Module Report

Transforming Pedagogy with Technology and UDL Approach in STEAM Education

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1. Introduction

This module report presents an overview and analysis of the professional development (PD) module titled *Transforming Pedagogy with Technology and the Universal Design for Learning Approach in STEAM Education*. The module was developed and offered by a team from Samtse College of Education (SCE) in collaboration with the Ministry of Education and Skills Development (MoESD) as an Open Educational Resources (OER) module.

The primary purpose of the module was to strengthen STEAM teachers' pedagogical capacity to integrate educational technologies meaningfully while applying the Universal Design for Learning (UDL) framework to address diverse learners. Grounded in the core UDL principles of multiple means of engagement, representation, and action or expression, the module aimed to support teachers in designing learner-centered, flexible and inclusive classroom practices.

The target audience for this PD programme comprised school STEAM teachers from Norbugang Central School, who were identified as the participating cohort. The module was designed to respond to their professional learning needs within the Bhutanese educational context.

The module was authored and delivered through the Moodle 4.5 learning management system, which served as the primary platform for facilitating online and blended learning. Moodle enabled the organisation of module content, learning activities, and assessments in a structured manner, supporting flexible access, interaction, and self-paced professional learning.

2. Module overview and structure

The module *Transforming Pedagogy with Technology and UDL Approach in STEAM Education* is systematically organised on the Moodle platform using a unit-based structure. The module comprises five instructional units, preceded by a welcome and introduction to the UDL topic section and ended by an endline survey component. This structure supports a coherent progression of learning, guiding participants from foundational concepts to applied practice and reflection.

The welcome section introduces participants to the module through a welcome message, consent form and baseline survey. This initial section establishes expectations, gathers baseline data on teachers' understanding of UDL, and orients participants to the Moodle learning environment. An introductory section on UDL provides conceptual grounding before participants engage with the core instructional units.

The five instructional units are thematically sequenced around the three core UDL principles and the ethical use of technology.

- Unit 1 focuses on *Multiple means of representation* and emphasises lesson delivery strategies.

- Unit 2 addresses *Multiple means of engagement*, with a focus on engaging and motivating students to learn.
- Unit 3 centers on *Multiple means of action and expression*, highlighting diverse assessment approaches.
- Unit 4 requires participants to apply their learning through lesson plan design and reflective practice.
- Unit 5 addresses the *ethical and responsible use of technology*, including online safety and data privacy considerations.

First three units follow a consistent internal structure, beginning with an "About this Unit" section that presents synopsis and objectives of the unit, followed by multimedia content such as instructional videos and interactive learning activities. The module makes optimum use of Moodle's activities and resources features, ensuring that content is accessed in a scaffolded and sequential manner. This design promotes learner engagement and supports mastery of concepts before progression to subsequent activities.

A good number quality resources and ICT tools are integrated throughout the module, including interactive videos, concept-checking activities using platforms such as Edcafe AI, discussion forums, wikis, databases, blogs, and assignments. In addition, PDF resources, research papers, sample lesson plans, and curated open educational resources (OER) are embedded to support deeper understanding and professional practice.

In terms of navigation and layout, the module demonstrates clarity and coherence through clearly labelled topic sections, concise summaries, and logical sequencing of activities. The structured use of topic headings, completion tracking, and progressive learning supports flexible, self-paced learning while maintaining a clear learning pathway for participants.

3. Learning objectives
By the end of the PD programme, participating teachers were expected to:
1. develop conceptual understanding of UDL principles-multiple means of representation, engagement, and action/expression
2. integrate appropriate educational technologies into their classroom practices for supporting diverse learners
3. design inclusive lessons using the UDL framework for accommodating diverse learners
4. apply student-centered pedagogical strategies
5. enhance assessment practices through technology and UDL framework
6. adapt UDL and technology through reflections

4. Teaching and learning approaches
The teaching and learning approaches adopted in this PD programme reflect a blended and learner-centered design, facilitated through the Moodle learning management system. Learning was initiated through a one-day face-to-face orientation workshop,

followed by more than a month of online engagement. This blended approach supported both initial orientation to the module and sustained professional learning over time.

During the face-to-face workshop, participants were oriented to the module structure, learning expectations, and Moodle navigation. Hands-on practice was provided for each module unit and associated activities, enabling participants to engage confidently with the online platform. In addition, participants were introduced to relevant educational technologies, such as Edcafe AI and Canva. This preparatory phase ensured that participants were equipped to interact meaningfully with the Moodle-based activities and apply these tools later in their classroom practices.

The module design reflects several key pedagogical approaches, particularly learner-centered, exploratory-based, and activity-based learning. Participants engaged actively with content through interactive videos, concept-checking tasks, and problem-oriented activities rather than passive content consumption. This module employed sequential access and activity completion tracking, requiring participants to complete learning tasks in a structured order before progressing. This design supported personalised learning pathways, enabling participants to learn at their own pace while ensuring mastery of key concepts.

