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Higher-order thinking skills in e-learning contexts in higher education: a phenomenological study

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Teaching and learning activities are primarily conducted through in-person classes and assessed by periodic examinations, with little emphasis on developing higher-order thinking skills (HOTS) in Asian territories and Nepal. In higher education, there is inadequate literature on the practice of HOTS in online and remote learning modes. Using a phenomenological approach, this study investigated how students experience and develop HOTS within the e-learning context of higher education in Nepal. Four students from an open and distance university were purposefully chosen for data collection. These students had been enrolled in online classes for at least one semester at the Bachelor's, Master's, or MPhil levels. With their consent, in-depth interviews using semi-structured, open-ended questions were arranged for approximately 1 h and conducted online in Zoom. The analysis involved coding and condensing the interview data into themes, which were then discussed in relation to the relevant literature. The findings indicate that the university manages its virtual classes in a blended mode, using both synchronous and asynchronous methods with limited e-resources such as MS Teams and Moodle. These platforms are used for innovative teaching approaches to strengthen HOTS, such as critical thinking, problem-solving, intercultural communication, and social networking. Teaching approaches included tutor lectures, student self-exploration, peer learning, collaboration, and networking. A significant finding was the gradual shift from tutor-led instruction to self-directed and self-motivated learning. The study concluded that e-learning in higher education has a notable transformative impact on developing HOTS and its application to students' personal and professional development.

KEYWORDS

higher-order thinking skills, e-learning, phenomenological approach, teaching strategies, transformation of skills, higher education, self-directed learning, blended learning

1 Introduction

Higher-order thinking skills (HOTS) are higher-level learning outcomes (Al-Khatib, 2019; Ganapathy et al., 2017; Yaniawati, 2013). In HOT skills, learners foster conceptual and disciplinary understanding and intentional participation that help them acquire intellectual rigor, develop skills for any curriculum, and achieve success in school and life (Saifer, 2018; Heron and Palfreyman, 2021). These skills are largely laid in Bloom's Taxonomy in which analyzing, evaluating, and creating belong to HOT skills or deep learning (Anderson and

Krathwohl, 2001; British Council, 2015; Chau and Ho, 2020; Kenny, 2020; Pishchukhina and Watson, 2021). Furthermore, these skills involve complex evaluative thinking beyond common thinking and entail cognitive manipulation of information (Saifer, 2018; Setyarini and Ling, 2019). Learners need to develop HOTS by observing and perceiving a phenomenon through the texts and graphics (images, animation, or video) into a coherent structure (Clark and Mayer, 2008; Suchyadi et al., 2021) in face-to-face or e-learning mode. However, maintaining balance among cognitive load, design principles, and use of technology to develop HOTS always remains a challenge (Ganapathy et al., 2017; He, 2020; Yoke et al., 2021). These skills are equally significant in integrating curriculum and instructional processes in higher education (Chinedu et al., 2015; Dahal, 2019).

Research by Setyarini and Ling (2019) and Yoke et al. (2021) has shown that storytelling, questioning (Dahal et al., 2019), mind-mapping, brainstorming, role-playing, and various other creative activities are effective teaching techniques for developing higher-order thinking skills (HOTS). Similarly, discourse, dialogue, support, cooperative learning, argumentation, interaction, critical thinking, problem-solving, self-learning, in-depth discussion, and instant access to multimedia tools can be useful ways to enhance HOTS (Cranton, 2016; Dahal, 2023; Heron and Palfreyman, 2021; Natarajan, 2006). Thus, discourse analysis and constructive dialogue are essential for understanding and addressing the issue of HOTS in e-learning (Clark and Mayer, 2016) through Moodle. The university should provide robust support services to ensure student success, creating an environment where cooperative learning strategies enhance engagement and comprehension. The study by Aziz and Rawian (2022) examined Pakistani university learners' higher-order thinking skills (HOTS) in English reading comprehension, finding that explicit HOTS assessments reveal strengths and weaknesses better than traditional methods, with metacognitive awareness positively influencing reading performance. Effective argumentation, based on evidence-based reasoning, is encouraged through regular interactions between students and faculty, fostering a collaborative learning atmosphere. Critical thinking skills are vital for analyzing complex problems, while innovative problem-solving approaches are necessary to address contemporary challenges. Self-directed learning empowers students to take control of their educational journeys, and in-depth discussions during class facilitate a deeper understanding of the subject matter. Through these methods, e-learning via Moodle supports the development of HOTS, preparing students to navigate and resolve real-world issues effectively. Next, learning via technological tools and engaging in collaborative activities in LMS and Google Apps, including forum discussions, choices, quizzes, lesson studies, workshops, and Google Docs activities (Docs and PowerPoints), are designed for on-campus, online, and distance education for fostering HOTS (Dahal, 2023). Some online or distance activities such as Video Think Aloud, self-quizzing, creative assignments, scenario questions, gaming experience, and collaborative and participatory activities are recommended to promote HOT skills (Kenny, 2020; Pishchukhina and Watson, 2021) in e-learning such as Moodle and Canvas. Heron and Palfreyman (2021) state that teachers' scaffolding of higher-order thinking is inadequate in higher education.

