusts upon pedagogic competencies like responsible use, problem-solving, communication, etc., essential to driving students in the digital world. This framework is a progression model outlining six stages through which teachers develop their competencies: (i) newcomer, (ii) explorer, (iii) integrator, (iv) expert, (v) leader, and (vi) pioneer.

Second, UNESCO (2018) also provides the UNESCO ICT Competency framework for teachers (UNESCO ICT CFT). This framework, which came after its previous two iterations in 2008 and 2011, is responsive in light of the 2030 Agenda for Sustainable Development. In sync with the DigCompEdu by the European Union (2017), UNESCO's (2018) framework also promotes, beyond teachers' development, their capacity to foster ICT competencies within their students. The UNESCO ICT CFT comprises 18 competencies that are organised into six aspects, i.e., (i) understanding ICT in education policy, (ii) curriculum and assessment, (iii) pedagogy, (iv) application of digital skills, (v) organisation and administration, and (vi) teacher professional learning. This framework is also progressive in nature and includes three levels: (i) knowledge acquisition, (ii) knowledge deepening, and (iii) knowledge creation.

After having summarised the global focus on competencies, including the need for effective TPDs, we now briefly highlight the discourse about TPDs in India. This discussion has been prominent in various national policies in post-independent India. In particular, the National Commission for Teachers (1983) pointed out the need for the teachers' to be equipped with the skills they need to transfer to their students. Fast forwarding to NEP 2020, we underscore the following six points that have been envisioned in regard to the AI-powered TPDs in the Indian context: (i) providing AI-enabled customised TPDs for teachers, (ii) employing platforms like SWAYAM and DIKSHA for teachers' training, (iii) training teachers for AI-assisted assessments, (iv) educating teachers

for responsible and ethical use of AI, (v) using data analytics for analysing students' behaviour and performance, and (vi) promoting self-paced courses through AI to bridge the digital divide. In the next section, we explain how the epistemologies underpinning different academic disciplines (HSS vs. STEM) shape the TPDs, particularly in the AI-driven landscape.

5. Disciplinary shaping of AI-powered Teachers' Professional Development

The integration of AI-powered teacher professional development (TPD) has predominantly been explored in STEM (Science, Technology, Engineering, and Mathematics) disciplines (Luckin and Holmes, 2016; Cheung et al., 2024; Nagaraj et al., 2023), with considerably less focus on Humanities and Social Sciences (HSS) (Jain et al., 2024). The rapid adoption of AI in education has created both opportunities and challenges for TPD programs. While on one hand it is reshaping personalised learning, automating administrative tasks, and supporting intellectual development of teachers, on the other hand its effectiveness cannot be generalised across different disciplinary contexts. AI-powered TPD in STEM (Science, Technology, Engineering, and Mathematics) discipline, align well with structured and measurable content along with quantitative skills. It can provide adaptive learning platforms and personalized feedback systems by tailoring content to individual teacher's strengths and weaknesses (Kamalov and Santandreu, 2023; Sajja and Chikmaz, 2024; Chaudhry and Kazim, 2022). Thus, STEM benefits from AI due to the structured nature of its content, where algorithms can easily be applied to enhance learning and provide real-time feedback.

In contrast, AI's role in Humanities and Social Sciences (HSS) is more nuanced. AI tools, such as Natural Language Processing (NLP), help students write, research, and analyze texts, enabling them to generate ideas and summarise academic articles (Motlagh & Khajivi, 2023). However, concerns arise about the reliability of AI-generated work, the erosion of critical thinking, and the potential biases in AI algorithms (Olga & Saini, 2023). HSS programs emphasize ethical and reflexive use of AI to support intellectual autonomy and critical engagement with complex content. Unlike STEM, HSS AI applications focus less on automation and more on fostering analytical, integrative, and critical thinking skills. The increasing demand for technologically skilled workers in the global economy has led to a significant investment in STEM education, making it the prime focus for AI applications in education. (Srivastava, et al., 2025). That being said, the ethical

implications of AI use also differ across disciplines. In STEM, concerns focus on data privacy, algorithmic fairness, and over-reliance on technology (Al-Zahrani, 2024). In HSS, the primary ethical concern is the potential undermining of critical thinking and intellectual rigor, with AI-generated content potentially diluting learners' ability to engage with primary sources and complex analyses (Motlagh and Khajivi, 2023). Recent literature underscores these challenges and highlights the need for AI solutions that are specifically tailored to HSS. Furthermore, a report by the OECD (2023) points out that the application of AI in education must be contextualized according to the unique demands of each subject area, suggesting that while AI can enhance STEM education, its role in HSS must be approached more cautiously and thoughtfully.

In conclusion, while AI-powered TPD has made significant strides in STEM fields, the potential of AI in HSS remains underexplored. The unique characteristics of HSS, including complexity, subjectivity, and ethical concerns, present considerable barriers to the adoption of AI tools. However, as AI technology continues to evolve, there is an increasing call for the development of AI tools that are adaptable and sensitive to the diverse needs of HSS education, ensuring that these disciplines are not left behind in the AI revolution. Given this, the current study focuses on a prelude to the theoretical conceptualisation of TPDs for HSS subjects only.

6. Factors shaping AI-TPDs

The conceptual model of TPDs demands an understanding of various factors that influence its effective implementation. Therefore, in this section, we classify 9 factors that regulate teachers' adaptation to AI, ultimately shaping their learning in AI-powered TPDs:

6.1. Motivation

Lack of motivation is one of the significant barriers teachers face when adapting to AIHE (Aljemely, 2024). Teachers are not motivated enough to use AI in their teaching because of their lack of familiarity with AI and how it can make their teaching more effective. Further, a lack of trust in AI compounds teachers' demotivation to experiment with AI in their classrooms (Saihi et al., 2024). This lack of trust could be evidenced by the automated recommendation systems committing a mistake or there being a disparity between the suggestions offered by AI and teachers' opinions (Nazaretsky et al., 2022). In order to motivate teachers, well-designed training

on how AI could enhance teaching methods could be provided to teachers (Aljemely, 2024; Al-Mughairi & Bhaskar, 2024; Polak et al., 2022). This can, in turn, foster trust in teachers for using AI (Viberg et al., 2024).