To support facilitation and monitoring, the thirty three (33) participants were grouped under five facilitators, with each facilitator responsible for approximately six to seven participants. Facilitators actively monitored progress through Moodle activity completion reports and provided guidance through email communication and a community of practice established via Telegram group. This ongoing facilitation enabled timely feedback, encouragement and targeted support throughout the module duration. Facilitators also participated in module activities and discussion forums, allowing for real-time formative assessment and deeper insight into participants' learning progress.

Collaborative learning formed a significant component of the module design. Moodle tools such as discussion forums, database and wiki activities were used to promote peer interaction, knowledge sharing, and collective problem-solving. For example, participants engaged in collaborative scriptwriting using the wiki tool and participated in discussion forums that encouraged reflection and the exchange of classroom experiences. These collaborative tasks strengthened professional dialogue and fostered a supportive learning community.

The module design demonstrates strong alignment with Universal Design for Learning (UDL) principles. Multiple means of representation were provided through videos, readings, research papers, and curated OER. Multiple means of engagement were embedded through interactive activities, collaborative tasks, choice-based assignments, and discussion forums. Multiple means of action and expression were supported through lesson planning tasks, database and blog activities, and reflective assignments, allowing participants to demonstrate their understanding in varied formats.

Overall, learning in the module was facilitated through a carefully structured Moodle environment that combined interactive activities, collaborative learning, reflective

practice, and facilitator support. This approach not only enhanced participants' engagement and understanding but also modelled inclusive, technology-enhanced pedagogical practices that teachers could adapt and apply within their own STEAM classrooms.

5. Concepts covered in the module

The module *Transforming Pedagogy with Technology and the Universal Design for Learning (UDL) Approach in STEAM Education* addresses a comprehensive set of concepts that underpin inclusive, technology-enhanced, and learner-centered teaching. The concepts covered in each unit are presented below:

Unit 1: Multiple means of representation

Concepts covered in this unit are diverse learners, different learning needs, inclusive access, technology integration, multimodal representations of content, perceptual variation, choice, accessibility, visual, audio, texts, interactive media, videos and kinesthetic, concept check and open education resources(OER).

Unit 2: Multiple means of engagement

Concepts covered in this unit are learner motivation, engagement, interest, choice, persistence, self-regulation, different learning needs, opportunities, technological tools, hands-on activities, engaging and inclusive learning experiences, collaboration and artificial intelligence.

Unit 3: Multiple means of action/expression

Concepts covered in this unit are diverse learners, expression, plan, organize, flexible instructions, communication, technological tools, different ways of demonstrating learning, digital storytelling, video creation, audio recordings, infographics, visual presentations, strengths, preferences, assessment and feedback.

Unit 4: Lesson plan and reflection

Concepts covered in this unit are learning objectives, multiple means of representations, multiple means of engagement, multiple means of expression, UDL aligned lesson plan format and reflection.

Unit 5: Ethical use of technology

Concepts covered in this unit are ethical use of technology, digital citizenship, data privacy, academic integrity, accessibility and equity.

6. Timeline of module implementation

According to the research calendar, the module was scheduled for a six-week implementation. The module was opened to the participants on 14th September and closed on 25th October 2025.

7. Learning activities and instructional resources

The learning activities included KWL boards, debate with AI, collaborative scriptwriting, discussion forums, blogging, concept-checking tasks via quiz, and summarisation activities. Learners were also encouraged to create and share artefacts in a database to demonstrate their understanding. Interactive video lessons and concept-checking activities using Edcafe AI were integrated to monitor learners' comprehension. In addition, learners planned lessons, implemented them in their classroom teaching, and shared their experiences through reflective practice. Curated videos, well-designed presentation slides, and carefully selected open educational resources (OERs) were provided to further enhance learners' understanding of key concepts.

8. Module completion rate

a. Overall completion (Data available from Moodle platform)

Thirty three (33) participants completed the module successfully.

b. Assessment completion rate (Data available from Moodle platform)

Table 1: Teachers' assessment completion rate

Area of assessments	Participants	Total
Module activities	33	33
Lesson Plan	33	33
Reflection	33	33

9. Time spent on the module platform

Time spent on the Moodle platform was estimated using course log data. Active engagement time was calculated by summing intervals between consecutive user actions, with inactivity periods exceeding 30 minutes excluded to avoid overestimation. This approach provided a reasonable approximation of participants' engagement with the online module

Table 2: Time spent by teachers on Moodle platform

Hours Spent	No. of participants	Total Hours
Less than 5	15	~68 hours
5 to 10	10	~75 hours
10 to 20	5	~90 hours
21 to 30	3	~100 hours

More than 30	0	0 hours
Total	33	~333 hours

Note: Actual calculations involve session reconstruction from timestamps, which shows that most participants engaged in multiple short-to-moderate sessions rather than extended continuous use.