However, in the Nepali education system, learning achievement is tested through periodic examinations, with little focus on developing HOTS (Mainali, 2012). It is empirically little known about practicing HOT skills and developing activities in online and distance

modes. In online and distance mode of higher education, some universities such as Nepal Open University (NOU), Kathmandu University School of Education (KUSOED), and other institutions like Open and Distance Education Centre (ODEC) under Tribhuvan University are delivering all/some academic or professional programs/courses. This study investigates how teachers have been promoting HOTS through e-learning in higher education in Nepal, focusing on a case study of Nepal Online University (pseudonym). The research aims to explore and understand students' personal and professional lived experiences in higher education as they engage with e-learning strategies designed to develop HOTS at Nepali university. It seeks to gain in-depth insights into their daily realities, identify effective e-learning techniques, evaluate the impact on their academic and personal lives, provide valuable information to improve educational practices, and contribute to the existing body of knowledge on e-learning and HOTS in the context of higher education in Nepal. Furthermore, this study addresses the following research question:

- 1 What are the lived experiences of students in higher education in Nepal as they engage with e-learning strategies to enhance their higher-order thinking skills (HOTS), and how do these experiences influence their overall learning outcomes?

2 HOT skills via e-learning: theory and practice

In learning, higher-order thinking skills (HOTS) lie at the upper level of learning, and among all literature, there is a consistent understanding of its importance in succeeding in one's life. It involves the mental processing of information, whereas lower-order thinking skills (LOTS) involve the straightforward or direct application of knowledge (Saifer, 2018). HOTS, introduced by William E. Doll in 1993, is defined as the ability to read between the lines (Williams, 2003). First, in HOTS, Williams (1993) recommended four thinking skills (e.g., richness, recursion, relation, and rigor) and later added one more component (i.e., relevance). In a taxonomy of thinking skills, Bloom's (1956) original taxonomy includes lower to higher order: knowledge, comprehension, application, analysis, synthesis, and evaluation, whereas, in the revised taxonomy of Krathwohl (2002) and the revised taxonomy from lower to higher order are remembering, understanding, applying, analyzing, evaluating, and creating (Saifer, 2018). Thus, revised taxonomy allows learners to develop a thorough and deep understanding of the contents and the ability to think critically and creatively (Krathwohl, 2002). To learn skills, application, analysis, and other higher levels focus on deep understanding and higher-order thinking (British Council, 2015). Table 1 below illustrates the HOTS: concepts, taxonomy, and benefits.

To develop students' HOTS, it is important to focus on how teachers create a supportive learning environment and use strategies such as group work, cooperative learning, collaborative projects, classroom setup, motivation, integrating learning strategies, and room for peer interaction (Budsankom et al., 2015; Gupta and Mishra, 2021; Lu et al., 2021). Studies have shown that peer interaction and motivation (Budsankom et al., 2015; Lu et al., 2021), classroom environment, and students' psychological and intellectual traits directly impact HOTS, while learning strategies have an indirect

TABLE 1 HOTS: concepts, taxonomy, and benefits.