6.2. Digital knowledge, including AI-related knowledge

AI is the more enhanced and advanced version of the digital world. To understand and utilise AI, even at its basic, teachers need basic digital knowledge and skills. However, the literature shows that many teachers lack technical knowledge and digital skills (Aljemely, 2024; Celik et al., 2022). This lack of knowledge also diffuses into the complex AI landscape (Nazaretsky et al., 2022; Chiu et al., 2023). Therefore, TPDs providing a basic understanding of standard procedures and AI practices becomes crucial (Nazaretsky et al., 2022; Wang et al., 2021; Viberg et al., 2024).

6.3. Discipline-specific training programmes

The method of teaching all the subjects is not universal as STEM subjects are more practical-oriented, whereas humanities and social sciences subjects are more critical and interpretive. Thus, AI tools suitable for one subject may not be feasible for another. In its light, AI-powered TPDs crafted as per the disciplinary needs are required (Aljemely, 2024).

6.4. Fear of losing jobs

Today, it is observed that AI is replacing humans in various sectors, particularly in areas requiring basic skills, which subsequently leads to increased unemployment. Teachers have the same fear that AI's capabilities may overshadow their traditional role, and they might lose their jobs (Aljemely, 2024; Al-Mughairi & Bhaskar, 2024). This fear seems to play a vital role in the teachers' community through an increased scepticism to adapting AI. Thus, it becomes the prerogative of the TPDs to help teachers understand AI as a supporting teaching aid (Al-Mughairi & Bhaskar, 2024).

6.5. Sociological factors

Factors like language, gender, level of education, age, and teaching experience, also play a significant part in developing effective teachers' training programmes (Viberg et al., 2024; Celik et al., 2022). Thus, there is a need for TPDs to take cognisance of these factors.

6.6. Regulations and guidelines

There are limited guidelines or policies governing the use of AI for educational purposes (Aljemely, 2024; Al-Mughairi & Bhaskar, 2024). Further, at the regulation level, different universities seem to have different rules regarding the use of AI. For example, while many universities restrict teachers from using AI tools like Chat GPT, others see it as an educational innovation. Therefore, clear guidelines regarding the use of AI for educational purposes are necessary for the effective use of AI in the teaching process (Al-Mughairi & Bhaskar, 2024).

6.7. Institutional support

Institutes play a significant role in adopting AI in the teaching-learning process. Apart from well-defined institutional guidelines, teachers need institute support at the resource level; they face a significant problem with limited software, hardware and internet access (Aljemely, 2024; Al-Mughairi & Bhaskar, 2024; Celik et al., 2022). For effective integration of AI in higher education, institutes should provide teachers with suitable infrastructure.

6.8. Privacy and data security

Teachers are also concerned about privacy and data security (Al-Mughairi & Bhaskar, 2024; Aljemely, 2024) because of the potential threat of misusing or mishandling the data (Saihi et al., 2024). So, to address this concern, institutions must prioritize data security, compliance with privacy regulations, and transparent communication about data handling practices (Saihi et al., 2024).

6.9. Ethical usage of AI

Finally, the debate on academic integrity puts AI technologies under an ethical scrutiny. This becomes acute due to overreliance on AI technologies, by assuming the generated information to be correct despite the possibility of inaccuracies. Further, overreliance on AI may lead to dehumanisation in educational experiences (Saihi et al., 2024). Therefore, educators need to be knowledgeable about the ethical usage of AI and its educational affordances (Aljemely, 2024; Viberg et al., 2024). Institutions also need to prioritize the ethical use of technology and offer guidance to teachers on fair use of AI, bias mitigation and accountability (Saihi et al., 2024).

Having explained the factors that shape TPDs, it also becomes important to understand some best practices for implementing TPDs in remote regions with low internet connectivity to guide the development of the conceptual TPD-model.

7. Best Practices

After having discussed the major factors shaping AI-TPDs for teachers', including the bottlenecks, this section specifically discusses the best practices that can be used for AI-powered TPDs in rural and remote regions, based on empirical support and case studies from the literature. As TPD implementation requires consideration at two levels, i) at specific level of individual teachers and ii) at the structural level and institutional level (Warr and Misra, 2021; Charania et al., 2024), the following best practices have been presented at these two levels.

7.1. At the Teacher's Level

7.1.1. Using Distance and Open Learning Options for Teachers

Especially post-COVID, the ubiquity of distance education for enhancing the teaching-learning paradigm is unquestioned, particularly in low-resource, crisis, and displacement contexts. Such programs allow for flexible learning and anytime access to study materials and resources, making them suitable for areas with erratic internet connections. For example, many projects in Uganda have been specifically focused on teachers and students with low bandwidth. One such example is TESSA, hosted on the Moodle platform, which, as an open-source LMS, adopted a lower bandwidth setting and allows for offline downloading of content. Some other pertinent examples of technologies that support offline access to digital resources include MoodleBox and the Learning Passport platform by UNICEF (UNESCO, 2020). This type of learning also promotes gender inclusivity, as female teachers in remote areas can gain greater confidence in learning compared to face-to-face learning (Khan, 2018).

7.1.2. Envisioning Teacher's as co-creators and not mere participants

Co-creation involves the participation of the parties in the ideation, development and brainstorming of solutions of any problem (Salminen et al., 2011; Botha and Herselman, 2016). Learning is most effective when a practitioner actively participates, produces artifacts (i.e. the

knowledge of participants produced through participation as community) and engages in discussions about practice (Thirumalai et al., 2019). In our case, the teachers face a number of problems while integrating AI into their teaching practice. For instance, many teachers receive training on how to use digital devices such as computers, tablets, and smart classrooms individually. However, they are not always equipped with the skills to effectively integrate and apply that knowledge into their classrooms in a practical and seamless manner (Were et al., 2011). As a result, teachers often avoid using the technology in classrooms. Thus, teachers can become co-creators of the TPD and leverage the new skills for improving their teaching practice, especially in resource-constrained areas (Ngeze and Iyer, 2022; Botha and Herselman, 2016; Botha and Herselman, 2018). For example, during COVID-19 pandemic, Republic of Korea facilitated its teachers to create and share their own weekly learning plans and share self-made Open Education Resources (OERs) for their colleagues on a voluntary basis (UNESCO, 2020). Similarly, AI-powered teacher professional development can include courses which are grounded in the Living Lab open innovation approach, as in the case of rural teachers in South Africa which included elements of gamification and stakeholder participation, badge linkages, etc. (Salminen et al., 2011; Botha and Herselman, 2019). It can also incorporate practice-based evidence of how new knowledge, proficiencies and skills gained during the TPD sessions can be adapted and implemented to their own subject and context by teachers (Botha and Herselman, 2019). This type of approach can not only provide support to teaching and learning, but also, if replicated, can improve higher education teacher's skills to address myriad challenges (Salminen et al., 2011; Habiyaemye, 2020).