Key Observations

1. The majority of participants (15 out of 33) spent less than 5 hours on the platform in total.
2. No participant exceeded 30 hours of engagement.
3. Engagement patterns indicate that most users accessed the platform in multiple shorter sessions rather than in long, continuous periods.

Overall, the total of 33 participants aligns with the table data, and the engagement distribution reflects a typical online learning pattern, where most learners participate moderately while a smaller group demonstrates higher engagement.

10. Engagement and participation in module activities

The online module comprised a total of 20 activities, including resources that the participants were supposed to go through or complete. All the participants successfully completed all module activities, indicating a high overall completion rate. Overall, the completion rate reflects a strong level of commitment among the participants.

For instance, a History teacher has used Canva tool to create an infographic as shown in figure 1 on water cycle and shared in a database.
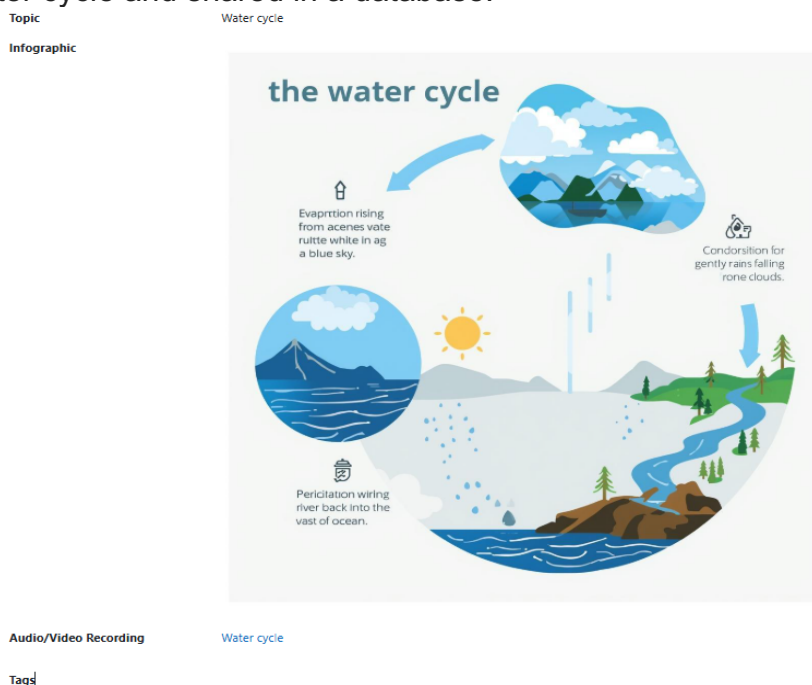

Figure 1: Water cycle

Figure 2 shows another example of how ChatGPT was used as a virtual debate partner by the Geography teacher and shared insight in the discussion forum for others to provide necessary comments.
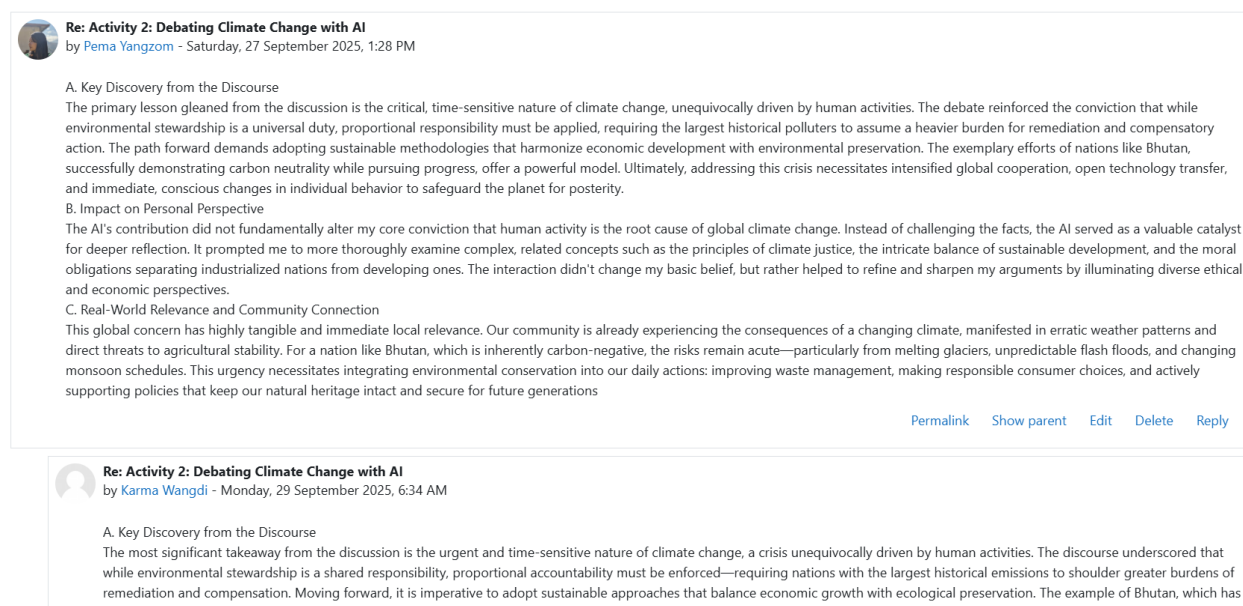

Figure 2: ChatGPT Use

Participant engagement was also evident through active involvement in the online discussion forums. For instance, in a forum on "engaging and motivating students", participants were provided with a list of ICT tools and asked to explore at least one tool and share their experiences, focusing on how the selected tool supported learning, motivation, or collaboration.