Concept	Details
Definition of HOTS	The ability to read between the lines (Williams, 2003).
Key components of HOTS	Originally: richness, recursion, relation, rigor; later added: relevance.
Difference between HOTS and LFS	HOTS involves mental processing; LOTS involves the direct application of knowledge (Saifer, 2018).
Bloom's original taxonomy (1956)	Knowledge, comprehension, application, analysis, synthesis, and evaluation.
Revised taxonomy (Krathwohl, 2002)	Remembering, understanding, applying, analyzing, evaluating, creating.
Benefits of HOTS	Develops deep understanding, critical and creative thinking (British Council, 2015).
Focus on higher levels	Application, analysis, and other higher levels emphasize deep understanding and higher-order learning.

effect. Several literature are available on HOTS learning activities with the connection of different factors such as student learning process, subject-based process skills, acquiring answers, solving problems, teaching through questioning, making decisions, and students' success in the workplace (Neo et al., 2012; Budsankom et al., 2015; Dahal, 2023; Pishchukhina and Watson, 2021; Suchyadi et al., 2020). Out of them, problem-solving is found to be an effective approach to inculcating student skills (Ganapathy et al., 2017; Mainali, 2012; Neo et al., 2012). As stated by Cunningham et al. (1993), technology-backed classrooms increased motivation and teamwork and enhanced understanding of the project. Similarly, in higher education, Heron and Palfreyman (2021) revealed that argumentation, justification, and reasoning assist in developing HOTS in quality seminar discourse. However, these findings are based on in-person or face-to-face learning situations.

Similar to face-to-face or in-person learning, different techniques and tools are found in the practice of e-learning environments or platforms. For example, in an e-learning system, Songkram (2015) states that teachers can support students in developing creative thinking using different online tools and techniques, such as reflecting tacit and explicit knowledge, collaborating, and acquiring knowledge. Desktop applications, presentation software, Moodle, slide share, chat, website, online documents, e-documents, blogs, and similar others are practiced as tools for e-learning, and as the pedagogical roles, technology for supporting learning, the role of learners, the role of instructors, self-direct, and evaluation are specified in practice (Ganapathy et al., 2017; Songkram, 2015) as a public audit. A public audit of e-learning practices on Moodle can offer valuable insights into the effectiveness of strategies to develop students' HOTS. Two key aspects of teaching HOT skills are face-to-face instruction and e-learning. The first aspect involves the pedagogical approaches used, such as interactive lectures, collaborative projects, and problem-based learning. For instance, the integration of problem-based learning (PBL) with participatory engagement in e-learning found that it improves learning outcomes and critical thinking skills, although results should be interpreted cautiously due to contextual and technological limitations (Wagino et al., 2024). These methods are designed to actively engage students and promote critical thinking, problem-solving, and analytical skills. The second aspect focuses on

the technological and logistical support provided, including access to digital resources, learning management systems such as Moodle, and synchronous and asynchronous communication tools. So, blended learning and asynchronous discussions about real-life situations are common e-learning interventions that promote critical thinking (CT) in higher education, with forums and collaborative learning being particularly effective (Puig et al., 2020). Together, these elements ensure that students have the necessary infrastructure and support to effectively develop HOT skills, regardless of the mode of instruction. So, technology and teaching methods (pedagogy) are crucial in elementary and higher education. In the context of online higher education in Nepal, whether in live (synchronous) or self-paced (asynchronous) e-learning environments, how teachers use teaching skills combined with technology to develop students' HOTS is an important area for further research.