7.2. At the Structural and Design Level

7.2.1. Structured planning rather than thumb rule

TPD should promote strategic thinking on technological integration so as to not get trapped in the “minutia of infrastructure and facilities” (Van Niekerk & Blignaut, 2014). This involves determining appropriate ICT tools, including the funding resources required for additional ICT resources, security measures, etc. along with planning on how teachers should be trained, incorporating those plans into actions and direct appropriate strategies. It also includes initiatives on the part of principals to organise TPD workshops, source funding for TPD's and allocate sufficient time for TPD as a kingpin through continuous support. While several developmental

models are available in the literature for planning TPD activities such as Toledo's (2005) which includes pre integration, transition, developmental, expansion and system wide integration, personalization stands at the core of the training. For example, at the initial level, generic training sessions can be organized for all teachers, post which different TPD's can be designed according to their development state and their comfort with technology. This implicates the shift from novice to expert stage where system-wide integration influences the curriculum (Van Niekerk, & Blignaut, 2014).

7.2.2. *Multilevel Dissemination and use of Frugal technology*

While technology is a desirable part of TPD's, in the context of under-resourced regions, they need to be adaptable to work online, offline and in blended formats. The ultimate goal should be to match the needs of the educators and students. It is important to plan the TPD, for online / offline and multimodalities along with compatibility with assistive technologies for example, using Universal Design for learning (UDL) and contextualizing the TPD, in terms of language, subject expertise and technological competence (Abu-Amsha & Center for Professional Learning, 2022). Sharing resources across myriad platforms can also increase discoverability (Wilichowski et al. 2024). One example of successful multimodal TPD dissemination is of the Global school leaders, an NGO engaged in professional development of teachers in marginalized settings. Offering several alternatives for teacher-learners to access content in high versus low bandwidth settings was a crucial component of this NGO's success. In circumstances with a high bandwidth, the modules were shared via the internet, but in low bandwidth settings, the modules were delivered in person and the experts followed up with the principals via phone calls (Wilichowski et al., 2024). Another noteworthy example is that of Puentes Educativos operating in rural communities in Chile which uses a mix of radio outreach programmes, social media such as Whatsapp, and video conferencing applications such as zoom to provide training and pedagogical support to remote areas of Chile (*Puentes Educativos*, 2021). The use of technologies such as SMS and messaging platforms, often termed as 'frugal' have proved to be relevant in remote areas, even in the technologically updated era of today (Portillo & Lopez de la Serna, 2021; Dreesen et al., 2020). Other mediums include secure digital (SD) cards for mobile phones preloaded with audio content or tablets as was done in the case of Burundi to families in hard-to-reach areas ("Promising Practices for Equitable Remote Learning: Emerging Lessons From COVID-19 Education

Responses in 127 Countries,” 2020). In Indian context, the TISS CLIX platform is promising for TPD in low resource settings.

7.2.3. *Content development and Microlearning*

Content development includes periodic update, maintenance, review of the resources and study materials of the modules so that they stay relevant with time. Structural updating of the content encompasses including proper URLs and inclusion of new research and evidence to support practical learning. For low bandwidth settings, it also involves exclusion of all such as content that requires high speed internet connectivity, or bulky files that are difficult to download, store and share. Microlearning is an approach that includes the creation of bite-sized, action-oriented content. It has a positive impact on the cognitive, behavioural and affective learning outcomes of the learners as per Bloom’s Taxonomy and leads to effective online and distance learning (Choo and Rahim, 2021; Monib et al., 2024). Considering the additional burden of teachers in low resource settings and lack of technological infrastructure, microlearning acts as a flexible and stress free mode of achieving digital growth for teachers (Kohnke, Fountoukidis & Zou , 2024). Thus, TPD’s should be designed with this approach instead of traditional methods.

7.2.4. *Timing and continuity of TPDs*

Educators in under-resourced contexts require more time to learn and adapt to the transition to GenAI. Teachers from remote areas particularly complained about the lack of time allotted to hands-on training in the context of TPD’s (Thirumalai et al., 2019). Therefore, AI-powered TPD activities should be tailored to accommodate the duration and frequency of training, as highlighted by Albion et al., (2015). They can be self-paced. If being conducted in a blended model, sufficient time should be allotted to the participants to engage in asynchronous sessions along with synchronous interactions and reach out to the peer groups through accessible technologies such as SMS, voice calling. A noteworthy example of this type of TPD is the Quality Holistic Learning (QHL) project, implemented in countries across the MENA and Sub-Saharan African regions, including Niger, Chad, Lebanon, and Kenya which was continuous and offered generous time to the participants to indulge in remote learning in low resource areas.

7.2.5. Translanguaging

The formation of inclusive instructors requires translanguaging. An appropriate example is the QHL project in Lebanon, where the online TPD course materials were released in both Arabic and English, with meticulous transcription services offered by NGOs and linguists. Since the majority of TPDs in remote places are limited to English, multiple language support can encourage instructors' full engagement and becomes essential to their effectiveness. Planning and budgeting for the TPD initiatives should take into account the increased time and expense required to formulate such TPDs (Abu-Amsa & Centre for Professional Learning, 2022). Taking the case of India, where the linguistic situation is increasingly complex, TPDs should include home, regional, and official language differences in its structure. For instance, TISS offers a blended modality of the PGC RTICT (Post Graduate Certificate Program, Reflective Teaching with ICT) in several Indian languages.