A wide range of ICT and AI tools were explored, including Kahoot, ChatGPT, Jamboard, Quizizz, Padlet, Edpuzzle, Google Forms, ClassPoint AI, NoteBook LM, and Perplexity AI. Participants' forum posts demonstrated meaningful reflection, contextual application, and peer interaction. For instance, a Geography teacher described using Kahoot to assess students' prior knowledge and interests while teaching Grade XII Geography, followed by Perplexity AI to support inquiry into emerging trends and local industries in Bhutan. This post illustrated thoughtful integration of ICT and AI tools to enhance engagement, formative assessment, and learner curiosity. Peer responses further validated and extended this reflection, highlighting appreciation for the interactive and learner-centered approach. Similarly, a Mathematics teacher shared experiences using Google Forms for real-time assessment and ClassPoint AI to generate interactive in-class questions. Peer feedback acknowledged the effective balance between structured assessment and dynamic classroom interaction, while also recognising the need to adapt AI-generated content to students' proficiency levels.

Overall, a substantial number of forum posts and peer comments were recorded, indicating active collaboration and professional dialogue. These interactions suggest that

the discussion forum functioned as an effective space for sharing practices, receiving feedback, and building a learning community.

Participants engaged consistently with online quizzes and interactive video lessons, which were embedded throughout the module. These activities supported concept checking, self-assessment, and reinforcement of key ideas. Evidence from module analytics and participant reflections suggests that these interactive elements enhanced engagement and contributed meaningfully to participants' understanding of UDL principles and technology-integrated teaching practices.

11. Assessment and feedback practices

Assessment in the module was designed to evaluate participants' learning through a combination of formative and summative assessment strategies, ensuring continuous monitoring of progress as well as evaluation of overall learning outcomes. The assessment approach was aligned with the principles of UDL, offering multiple opportunities for feedback, reflection, and demonstration of understanding.

At the outset of the module, participants completed a baseline survey as a prerequisite for module participation. This survey consisted of 45 items focusing on key themes related to participants' knowledge, attitudes, and practices (KAP) in using educational technology tools within the UDL principle. The baseline survey served as a diagnostic assessment, providing insights into participants' initial understanding and informing subsequent facilitation.

Throughout the module, formative assessments were embedded within each unit to support ongoing learning. Quizz designed using the Wayground platform was used to check participants' understanding of key concepts. This quiz provided immediate automated feedback, indicating whether responses were correct or incorrect, and allowed participants to review incorrect responses upon completion. This instant feedback supported self-regulation and reinforced conceptual clarity.

In addition, a range of interactive formative assessment activities were integrated using digital tools such as Edcafe AI and AI-supported debate activities. Participants engaged in concept-checking tasks, AI-facilitated debates, discussion forums, and blogging activities. These tasks encouraged critical thinking and reflective practice, while enabling peer feedback and facilitator feedback through Moodle forums and activity comments. Such collaborative assessment practices strengthened professional learning communities and deepened conceptual understanding.

Summative assessment was addressed through applied tasks that required participants to demonstrate their learning in authentic contexts. Participants were required to design and submit one UDL-aligned lesson plan based on the concepts covered in the module and to produce a reflective report following the classroom implementation of the lesson. These submissions were assessed using clearly defined rubrics.

To measure learning gains over the duration of the programme, participants completed a 45-item endline survey at the conclusion of the module. This survey mirrored the baseline

instrument and enabled comparison of changes in participants' knowledge, attitudes, and practices related to UDL and technology integration.

In addition to formal assessments, participants were required to complete all interactive and engagement-based activities embedded throughout the module. Activity completion tracking in Moodle ensured accountability and supported facilitators in monitoring progress and providing timely support.

Overall, the assessment and feedback practices in the module reflect good assessment design, characterised by the use of rubrics, peer and facilitator feedback, reflective assessment, and technology-enabled formative evaluation. This comprehensive approach supported continuous learning, professional reflection, and meaningful application of UDL principles in classroom practice.

12. Analysis on lesson plan evaluation

Overview of the evaluation

Lesson plans submitted by 33 participants (Codes 2501–2533) were evaluated using a four-point rubric (*Excellent = 4, Good = 3, Satisfactory = 2, Needs Improvement = 1*) across five dimensions:
 i.   assessment of learning outcomes,
 ii. integration of UDL principles,
 iii. use of ICT tools,
 iv. academic language and lesson structure, and
 v.   inclusion and equity.