3 HOTS in higher education: e-learning context

The literature discusses various techniques and technologies for learning higher-order thinking skills (HOTS). HOTS makes it possible to learn using multimedia such as lecture units, interactive multimedia, email, Web-based Instruction (WBI), Webinar, CD-ROM, virtual laboratories, teleconferencing, and quiz (Dahal and Pangen, 2019; Dahal et al., 2022a; Natarajan, 2006). They positively affect learning problem-solving and creativity skills or higher motivation in a constructivist learning environment (Acharya, 2014; Neo et al., 2012; Suchyadi et al., 2021). Similarly, students' creative thinking and product creativity, which require in-depth knowledge to apply the learning in a new context, are measured by the Torrance tests of creative thinking or/and the creative product semantic scale (Kassim et al., 2014). Some technological tools, such as Google Apps and other open-source tools, can be used in hands-on activities to develop HOTS. These include forum discussions, quizzes, lesson studies, workshops, and Google Docs activities (Docs and PowerPoints) (Dahal, 2023; Natarajan, 2006). For successful students, Mainali (2012) emphasizes developing their mastery in decision-making, prioritizing, strategizing, and collaborative problem-solving.

However, teachers infrequently incorporate ICT tools such as mobile phones, laptops, multimedia projectors, and web resources such as YouTube, Facebook, Wiki, email, and blogs into their teaching practices (Ganapathy et al., 2017). Instead, lectures and oral presentations are prevalent across most classes and subjects. Mainali (2012) highlights the need to enhance higher-order thinking skills (HOTS) due to the limited implementation of HOTS activities in classrooms, where teachers predominantly involve students in lower-level thinking tasks. Dahal et al. (2019) and Khadka (2021) also revealed that teachers mostly used lower-order questioning and then higher-order questioning. However, these instances are concerned with the face-to-face mode of education. During the COVID-19 pandemic, teaching-learning turned to distance and online modes worldwide. Nepal also shifted educational activities to distance and online modes. Stakeholders in Nepal such as the University Grants Commission and some universities such as Kathmandu University and Nepal Open University (to name a few) issued directives for the distance and virtual classes through TV, Radio, MS Teams (Teams), Google Meet, Zoom and similar techniques, and online assessments

(University Grants Commission, 2020; Nepal Open University, 2020). Nepal Open University and other universities (such as Kathmandu University and Tribhuvan University, to name but a few) have been delivering e-assessment since then. However, other institutions' focus was to revive the deadlock situation of educational activities, and they did not pay any more attention to learning skills or any other life skills during this period. Since the global pandemic, many universities in Nepal have been running their classes and evaluations online. Kathmandu University School of Education, Nepal Open University, and Tribhuvan University are a few of them that initiated and continued the teaching and learning process in online and distance modes as the form of blended learning, ensuring higher learning outcomes (Dahal et al., 2023). As a result, online and blended learning show promise in fostering higher-order thinking skills such as creativity and critical thinking in higher education (Hague, 2024). For instance, Kathmandu University School of Education runs its programs in blended modes, combining online and face-to-face, starting in 2020. Similarly, Nepal Open University and Tribhuvan University have launched teacher education programs such as Master in Pedagogical Sciences that deliver courses like 21st-century skills to develop HOTS (Nepal Open University, 2023; Open and Distance Education Centre, 2023). In addition to those attempts, how teachers deliver lessons to develop HOTS and what activities, tools, techniques, and technologies are used in the e-learning context of Nepal are yet to be explored further because understanding e-learning scenarios might contribute to bringing desirable improvements in online and distance learning in Nepal.

4 Phenomenological study as a research method

4.1 Research aim and purpose

This study aims to “understand the essence of the experience” or participants' lived experiences on the phenomenon (Creswell and Poth, 2018, p. 110) of higher-order thinking skills (HOTS) in relation to teachers' activities in online classes that develop learners' HOTS. To explore participants' (learners) experiences in learning HOTS, this study employs phenomenology as a research approach aligned with the interpretive paradigm, using the case of Nepal Online University (pseudonym), which has been offering higher education programs for a few years and delivering is online and distance mode. Thus, this study aims to understand the essence of participants' lived experiences regarding the phenomenon of HOTS concerning teachers' activities in online classes. As Creswell and Poth (2018) described, this approach seeks to capture the core meaning of participants' experiences engaging with HOTS learning through e-learning on the Moodle platform. Table 2 shows an overview of the study.

4.2 Research design and paradigm

This study is rooted in the interpretive paradigm, employing a phenomenological approach to explore participants' lived experiences with higher-order thinking skills (HOTS) in an online higher education setting. The primary concern of the interpretive paradigm

TABLE 2 Study overview.