8. Research Design

This study comprehensively unpacks the contextual factors influencing AI integration in remote Indian colleges by gathering insights from faculty members across various departments within the HSS disciplines. It identifies the determinants shaping perceived competencies, revealing the faculty's confidence levels, training, and comfort with AI-driven tools. It examines utilisation patterns, providing information on how AI tools are used or underused in administrative and teaching processes in remote Indian colleges. Faculty members offer context-specific insights into barriers and enablers that facilitate or hinder AI adoption. The interviews highlight how demographic characteristics, such as age, gender, and rural or urban settings, influence the use and acceptance of AI in higher education. These insights offer a prelude to developing an AI-powered TPD in remote and rural areas. In this section, we explain how the interview schedule was developed, data was collected, and further analysed.

8.1. Tool Development

This study uses semi-structured interviews as the mode of data collection from selected college teachers. For this, interview schedules were prepared, by eliciting questions from literature and internal discussion with the team. After generating the initial pool of questions, we moved forward

with its qualitative content validation. Four experts were contacted for this: two were domain experts, 1 was a language expert, and 1 was an educator. Experts were requested to provide input on what modifications were needed, including those related to language comprehensibility. They were also requested to give their overall comments. Based on the feedback received, several items were revised and a few items were added. This approach to purification has been well-established in literature (Mandal & Sareen, 2023). After multiple iterative revisions, we were left with 22 guiding questions (Appendix I). This final interview schedule was structured around six core themes: (i) past experiences of TPDs, (ii) preferences for future TPDs, (iii) perceptions of AI in higher education, (iv) subject-specific applications of AI, (v) barriers to integrating AI in teaching, and (vi) support needed from TPD programmes.

8.2. Data Collection

Data collection through semi-structured in-depth interviews allowed for flexibility while ensuring consistency in the themes explored. Each participant was interviewed individually, either in person or via phone, between February 2025 and mid March, 2025. Interviews were conducted in English or Hindi, depending on the participant's preference. The duration of the interview sessions ranged from 30 to 50 minutes.

A total of 5 colleges were selected as sample sites in Ladakh. These include: (i) Govt. Degree College Kargil, (ii) Govt. Degree College Drass, (iii) Eliezer Joldan Memorial College Leh , (iv) Govt. Degree College, Khaltse, and (v) Govt. Degree College, Zanskar. Herein, Govt. Degree College Kargil served as the main college for the study. Other colleges were included to provide insights from a rural perspective and to represent gender diversity and additional regional viewpoints. It also contributed to broadening perspectives across different departments and institutional contexts. The study also includes Govt. Degree College Zanskar, which is the remotest college in Ladakh, notable for its unique challenges, as the region only gained internet access in 2021.

Data was collected from faculties from different departments of HSS to ensure the inclusion of multiple perspectives. Fifteen participants were selected based on a non-probabilistic purposive sampling approach from various higher education institutions across Ladakh. The participants were assistant professors from diverse academic disciplines, having a range of teaching experience spanning from one to fifteen years. Hennink et al. (2019) and Palinkas et al. (2015) argue that

purposive sampling allows researchers to deliberately select participants who can provide comprehensive insights, thereby facilitating the identification of patterns and themes across the dataset.

The rationale for sample size is rooted in data saturation. The effectiveness of purposive sampling in achieving saturation is widely supported in the literature. Saturation in qualitative research involves ensuring that data collection encompasses the widest possible range of diversity within the study category. It was decided to conduct a minimum of 10 interviews to achieve saturation (Appendix II), with a flexibility in increasing the sample size until saturation was reached. Saturation was to be confirmed when no new themes emerged after a few consecutive interviews (Francis et al., 2010). The adequacy of sample size for reaching saturation varies across studies. Fowler et al. (2019) reported reaching saturation after data collection from the 9th respondent, following attempts with eight others. On the other hand, Gentles et al. (2015) argue that it is not possible to predefine a specific sample size for qualitative studies. Instead, they advocate for ongoing sampling, where the sample size is increased incrementally until sufficient information has been obtained to address the research questions. Similarly, Hennink et al. (2019) and Vasileiou et al. (2018) emphasise that sample size decisions depend on the depth and richness of the data collected rather than fixed numerical targets. The process of ongoing sampling ensures that researchers continue collecting data until no additional themes or insights emerge. In this study, a total of 15 interviews were conducted, ensuring data saturation, thus capturing a comprehensive understanding of the contextual factors influencing AI integration in remote Indian colleges. By adhering to these principles, the study produced meaningful and actionable insights grounded in the diversity and depth of the data collected.

8.3. Data Analysis

Mixed-method content analysis with primary focus on the qualitative side was employed to explore and enhance higher education teachers' competencies in AI. Since, the study aimed to understand educators' experiences, perceptions, and needs related to AI integration in their teaching contexts, it focused on qualitative content analysis for the subjective interpretation of the data through the systematic classification process of coding and identifying themes or patterns emerging from the data (Hsieh & Shannon, 2005).

Content analysis is a technique for the objective, systematic, and quantitative description of the content for the purpose of measuring variables (Berelson, 1955; Prasad, Devi, 2008). Herein, content analysis is used to draw inferences on the opinions of the teachers on TPD for integration of AI into the higher education. In particular, we used the mixed method content analysis (White & Marsh, 2006; Creswell and Plano Clark, 2007), wherein the focus included both (i) counting and measuring, like the frequency of a term, i.e., quantitative content analysis, and (ii) concentrating on abstract things like, people's thoughts, opinions, feelings and perspectives to bring out the underlying themes and patterns through subjective interpretations, i.e., qualitative content analysis (Elo & Kyngäs, 2008).

Based on initial reading of two interview transcripts, meaningful units were condensed from the transcripts while maintaining its essence, thus resulting in the preliminary codebook. This codebook was further developed based on an iterative process shaped by through reading of the remainder 13 interview transcripts (Hsieh & Shannon, 2005).

9. Empirical Findings

This section summarises the findings from content analysis, sourced from analysing the codebook (in Appendix III).