Overall results indicate strong pedagogical planning skills, with evidence of UDL-informed and technology-enhanced instructional design across subject areas as shown in figure 3.
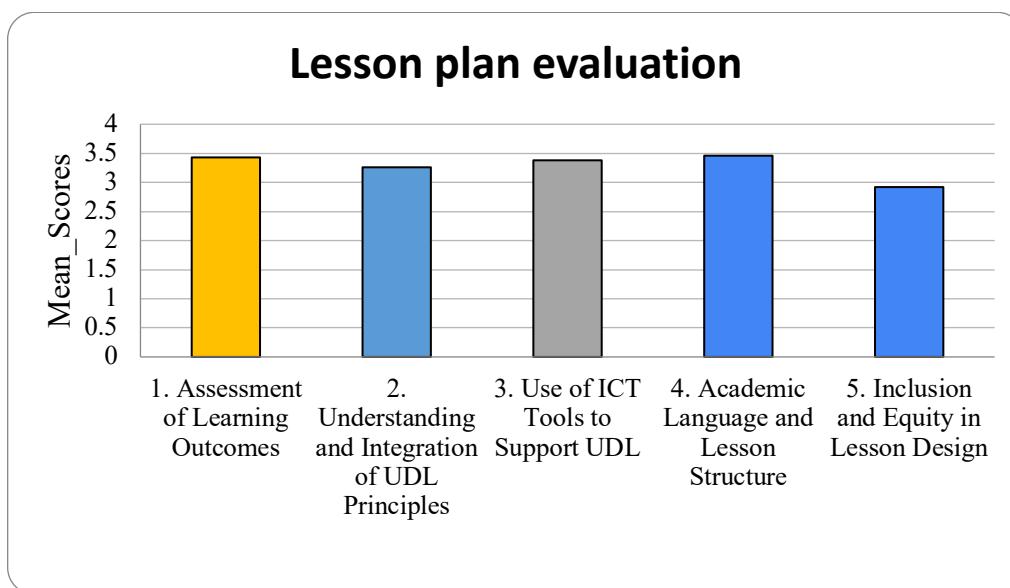

Figure 3: Lesson plan evaluation

Assessment of Learning Outcomes

Most participants demonstrated a strong ability to design clear and measurable learning outcomes aligned with lesson activities and assessments with overall mean (M=3.43). Lesson plans rated *Excellent* typically integrated multiple assessment modes, enabling learners to demonstrate understanding in varied ways. Below are some subject based examples:

- Health & Physical Education (HPE): The HPE teacher (P2501) assessed learner understanding through online quizzes, digital checklists, and reflective prompts, allowing both immediate feedback and self-monitoring of learning progress.

- History: History teachers showed particularly strong assessment diversity. For example, one history teacher (participant 2502) combined AI-generated quizzes, infographic presentations, Canva posters, and structured note-taking tasks to capture conceptual understanding and analytical thinking. Similarly, another history teacher (participant 2506) triangulated learner evidence using Kahoot, Padlet, and Edcafe AI, integrating both formative and summative assessment strategies.

- Biology: The Biology teacher (participant 2508) employed Canva-based concept mapping and Edcafe AI quizzes alongside teacher observation, supporting multiple modes of learner expression and reinforcing conceptual accuracy.

Lessons rated *Good* demonstrated appropriate alignment between objectives and assessment but relied on limited assessment formats. For instance, Dzongkha teacher (participant 2507) and Physics teacher (participant 2510) teachers primarily used quizzes and short written responses, reducing opportunities for alternative demonstrations of learning. This pattern suggests the need to further strengthen assessment differentiation in alignment with UDL principles.

Understanding and Integration of UDL Principles

The majority of participants demonstrated a clear conceptual understanding of Universal Design for Learning (UDL), particularly the integration of multiple means of representation, engagement, and expression with overall mean (M=3.26). Below are some subject based examples:

- Dzongkha and History: Dzongkha teacher (participant 2503) and History teacher (participant 2504) systematically embedded all three UDL principles across lesson phases. Visual texts, collaborative discussion, and varied expression options (oral explanation, drawings, and digital artefacts) were intentionally aligned to address diver learners.

- Science (Biology & Chemistry): Biology teacher (participant 2508) and Chemistry teacher (participant 2518) consistently planned UDL strategies across lesson

introduction, guided practice, assessment, and reflection stages, demonstrating strong alignment between pedagogy and learner needs.

Some participants demonstrated partial but uneven application of UDL. For example, HPE teacher (participant 2501) and English teacher (participant 2505) teachers incorporated multiple representations and engagement strategies but offered limited learner choice within each principle. At the Satisfactory level, lessons such as English teacher (participant 2529) and Dzongkha teacher (participant 2531) showed awareness of UDL terminology but lacked consistent implementation across lesson components.