Component	Description
Research aim	To understand participants' experiences regarding higher-order thinking skills (HOTS) in online classes (Creswell and Poth, 2018).
Research design and paradigm	Qualitative study using a phenomenological approach.
Case context	Nepal Online University (pseudonym) is an institution that has been delivering online higher education programs.
Data collection	In-depth interviews using a semi-structured format (Stenhouse, 1980; Creswell and Poth, 2018).
Data analysis	Thematic analysis through coding, condensation, and contextual interpretation of interview data.

is to generate a context-based understanding of students' thoughts, beliefs, values, and associated social actions (Taylor and Medina, 2011). Phenomenology is a distinctive qualitative research method that explores the lived experiences of human existence, aiming to understand these experiences from the participants' perspectives (van Manen, 2007, 2017). The case study of Nepal Online University (a pseudonym), which has been delivering higher education programs online since 2018, was selected to provide a contextualized understanding of these experiences.

4.3 Participant selection and context

Given the multiplicity of meanings that learners may attribute to their experiences, in-depth interviews using semi-structured open-ended questions were chosen as the primary method for data collection (Stenhouse, 1980; Creswell and Poth, 2018). The learners might have diverse understandings and experiences toward higher-order thinking skills (HOTS) learning, so interviews, as recommended by Stenhouse (1980) and Creswell and Poth (2018), were carried out to collect the individuals' lived experiences. Considering a heterogeneous group of three to four individuals for qualitative study (Creswell and Poth, 2018), we have purposively selected four participant students as the units for analysis. To ensure gender and level representativeness, we selected the participants who had been taking online classes at the university for at least one semester at the Bachelor's, Master's, or MPhil degrees level.

Thus, a purposive sampling strategy was used to select a heterogeneous group of four students (Dahal et al., 2024). In this study, four participants were selected from the diverse context of Nepal in terms of their region, ethnicity, culture, and religion. However, they were regular university students taking classes online at the Bachelor, Master, and MPhil levels in the faculty of education. A similarity was found that all were school or college teachers in different locations of the country. Table 3 below illustrates the participant profiles.

The individual participant's context is briefly presented as follows:

Sonam (pseudonym) is a resident of Sindhupalchowk district, a hilly region in a remote area of Bagmati Province, Nepal. He is from the indigenous community of Janajati. He has been working as a community schoolteacher for the last 5 years. Before he began teaching in his current position, he taught in various institutional schools in Kathmandu Valley. He came from a farming background.

TABLE 3 Participant profile.

Participant	Degree level	Region/area	Ethnic/community background	Professional background	Notable contextual details
Sonam	Master's in Educational Sciences (ongoing)	Sindhupalchowk (remote, hilly region)	Indigenous (Janajati)	Community school teacher; former teacher in Kathmandu; farming background	Holds a Master's in Business Studies and a B. Ed; diverse teaching experiences
Mahima	MPhil in Sociology	Kapilvastu (Terai region)	Chhetri	School teacher for classes 11, 12, and bachelor's courses; 14 years of experience	Joined the university for advanced education; lives with a family of five
Nayan	Bachelor of Arts	Originally from Shankhuwashava (mountain), now Sunsari (Terai)	Brahmin	Private school teacher; supports school management	Motivated by the orientation speech about online classes
Sharmila	MPhil in Health Education	Sarlahi (Terai region)	Brahmin	Teacher of health and physical education at a local community college	Lives in a joint family of nine, influenced by friends' recommendations

However, he completed his master's degree in business studies from the faculty of Management, Tribhuvan University, and a 1-year B. Ed from the same University. Currently, he is studying master's degree in educational sciences at Nepal Open University (NOU) online.

Mahima (pseudonym) is an MPhil student in sociology at NOU. She lives in Kapilvastu district, Terai region, which is located in Lumbini Province, Nepal. She is from the Chhetri ethnic community. She lives with a five-member family. She teaches sociology in classes 11 and 12 and has a bachelor's degree at a local community campus. She has 14 years of teaching experience. Realizing the importance of higher education, she joined NOU to further her education.