9.1. Teaching with AI

Responses from the participants revealed a mix of perspectives. While many expressed optimism about AI's potential to transform education into a more personalized and student-driven experience, some raised concerns about its limitations in teaching and learning. Specifically, participants noted that AI lacks the human interaction inherent in traditional teaching, which many find more appealing. Additionally, there were concerns about the tendency of AI to generalise learning patterns and paces, potentially overlooking the contextual understanding of individual students.

Some responses also reflected a sense of rigidity, with teachers expressing the belief that books and human educators cannot be replaced. Many participants emphasised the irreplaceable role of teachers in understanding students' emotional and social needs, which AI cannot do.

Beside having these challenges in AI usage in teaching, there are other positive sides which participants highlighted. A few responses mentioned that AI can automate and standardise

evaluations, making them more objective based on the merit. It was highlighted that AI can bridge the physical gap for students who are unable to attend college in person. Participants also pointed out that the AI has the potential to personalise learning to meet individual student needs and increase the overall accessibility of education. It was highlighted that AI can fill in the physical gap for students to attend the college physically.

Moreover, 9 out of 15 participants indicated that AI integrated teaching has made their instructional process more efficient, benefitting both themselves and their students. For them, AI has also simplified note-taking and made presenting topics in class more engaging and appealing to students. Additionally, study materials are now more easily accessible, participants reported. However, they also noted that traditional teaching, which involves face-to-face interaction, allows teachers to more effectively assess whether students have grasped the material.

They highlighted that digital teaching has enabled both teachers and students to conduct classes anytime and anywhere, providing introverted students the opportunity to find answers without hesitation. Furthermore, they emphasised that the integration of AI has made students more focused and active in their learning with the help of attractive visuals and interactive elements in videos.

Concurrently, a critical examination of both traditional and AI-integrated teaching pointed to reduced students' attention spans, a challenge that was not as prevalent with the traditional method of teaching. In addition to this challenge, participants shared that while the use of AI is a time-saver, teachers must remain mindful of ethical considerations and ensure the authenticity of the information provided by the AI. They also noted that traditional teaching fosters a personal connection with students, which is often lacking in AI-integrated methods. One participant shared that it represents a transition from quality to quantity. With digital teaching, there is increased access to information, but this often comes at the expense of quality, understanding students' context.

9.2. Comfort with AI

Six participants said they are comfortable using technology, while six expressed discomfort. Further, fourteen participants reported that they lack adequate skills and knowledge regarding AI, though many expressed curiosity and a willingness to learn. One participant raised concerns about data security. Notably, most participants were familiar with basic AI tools such as ChatGPT, Jenni

AI, ScholarGPT, and QuillBot, primarily for tasks like making presentations or summarizing content. Seven respondents learned about AI from family, friends, colleagues, NGO members, or research groups. Four learned about it through social media platforms, and one via newspapers. Many associated the term "AI in education" with advanced technology and more effective learning. One participant described it as a form of automation in education.

9.3. Students and AI

The responses collected through the interview provide a variety of opinions about the students' perception of the role of teachers in the classroom. Among 15 participants, 4 specifically highlighted reduction of dependency on teachers. They noted that, with the growing awareness of AI among students, there is a diminishing reliance on teachers for guidance and support. This shift suggests that students are becoming increasingly independent in their learning, with teachers' roles involving primarily that of facilitators.

One common aspect raised by the participants was the concern that, as the use of AI has increased, students are losing interest in traditional classroom instruction. In the light of this reduction in dependency, participants expressed hesitation in using AI in teaching and learning processes. Five participants also highlighted some concerns that AI diminishes originality, and raised doubts about authenticity and reliability of AI tools.

Besides, above mentioned critics of integrating AI in education, few participants believed that students are not yet in a position to effectively evaluate teachers. They suggested that there has been only minimal change in this regard and students still value their teachers, indicating that the role of teachers in the classroom remains largely unchanged despite the growing presence of AI tools.

Additionally, one participant shared a unique case in which students were not using any AI tools in their Urdu subject. This observation contrasts with the broader trend, highlighting how AI usage may vary depending on the subject matter.

9.4. Past experience with AI-TPDs

The frequency of attending TPD programmes among the sample participants was generally low. The same trend continued for TPDs specific to AI, where only 2 out of 15 participants reported having attended AI-TPDs, though of inadequate quality. The reasons for attending TPDs were

polarised, varying from a formal requirement for their annual performance report (reported by 7 out of 15 teachers) to updation of knowledge and career advancement (reported by 8 out of 15 teachers). The major barrier for teachers for enrolling in an AI-TPD constituted inconvenient time and workload (i.e., 6 out of 15). One participant expressed skepticism toward AI, questioning its authenticity and the potential loss of originality in teaching. Another respondent mentioned a preference for short-term training.

9.5. Major bottlenecks for integrating AI

Fourteen out of fifteen respondents reported a lack of basic facilities like electricity, internet, hardware, and software. The extent of these issues varied across colleges, but electricity shortages were the most commonly cited problem. Seven respondents highlighted geographical remoteness, and two mentioned that financial constraints prevent students from owning digital devices, relying instead on government support. There is also limited awareness about AI among students.

Further, the responses reveal several contextual and demographic factors that influence the integration of AI in education at the college level. These factors include demographic factors, academic discipline, infrastructure & climate, cultural & religious factors and ethical concerns. A significant number of responses (nine out of fifteen) focused on demographic factors, particularly age and gender as key components. Age was identified as a factor, with older educators expressing difficulty in adapting to technological advancements. Similarly, cultural beliefs, additional responsibilities at home, and time constraints were noted by five participants as barriers that limit the exposure of girls and women to technology and digital devices. Even when they do have access, they often face challenges in adopting the latest technologies. In contrast, the situation was found to be more favorable for boys and men, who tend to have greater exposure to and engagement with technology.

Academic Discipline is another factor influencing the AI integration in teaching and learning, where six participants highlighted that AI is more quickly adopted in the science disciplines, where technology is integral, whereas humanities disciplines are slower.

Other factors provided by the respondents include infrastructure and climate, with specific reference to the extreme conditions in Ladakh. Participants reported that conducting classes during winter months becomes very challenging due to the frequent winter storms, which often results in

power outages. These conditions significantly hinder the smooth delivery of lessons and the effective integration of technology in the classroom.