These findings indicate a shift from theoretical understanding of UDL toward practical classroom integration, with learner choice and barrier-sensitive planning emerging as key areas for professional growth.

Use of ICT Tools to Support UDL

ICT integration emerged as a notable strength across lesson plans, with many teachers purposefully selecting tools to support UDL principles with overall mean (M=3.38). Below are some subject based examples:

- History and Dzongkha: History teacher (participant 2502) and Dzongkha teacher (participant 2503) used YouTube, Padlet, Canva, and Kahoot to enhance representation, engagement, and learner expression.

- Science: Simulation-based learning was prominent in science lessons. For instance, Biology teacher (participant 2508) and History teacher (participant 2504) incorporated PhET and Olabs simulations, enabling learners to visualise abstract concepts and test hypotheses interactively.

- Mathematics and English: Mathematics teacher (participant 2515) and English teacher (participant 2524) demonstrated advanced ICT integration by combining videos, AI-generated quizzes, simulations, and digital artefact creation, supporting diverse learner needs and preferences.

Lessons rated *Good* often used ICT tools primarily for content delivery and assessment (e.g., Physics teachers (participant 2510 & 2520), with fewer opportunities for student-generated digital expression. A small number of lessons lacked clarity in how ICT tools aligned with UDL principles (e.g., Dzongkha participant 2530; IT participant 2532).

Inclusion and Equity in Lesson Design

Inclusion and equity were addressed inconsistently across lesson plans. Lessons rated *Excellent* explicitly planned for differentiation and equitable access with overall mean (M=2.92). Below are some subject based examples:

- Dzongkha and History: Dzongkha teacher (participant 2503) and History teacher (participant 2506) included scaffolding for struggling learners and extension tasks for advanced learners, demonstrating intentional differentiation.

- Chemistry: Chemistry teachers (participant 2518, participant 2525) incorporated learner choice in modes of engagement and expression, supporting both accessibility and learner autonomy.

Lessons rated *Good* addressed inclusion implicitly through group work and varied representations (e.g., Dzongkha participant 2507; Science participant 2514; Chemistry participant 2521) but lacked explicit planning for learners with diverse needs. At the Satisfactory level, English (participant 2529) and History (participant 2533) lessons treated learners uniformly, with minimal attention to accessibility or individual support.

Analysis of Reflective Writing Evaluation

Overview of the evaluation

Reflections submitted by 33 participants (Codes 2501–2533) were evaluated using a four-point rubric (*Excellent = 4, Good = 3, Satisfactory = 2, Needs Improvement = 1*) across four reflective dimensions:
  i. description of lesson implementation
  ii. reflection on significance and learner response
  iii. forward planning for improvement, and
  iv. understanding and application of UDL principles.

Overall, the reflections reveal emerging reflective competence and growing familiarity with UDL, with notable variation in depth, analytical quality, and future-oriented planning as shown in figure 4.
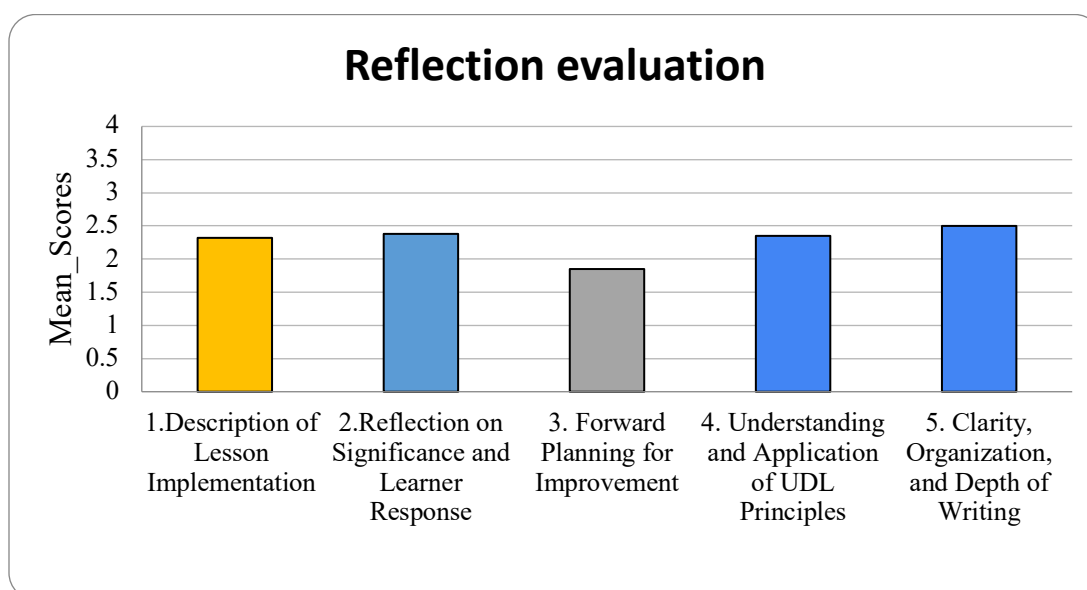