Nayan (pseudonym) is a Bachelor of Arts (BA) student at NOU. He is from the Brahmin community. He is from Shankhuwashava district, a mountain region, but he is currently living in Sunsari district, a Terai region located in Koshi Province, Nepal. He has been teaching at a private school and supporting the management in the administration section. He joined NOU, motivated by the orientation speech that he could attend the class online.

Sharmila (pseudonym) is an MPhil student in health education at NOU. She is from the Brahmin community and from the Sarlahi district, Terai region, which is located in Madhesh Province, Nepal. She is teaching health and physical education at a local community college. She is living in a joint family of nine members. She was encouraged to join MPhil by her friends' sharing and motivation.

4.4 Data collection procedures

With the consent of the participants, the interviews were scheduled for approximately 1 h and were conducted online through the Zoom platform. In-depth interviews using semi-structured open-ended questions were conducted online via Zoom platform. Each session, lasting approximately 1 h, was arranged at a time convenient for the participants, ensuring a natural flow of conversation and comfortable responses. Interviews were conducted in Nepali by the first and third authors, allowing participants to express themselves comfortably. Table 4 below shows the stages, data collection procedures, and key considerations.

TABLE 4 Stage, data collection, and key considerations.

Stage	Process/method	Key details/considerations
Interview scheduling	Arranged online via the Zoom platform	Each session lasted approximately 1 h, scheduled at a time convenient for the participant.
Interview conduction	Conducted in Nepali by the first and third authors	Facilitated ease of expression and natural conversation
Data transcription	Interviews were transcribed and then returned to the participants	Member checking was performed (Denzin and Lincoln, 2018) to ensure accuracy
Data analysis	Thematic qualitative analysis	The process involved coding, condensation of data into themes, and relating themes to participants' contexts and existing literature (Creswell and Poth, 2018)
Bracketing	Researchers set aside personal experiences	Ensured neutrality and an authentic interpretation of the participants' lived experiences, minimizing bias

4.5 Data analysis process

Phenomenological data analysis involves systematically examining and interpreting individuals' lived experiences to uncover the essence and meaning of a particular phenomenon (Finlay, 2014). The information collected from the participants through the interviews was analyzed using the process of thematic analysis through coding, condensation, and contextual interpretation of interview data. After transcribing the interviews, as per Denzin and Lincoln (2018), we sent the transcripts to the participants for member checking to verify the accuracy of the data. All potential ethical issues, including written informed consent, language use, anonymity, and confidentiality, were addressed throughout the research process. To interpret the participants' experiences, we related the data to their different contexts and daily activities and analyzed them using thematic qualitative data

analysis. This involved reducing the interview data into themes through coding and condensing. Finally, the themes were discussed to make meaning in relation to the available literature and study contexts (Creswell and Poth, 2018). Furthermore, with utmost care, we kept aside our personal experiences of online teaching and learning through the e-learning platform Moodle to make a fair analysis of participants' experiences.

Thus, the transcribed data were analyzed using a thematic qualitative analysis approach. This process involved breaking down the interviews into meaningful units through coding, reducing the data to core themes that captured the essence of the participants' experiences, and relating these themes to the broader context of the participant's daily activities and available literature. Next, we consciously set aside their experiences with online teaching and learning by adhering to phenomenological principles, ensuring that the analysis remained true to the participants' perspectives. This practice of bracketing helped maintain neutrality and fostered a more authentic interpretation of the data. Table 5 below shows the data analysis process.