Furthermore, in rural areas, the lack of AI awareness further limits the integration, while in some institutes, insufficient resources, such as interactive panels, hinders advancements. Moreover, authorities often are not aware of the potential of AI, which often prevents them from supporting necessary changes. There are also concerns regarding the authenticity of AI-generated content, causing some educators to be hesitant to rely on AI.

9.6. AI and Ethics

Many participants have raised significant ethical concerns regarding the usage of AI in teaching and learning. The majority of participants (thirteen out of fifteen) emphasised concerns related to the unethical use of AI such as, misuse of AI during exams, plagiarism, and lack of originality in students' work. Additionally, it was noted that the potential for AI misuse is not limited to students; teachers may also exploit AI inappropriately, making it more challenging in ensuring the responsible and ethical integration of AI in teaching and learning process.

Data security was mentioned as a critical ethical concern, with three participants highlighting the risks related to privacy breaches and the potential misuse of personal data when using AI tools. In addition to data security, other participants raised concerns regarding the authenticity and reliability of the information provided by AI tools. They pointed out that these concerns make it increasingly difficult to discern between truth and misinformation. As a result, it was emphasised that educators must take extra precautions to verify the information before incorporating AI tools into their teaching practices.

9.7. Need for Institutional support

To increase AI integration in education, higher education institutions should take active step to develop pedagogy, to foster within the departments. These initiatives can be complemented by providing proper training in AI, ensuring access to the necessary resources, and facilitating workshops for both students and teachers. There should be efforts for infrastructure and internet connectivity. Furthermore, initiatives should be taken at the institutional level, by the institute itself along with the bottom-up approach, with efforts to extend it to remote areas like Zaskar or Drass.

Additionally, colleges should consider taking a balanced approach where traditional teaching is enhanced with AI.

9.8. Content preference for future AI-TPDs

All participants expressed a desire to learn how to integrate AI into their specific subject areas. Nine participants preferred practical applications of AI in their subjects. Four participants wanted both practical and theoretical knowledge, while only one participant showed interest in theoretical concepts alone. Further, nine participants mentioned using AI for tasks like making notes, preparing PPTs, converting audio to text, and enhancing content explanation. Four participants focused on student skill development, four on both teacher and student skills, and four said they do not seek AI assistance in teaching.

Orientation on the academic use of AI is highly necessary, and this includes instruction on data security protocols and other AI applications pertinent to particular subjects. Some of the educators are interested in learning its utility in education and academics and explore the potentials and limitations of AI. The educators want to learn how to integrate AI is discipline specific. They are also eager to learn about AI tools, their benefits, drawbacks, how to apply them effectively in classroom settings. Teachers suggest there should be hands-on training or workshops to enhance learning. Training on tools like Excel in AI, along with broader sessions on how AI can be integrated into humanities and other disciplines, is requested.

While teachers do think AI is necessary, they also believe that there should be space for human interaction and a need for socio-emotional learning. Further, one of the key targets to integrate AI into the system is to enhance skills and employability. Many of the respondents believe as teachers are not replaceable, AI can help teachers in preparing lesson plans and make assessment effective maintaining the balance. Since there is concern with respect to the originality, the respondents believe a new assessment method should be designed which doesn't get influenced by AI. Moreover, the training should involve both the faculty and students how to use AI cautiously, with a balanced approach for traditional methods and AI integrated into it.

9.9. Format preferences for future AI-TPDs

Ten participants preferred TPD sessions in offline mode, one preferred online mode due to ease in access, and two opted for a hybrid mode. One participant specifically mentioned poor internet

connectivity as a reason for avoiding online TPDs. Preferences for timing varied: four preferred sessions during semester breaks, three during exam periods, two on weekends, three after regular classes, and one in the first half of the day.

10. Prelude to the AI-TPD model

Having discussed the findings from literature and the empirical insights, this section offers some suggestions as a prelude to the AI-TPD model in rural and remote regions, specially catering to HSS disciplines.

1. It should be the foremost responsibility of an AI-TPD to critically look into, and clarify its positioning on various myths related to: (i) limited interaction with AI, (ii) lack of personalised learning with AI, (iii) AI replacing teachers, and (iv) AI-technologies replacing classroom learning.
2. Some generic and basic sessions could be conducted for all teachers to bring them to the same level, followed by tailoring the AI-TPD as per the disciplinary requirements of teachers. This is in accordance with the principle of moving from general to specific AI-TPDs, discussed in section 7.
3. Given limited strides in localising AI-TPDs, teachers should be considered as co-creators in the developmental process (section 7). This will, for example, help the Urdu teachers to co-create their AI-learning from the TPDs through translanguaging (section 7).
4. The training must encompass atleast one module on ethical use of AI so that teachers are able to employ these technologies more mindfully.
5. There is a need to balance theory and practical part in AI-TPDs in remote regions, focussing on making notes, preparing PPTs, converting audio to text, and enhancing content explanation.
6. An AI-TPD needs to teach such teachers on how to automate tasks through praxis, including students' evaluation.
7. Given teachers' hectic schedules and internet-related bottlenecks, distance and open learning options, with an in-person guide could be used as a plausible way. In this sense, multimodal delivery of AI-TPDs should be preferred, with an integral in-person component.
8. Bite-size content may help minimise the internet-related problems during the AI-TPDs.

9. Prolonged engagements could help in lasting impact in such contexts with limited exposure.
10. There is a need for institutional initiatives and policies to guide teachers for sustainably using AI in their teaching.
11. AI-TPDs in rural and remote areas need to be cognisant of gender, culture, and age of teachers, and accordingly, specialised AI-TPDs catering to these aspects within HSS disciplines are encouraged for inclusivity.

11. Conclusion

The study provides a prelude to an AI-TPD for rural colleges within HSS disciplines. The suggestions from this study could help ground AI-TPDs to be more inclusive for these peripheral regions. The project is completed as per the plan. We acknowledge the support of COL-CEMCA in this study.