Figure 4: Reflection evaluation

Description of Lesson Implementation

Participants demonstrated uneven ability to clearly and explicitly describe lesson implementation with overall mean (M=2.32). Reflections rated *Excellent* provided coherent, lesson-specific accounts that articulated objectives, ICT tools, and the intentional application of all three UDL principles. Below are some subject based examples:

- Health & Physical Education (HPE):The HPE teacher (participant 2501) provided a rich, contextualised account of a *"Good Citizen"* lesson, detailing the use of videos, infographics, EdCafe, Google Drive, and AI tools. Each tool was explicitly linked to UDL principles-engagement through interactive media, representation through multimodal content, and expression through learner-created artefacts.

- History: History teachers demonstrated strong descriptive clarity. Participant P2502 and 2504 clearly articulated lesson objectives and explicitly connected tools such as Padlet, Canva, YouTube, Kahoot, EdCafe, and Mentimeter to UDL-informed instructional decisions. These reflections demonstrated how digital quizzes, visual resources, and collaborative tools supported diverse learners.

- Dzongkha and English: Dzongkha teacher (participant 2503) and English teacher (participant 2505) provided structured descriptions of lesson flow, highlighting simulations, visual aids, and learner-created artefacts as mechanisms to support learner variability and inclusive participation.

Reflections rated *Good* typically described lesson stages and ICT tools but applied UDL implicitly rather than explicitly. For example, Dzongkha teacher (participant 2507) and Physics teacher (participant 2510) teachers described activities and technology use but did not clearly articulate how these aligned with UDL principles. In some cases, reflections were generic or loosely connected to the submitted lesson plan (e.g., Biology teachers (participant 2511 & 2512).

At the *Satisfactory* and *Needs* Improvement levels, reflections lacked lesson specificity, clear objectives, or explicit reference to UDL and technology (e.g., Geography teacher (participant 2513); English teacher (participant 2529); Dzongkha teacher (participant 2531). Some reflections focused broadly on UDL concepts or personal learning experiences without describing an implemented lesson (e.g., History teacher (participant 2533).
While many participants can narrate classroom activities, fewer are able to explicitly articulate the pedagogical reasoning behind their design choices, indicating a gap between implementation and reflective articulation.

Reflection on Significance and Learner Response

Higher-quality reflections demonstrated analytical insight into learner engagement, outcomes, and inclusion, explicitly linking learner responses to UDL principles with overall mean (M=2.38). Below are some subject based examples:

- History: History teacher (participant 2502) noted that "even quieter students were more comfortable participating through digital tools," highlighting the inclusive affordances of ICT-supported expression. Participant 2504 further analysed improvements in learner confidence and conceptual understanding resulting from UDL-enhanced lesson design.

- Science (Biology, Chemistry, Physics): Biology teacher (participant 2508) and Chemistry teacher (participant 2518) provided detailed reflections on how simulations, hands-on tasks, and interactive quizzes supported diverse learning preferences and made abstract concepts more accessible. Mathematics teacher (participant 2519) similarly reflected on improved motivation and conceptual clarity through UDL-informed strategies.

Reflections rated *Good* acknowledged increased engagement and enjoyment but lacked critical analysis of learner variability or inclusion. For instance, Dzongkha teacher(participant 2507) and Science teacher (participant 2514) teachers noted participation gains without examining why specific strategies were effective. Some reflections remained descriptive rather than analytical (e.g., Physics teacher (participant 2510; Chemistry teacher (participant 2521).

Lower-rated reflections focused on general outcomes or personal impressions, with minimal attention to learner impact or UDL relevance (e.g., Geography teacher (participant 2513; English teacher (participant 2529; Dzongkha teacher (participant 2530). A few reflections adopted a learner perspective rather than a teacher's reflective stance (e.g., Dzongkha teacher (participant 2531).

Participants increasingly recognise the engagement benefits of UDL-informed teaching; however, deeper analytical reflection connecting learner responses to inclusion and learner variability remains underdeveloped.

Forward Planning for Improvement

Forward planning was the weakest reflective dimension, with many participants struggling to translate reflection into actionable improvement strategies with overall mean (M=1.85). Below are some subject based examples:

- HPE and History: HPE teacher (participant 2501) articulated clear, UDL-aligned next steps, including comparison charts, group projects, increased learner choice, and visual scaffolds. History teacher (participant 2504) outlined follow-up design tasks and reflection journals to deepen learning.

- Science: Biology teacher (participant 2508) proposed concrete improvements such as enhanced scaffolding and expanded use of interactive ICT tools, demonstrating strong alignment between reflection and future planning.