4.6 Researchers positioning and reflexivity

As stated by Denzin and Lincoln (2018) as well as Creswell and Poth (2018), we were bracketing or positioning as being indifferent throughout the analysis while analyzing the evidence collected from the participants on their experience of higher-order thinking skills (HOTS) learning in higher education of Nepal. As we are the tutors of the online classes, we are familiar with some experiences on the online teaching and learning activities. In the activities, we would focus on activities that would make it possible to achieve higher learning outcomes of the courses or lessons rather than specific HOT skills. However, we usually focus on online group activities using breakout rooms in MS Teams, individual participation using question-answer techniques or whiteboard activities, and discussion or presentation sessions. In addition, we use PowerPoint presentations to deliver the lessons using a more conventional method such as the lecture method. In assessment, some of us provide quizzes, discussion forums, glossary preparation, and literature-based written assignments using the e-learning platform Moodle. We provide some field-based studies as group assignments. However, we know a little about what our participants experience in HOTS learning and how they transform the skills into their daily lives. Being an insider in the online teaching-learning context (Neuman, 2006), we could build a rapport with the participants and understand their learning experiences in the online context. However, we were not their subject tutors in the online classroom, so we remained neutral while analyzing their experiences, and their context analysis would also help us be closer to their meaningful experiences. Table 6 below illustrates the researchers' positioning and reflexivity.

4.7 Ethical considerations

To ensure the validity, we supported our claims with convincing evidence and maintained honesty and integrity in the research, considering the "extent to which claims are supported by convincing evidence" (Anderson, 2010, p. 2). Throughout the research process, all ethical issues were carefully addressed to ensure the integrity and

TABLE 5 Data analysis process.

Step	Action
Immersion	Repeatedly read transcripts to identify significant statements about higher-order thinking skills (HOTS) experiences.
Horizontalization	Treated all participant responses as equally valid without hierarchy.
Thematic coding	Coded data into themes (e.g., "contextual barriers" and "skill internalization").
Emergent themes	Digital tools and technologies used in e-learning, strategies used to foster the HOTS in e-learning, and transformation of HOTs into practice through e-learning
Essence synthesis	Integrated themes to articulate the core structure of HOTS learning (e.g., student-student dynamics).
Contextual linking	The analyzed findings were aligned with Nepali socio-geographic diversity and participants' teaching roles.

TABLE 6 Researchers positioning and reflexivity.

Aspect	Description
Insider status	Researchers are online tutors familiar with tools (Teams, Moodle) but did not teach participants.
Bracketing strategies	Avoided assumptions about HOTS outcomes; focused on participant narratives.

validity of the study. Written informed consent was obtained from all participants, and confidentiality and anonymity were rigorously maintained. Similarly, written informed consent was also obtained from all four participants to publish any identifiable images or data in this article. Language uses were carefully monitored, and cultural sensitivity was ensured by conducting interviews in the participants' preferred language, Nepali. These measures were integral in aligning the study with ethical standards in qualitative research.

5 Findings and discussion

The analysis of Zoom interviews with participants of their engagement in learning through Moodle, an e-learning platform, reveals that teachers and students in online classes participate in various activities. These activities include group discussions, project work, self-study, self and peer assessments, class presentations, and research, all facilitated by advanced digital tools and technologies. In line with addressing the research questions, the data analysis emerged with the main three themes: Digital tools and technologies used by the teachers, strategies used by teachers to foster HOTS, and transformation of skills and knowledge in their daily lives. Furthermore, the findings are discussed based on previous studies, theories, and context analysis (Anderson, 2010; Finlay, 2014).

5.1 Digital tools and technologies used in e-learning

Nepal Online University (NOU) manages its online classes in blended mode: synchronous and asynchronous. Most importantly,

students are allowed to access the courses in the learning management system (LMS)—Moodle, which offers the opportunities to participate in discussion forums, choices, workshops, quizzes, and assignments (to name a few). In particular, teachers upload and upgrade all the reading materials in Moodle, a course management system used by the university, so that students can participate in various activities such as reading, writing, and debating on specified topics anytime and anywhere.