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Appendix I

Interview Schedule (HSS Teachers Only) **Guiding Questions (Semi-Structured Interview)**

Teaching background

Q1. Demographic Information

- a) Name :
- b) Age:
- c) Gender:
- d) Designation/Position:
- e) Years of Teaching Experience:
- f) Subjects Taught:
- g) Geographical Location (Urban/SemiUrban/Rural/Remote):
- h) Masters/ PhD completed from - (name of the university)

TPDs on AI: Past Experiences and Preferences

Q2. When did you last attend a TPD? How frequently do you attend these training programmes?

What is usually your motivation to attend TPDs?

Q3. Have you attended any TPD on AI recently or in past? If yes, what was your motivation to attend TPDs on AI? What content was mainly covered in such TPDs? How useful was it for you?

Q5. What is your motivation to attend TPD on AI in future (if there is)? Could you also discuss any possible factors that may discourage you from participating in AI-related TPDs?

Q6. Are there any specific topics or areas in AI that you would like to learn to enhance your teaching, specifically for your subject?

Q7. If such a TPD were to be implemented in your college, would you prefer more practical examples of AI applications (how can AI be used in your subject) or theoretical knowledge about AI-related concepts (different key terms and theories related to AI) in the TPDs?

Q8. If such a TPD were to be implemented in your college, what time of the day would you prefer for the sessions of this TPD? How long (given your workload)? Would you prefer the TPD to be delivered online, offline, or in a hybrid format?

Perceptions of AI in higher education

Q9. How comfortable are you with using technology in your teaching practices? How/ where did you get to know about AI, including GenAI? What do you understand by the term "AI in education"? Do you currently use AI-based tools or platforms in your teaching? If yes, which ones?

Q10. How different is traditional teaching from digital teaching and now the AI-integrated teaching?

Q11. Some people say AI can transform education into a more personalized and student-driven experience. Do you agree or disagree? Why? How has the assessment, evaluation and addressing the individual differences in the students changed after the integration of AI (or how you think it potentially can change, if not using AI already)?

Q12. Do you feel that your current knowledge and skills are sufficient to use AI tools effectively in your classroom? Why or why not?

Q13. How do you think the perception of students has changed with respect to the role of teacher in classroom (after active use of AI)?

Application

Q 14. In what areas within your subject could integrating AI be helpful?

Q 15. What kind of assistance do you seek from AI in teaching-learning? Having mentioned the areas- which skills do you think you are catering to? (your skills and/or your students' skills)

Barriers

Q16. How the location of your college (urban, rural, or remote) impact your access to AI tools and training (if it does)? How does it impact the students? Given the rural/ remote set up, what kind of barriers do you face in integrating AI in your teaching?- (i) infrastructure (eg., devices), (ii) network (eg., internet), (iii) electricity and transportation?

Q 17. What contextual factors specific to your college (eg., gender, climate, religion, culture, age, previous qualifications, academic discipline, etc.) impact the integration of AI?

Q 18. Do you think there are any ethical concerns with using AI in teaching and learning at the college level? Could you elaborate?

Q 19. What are the barriers other than resource constraints which stop you from integrating AI within your subject for teaching-learning (if any)?

Support

Q 20. What kind of support mechanisms would help you integrate AIHE in your teaching and in college in general? How can your college facilitate the adoption of AI in your teaching and learning process?

Overall Suggestions

Q21. If you are asked to suggest changes in (i) teaching (ii) learning and (iii) assessment in the era of AI, what would they be?

Q22. If a TPD on AI were to be planned in your college, what specific skills or knowledge would you like to gain by the end of this TPD? Do you have any suggestions or additional expectations from such a TPD?

Appendix II

List of interviewers for the study

S.No	Department	College
1.	History	GDC Kargil
2.	Commerce	GDC Kargil
3.	English	GDC Kargil
4.	Education	GDC Kargil
5.	Persian	GDC Kargil
6.	Sociology	GDC Drass
7.	Political Science	GDC Kargil
8.	Social Work	GDC Leh
9.	Economics	GDC Khaltse
10.	History	GDC Khaltse
11.	Travel and Tourism Management	GDC Kargil
12.	Hindi	GDC Kargil
13.	Education	GDC Zanskar
14.	Political Science	GDC Zanskar
15	Geography	GDC Leh

Appendix III

Code	Meaning
APR requirements	Annual performance report requirement for teachers to attend TPDs
No TPD	No experience in TPD of any kind
No training	No experience in TPD in AI
Student Workshop	Conducted AI workshop for students and not for teachers; student-centric workshop on AI
Update with new technologies	Keep up with new AI technologies and tools, which save time; educational trends; to increase teaching proficiency
Scepticism in AI usage	Teachers are more hesitant in using AI in the teaching and learning process, dependency on AI kills originality, doubt the authenticity of AI tools, less interaction with teachers
Policy requirement	Awareness of educational policies
Motivation	Willingness or drive to learn and adopt AI in teaching-learning, career advancement, for certificate courses or online courses, learning software learning tools
Understand basic AI tools	Awareness and usage of basic AI tools like Chat GPT, Jenni AI, scholarGPT and AI for basic purposes like making PPT, Quilt bot aware of practical usage
Curiosity	Eagerness to know and understand AI
Clash with class	Less motivated to attend TPD if the programme clashes with the class timings
Minimal recall	Teachers recall the least information from their last AI TPD session
Workload	increased amount of work, beyond the capacity of the teacher, a busy schedule, and small colleges
AI integration in the discipline	Learn how to use AI in teaching topics in their discipline (subjects); incorporating AI education through regular one-hour classes or programs, aimed at equipping students with essential AI knowledge and skills.
Theoretical knowledge	Know different key terms, theories and ideas related to AI
Practical knowledge	Hands-on activities and practice on use of AI in their teaching and learning
Semester break	Having TPDs in the gap between two semesters
Weekends	Having TPDs in weekends
Long duration TPD	Training session more than a week