Some participants demonstrated emerging planning capacity by identifying challenges and partial solutions. For example, Dzongkha teacher (participant 2507) identified

sequencing and time-management issues, while Dzongkha teacher (participant 2516) and English teacher (participant 2524) teachers proposed using handouts, diagrams, and creative projects in future lessons.

However, many reflections at the *Good* and *Satisfactory* levels referenced improvement only in general terms, without specific actions or UDL alignment (e.g., Physics teacher (participant 2510); Biology teacher (participant 2512); Chemistry teacher (participant 2521). Several participants cited constraints such as limited devices or large class sizes but did not articulate feasible instructional responses (e.g., Chemistry teacher (participant 2522); English teacher (participant 2529). A number of reflections lacked forward planning altogether (e.g., Dzongkha teacher (participant 2530); History teacher (participant 2533).

While participants can identify challenges, many struggle to operationalise reflection into UDL-informed instructional improvements, indicating a need for structured scaffolds for forward planning.

Understanding and Application of UDL Principles

Participants' understanding of UDL ranged from explicit and well-articulated to minimal or superficial with overall mean (M=2.35). Below are some subject based examples:

- Dzongkha, History, and English: Dzongkha teacher (participant 2503) organised reflection explicitly around engagement, representation, and expression, providing concrete classroom examples. English teacher (participant 2505) and History teacher (participant 2506) clearly articulated how simulations, discussions, and learner-generated artefacts aligned with UDL principles.

- Science: Biology teacher (participant 2508) and Chemistry teacher (participant 2518) demonstrated strong conceptual understanding, explaining how ICT tools created inclusive spaces for learners less confident in oral participation. English teacher (participant 2524) explicitly linked tool choice to learner variability.

Reflections rated *Good* showed awareness of UDL but relied on implicit descriptions rather than explicit conceptual framing (e.g., Dzongkha teacher (participant 2507); Science teacher (participant 2514); Physics teacher (participant 2520). At the Satisfactory level, UDL was often reduced to representation alone, with limited attention to engagement and expression (e.g., Geography teacher (participant 2513); English teacher (participant 2529). Some reflections showed little or no evidence of UDL understanding (e.g., Dzongkha teacher (participant 2531); History teacher (participant 2533).

Participants often demonstrate stronger UDL application in practice than in reflective explanation, suggesting that explicit articulation of UDL theory remains a key professional learning need.

13. Conclusion

The professional development (PD) module *Transforming Pedagogy with Technology and the Universal Design for Learning (UDL) Approach in STEAM Education* represents a meaningful and contextually grounded initiative to strengthen inclusive, technology-enhanced pedagogical practices among STEAM teachers of Norbugang Central School. Designed and implemented through a collaborative partnership between SCE and the MoESD, the module successfully leveraged an open educational and blended learning model to address teachers' professional learning needs in a systematic and sustainable manner.

Overall findings from module analytics, activity completion data, lesson plan evaluations, and reflective writing analyses indicate a high level of participant commitment and engagement. All 33 participants successfully completed the module, including core learning activities, lesson planning and reflective writing. Evidence from Moodle logs further suggests that participants engaged consistently through multiple short and purposeful learning sessions, reflecting authentic professional learning patterns rather than superficial participation.

Pedagogically, the module demonstrated strong alignment with the three core principles of UDL-multiple means of representation, engagement, and action/expression-both in its design and in participants' classroom applications. Lesson plan evaluations revealed substantial strengths in the alignment of learning outcomes, effective integration of ICT tools, and overall lesson structure. Many participants demonstrated growing competence in designing learner-centered, technology-supported lessons that offered varied ways for students to access content, engage with learning, and express understanding. The use of digital tools such as Canva, Kahoot, Padlet, Edcafe AI, simulations, and AI-supported applications further enhanced instructional flexibility and inclusivity across subject areas. Reflective writing analysis, however, highlighted important areas for continued professional growth. While participants increasingly recognised the value of UDL-informed teaching and were able to describe lesson implementation and learner engagement, many struggled to articulate deeper analytical reflections, explicitly connect practice to UDL theory, and translate reflections into concrete forward-planning strategies. In particular, planning for inclusion, equity, learner choice, and differentiated support remained uneven across participants. These findings underscore the need for continued scaffolding in reflective practice, with greater emphasis on analytical reflection, theory-practice connections, and actionable instructional improvement.

Collectively, the outcomes of this module suggest that sustained, well-structured PD supported by blended learning, active facilitation, collaborative learning, and authentic classroom application can effectively support teachers in moving beyond tool-based technology use toward principled, inclusive pedagogical design. The module not only enhanced participants' pedagogical content knowledge and confidence in using educational technologies but also modelled UDL-aligned practices that can be adapted across diverse STEAM classrooms.

This module provides a strong foundation for scaling and refining UDL-focused professional development in Bhutan. Future iterations may further strengthen impact by incorporating structured reflective scaffolds, explicit inclusion planning tools, and extended follow-up support to deepen teachers' reflective competence and long-term pedagogical transformation.