Short-duration TPD	Training session is a week or less than a week
Offline sessions	Prefer training in face-to-face mode, weekly after 4 pm
Online sessions	Prefer training through digital platforms, like Zoom, Google Meet mode
Hybrid sessions	Prefer a combination of both online and offline modes
First Half	Before the lunch session during college hours
Comfort	Comfortable using technology and AI in teaching-learning by the teachers and students, such as clarifying and making PPTs
Discomfort	Not comfortable using technology and AI in teaching-learning by the teachers and students
Issues in online	Network issues in Online mode
Under-utilising technology	Being aware of AI technologies but not completely using all of them
Lack of skills and knowledge	Teachers do not have enough knowledge and skills about how to utilise AI in the teaching and learning process effectively
AI Awareness	Interest in AI tools for practical, time-saving applications, knowledge of AI in specified domains
Known people	knowing AI through family, friends, colleagues, staff, acquaintances, NGO, scholar groups
Social media	Know about AI through social media like Instagram, Facebook, Twitter, WhatsApp, and YouTube
Traditional teaching	Physical mode of teaching, which involves face-to-face interaction
Personal connection	Physical interaction in traditional training amongst teachers and students with emotional support
Digital teaching as a solution	Digital teaching helps teachers and students to take classes anywhere, helps both to make notes, time saving, helpful for introvert students who hesitate to ask questions in traditional teaching; students are more focused and active
Digital teaching problem	Digital teaching lacks the personal touch & connection with students
ease in teaching and learning	With AI, for teachers and students, teaching and learning become easier and more attractive and interactive, which helps in developing lesson plans and also provides additional information; easy availability of study material; it also reduces the high dependency of students on their teachers; filling the knowledge gap, & objective assessment
No help required	No assistance is sought from AI

Students AI awareness	With awareness of AI, students can take advantage of and fully utilise AI in learning, the knowledge gap between teachers and students has reduced, and students are less hesitant to ask questions.
Minimal changed perspective	Minimum change in students' perception of the Teacher's Role Post-AI
Unaware of students' context	AI does not take into account students' context, which includes their socio-cultural, educational, economic and emotional background
Generalised AI	AI does not take specific considerations and makes a general understanding
Data security	Concern for data security and authentic information in AI tools
Loose interest	Students lose interest if the teaching content is the same as ChatGPT
Crave for different knowledge	Student demands for different knowledge which is not easily found in ChatGPT
Lack of basic facilities	Absence of software, hardware, good internet connectivity, electricity, infrastructure and proper transportation facilities; also a lack of interactive panels
Remoteness	The place is far from the majorly populated parts, due to which it is difficult to access training and resources
Nonphysical barriers	Digital divide, knowledge gap, Upbringing and socialisation, which cause problems in AI integration in teaching and learning
Gendered workload	Add on work at home form women and time constraints, females fail to adopt the latest technology
Gender Specific	Due to culture and belief system, girls/women are less exposed to technology and digital devices; boys/men are more tech-savvy
Discipline affecting adoption	Discipline affecting the adoption of AI in teaching, science being more advanced stream
Lack of willingness	Teachers showing a lack of willingness to adopt and integrate new technologies in the teaching learning process
workshop on AI	Conducting hands-on training sessions or one-hour classes of AI applications for teachers and students (by the institute); once a year
Basic facilities	availability of software, hardware, internet connectivity, electricity and proper transportation facilities
Balanced approach	Teachers should use technology to enhance their teaching experience, skills and evaluation of students, but not over-reliance on technology.
Overcoming the language barrier	Teachers use AI to make content easy so that students from other dialects/languages can easily understand
Hesitation	Students' reluctance to indulge in discussion with teachers

Positive student perception	Students see their teachers using AI technology as advanced
Negative student perception	Students take their teachers at ease
Climate barrier	Classroom interaction is hampered due to extreme weather conditions like heavy snowfall and rainfall; due to snowfall, solar electricity doesn't work
Difficulty in knowing the truth	Difficulty in differentiating between truth and false
Lack of originality of ideas	Unable to produce new, unique ideas, the ideas might be repetitive or taken from AI
institutional initiatives	Institutes' willingness to adopt AI in the teaching-learning process in the classroom, and for that, making guidelines for easy AI integration
Post working hours	Time after the official working hours
Lack of student-driven experience	AI does not focus on the requirements of students for improving their learning experience.
Transition from quality to quantity	shift from traditional teaching, which focuses more on serving quality content to the quantity of information through online and AI
Possibility of replacing the teacher	There is a possibility that AI might replace teachers
Demographic factors	Age, gender, ethnicity, location and educational qualification impact the integration of AI in teaching-learning
Unethical use of AI	It means teachers or students use AI to substitute teaching practices and use for copying in exams or assignments
Provide basic facilities	provide facilities and resources such as software, hardware, internet connectivity, electricity and proper transportation facilities
Irreplaceable teachers	
Less Training Attendance	Attended the session very few times
Social Media Influence	AI knowledge through social media only
Guidance on AI usage	Need of rules and guidelines on ethically using AI in the teaching and learning process
Practicality	AI concepts theoretically is important, but the true value lies in applying this knowledge in practical scenarios.

Interaction Dynamics	In traditional teaching, communication flows only from teacher to student, while digital teaching with AI promotes a two-way interaction, allowing for more engagement and feedback between teachers and students
Student engagement	Digital teaching with AI promotes a two-way interaction, allowing for more engagement and feedback between teachers and students.
Trade offs	Benefits and demerits of AI
Lack of AI awareness	Lack of AI publicity and awareness in rural areas, among higher authorities in remote colleges
Age anxiety	Age anxiety refers to the apprehension about ageing, particularly after 50, when individuals may feel anxious about adapting to new technologies.
Dependency Reduction	Dependency Reduction refers to a decrease in reliance on teachers for guidance and support, indicating that students are becoming more independent in their learning process; teachers become more facilitators.
Classroom discussion	Interaction and discussion between students in a face-to-face traditional classroom
Experiential learning	Use AI for experiential learning, like virtual tourism,
Catering to students' needs	Use AI to serve different students
Cater to teachers' needs	Use AI to serve different teachers' needs
Attendance shortage	Due to AI, students no longer require teachers, then students do not attend classes, and there is a shortage of attendance.
Safety	Institutions provide safety and cybersecurity in general (need to check in the context transcript)
Working below capacity	Teachers do not fully utilise their potential in teaching because of AI, like a creative way of teaching
Excess information	The availability of a lot of information makes it difficult for teachers and students to get personalised information
Information:	
Pink	Code updated; need to modify the transcript which used this code
Blue, Green	Similar codes
strikethrough	Code discarded