In this study, in addition to the use of Moodle, participants shared their experiences of getting involved in the discussion, writing, and exchanging their ideas through collaborative activities, gamification, video conferencing, and interactive content creation tools such as Google Docs, Google Sheets, Google Slides, Padlet, Kahoot, Zooms, Google Classroom, MS Teams, breakout rooms in the MS Teams for creating interactive videos, group work, presentation, and quizzes. For example, in the question: what were the leading online activities, electronic software, or materials used by their tutors in teaching and learning activities to develop their higher-order thinking skills? Participant Sonam says, “We learned how to use MS Teams and handle Moodle.” To talk about both, I used them in the classes of NOU for the first time. I did not know this before. Furthermore, he shares, “We, in the third semester, conducted a seminar in which Babu sir (Pseudonym) facilitated us and also helped us develop digital literacy.” Like Sonam, Nayan says, “MS Teams was most often used in our virtual classes. We used a whiteboard of the Teams platform, particularly for mathematics but not for other subjects. Teachers provided us with tasks in the slides and asked us to discuss them. We have not used any other virtual platform except Teams.” In line with others, Sharmila says, “Our teacher sometimes allowed us to discuss in the breakout rooms of teams. Many teachers were not using that before, but when we came to the second semester, one of the teachers used that feature, which helped us discuss the issue rigorously.” In addition to using Teams or Moodle, their teachers help them use other digital tools and techniques. In addition to many common features of digital learning, we have many other software such as SPSS, Google Docs, citation, and referencing tools such as Zotero and Mendeley while writing the research report, Kahoot, and so on. Mahima says. In the same line, Nayan says, “...Moreover, I learned how to handle technology. For example, I learned the skills for virtual learning, use of Moodle, downloading, reading, writing, and class discussion.”

We observed the tools and techniques used in e-learning from two perspectives: *types of tools and techniques* and *tools/techniques for learning modes* in the e-learning environment. As the framework presented by Joshi et al. (2021), the participants are familiar with and capable of various *types of tools and techniques* in the classes. For example, they can handle *writing and presentation tools* such as slides; *internet surfing and communication tools* such as Google/Teams Meet and Google Search; *course management and evaluation tools* such as Moodle and Google Classroom; *learning and sharing tools* such as Google Docs; *subject-related applications* such as mobile apps; and audio and visual document development tools such as video recording of synchronous classes. Moreover, as stated by Dahal et al. (2022b), as shared by the participants learned some collaborative activities on Google Apps and other open-source tools, including forum discussions, choices, lesson studies, workshops, and Google Docs activities (Docs and PowerPoints), *assessment tools* such as quizzes, and Kahoot, to name of few.

This evidence demonstrated that the students were exposed to advanced communication digital tools and technologies. For participants, online learning fosters digital skills, eventually supporting higher-order thinking skills. Both synchronous and asynchronous learning modes allow exploring and utilizing digital tools. Moodle or Teams might create active and social learning models (Sabin and Olive, 2018) as they are engaged individually or in a group. They use mainly Teams for live classes that are in synchronous mode. They are positive about this platform (Teams), which provides a learning environment in which to share their experiences or collaborate (Dahal, 2023; Stramkale, 2023). As an asynchronous mode of learning, participants use Moodle, which is an open-source software managed by the university that allows them to link to web-based resources such as Facebook, YouTube, X, LinkedIn, and others. The participants attended self-quizzes that enabled them to learn a higher-order metacognitive skill (Kenny, 2020). A review of the experimentation experiences by Pishchukhina and Watson (2021) illuminates that online quizzes could be used to promote learners' analysis, evaluation, and creating skills. Similarly, creative assignments, discussion forums, or gaming experiences help reach HOT skills in higher education.

5.2 Strategies used to foster the HOTS in e-learning

To explore the teaching strategies used by the tutors in the e-classes, the participants were asked: *What kind of support have you (participants) been experiencing from the teaching and learning activities to develop their higher-order thinking skills like critical thinking, problem-solving, analytical and reflective skills, application skills, digital skills?* The tutors in online classes used various techniques and strategies to enhance students' higher-order thinking skills through e-learning. E-learning platforms: Moodle and MS Teams were used mostly to facilitate the students' learning process. The analysis of the participants' expressions showed teachers used discussion forums, project works, case studies, self-study tasks, presentations, paper reviewing, polls, writing assignments, and reviewing peer's write-up. The following two themes were generated further to understand the teaching strategies in e-learning at the university.

5.2.1 HOTS learning through collaboration and networking

Teachers assign the task for each student to present the contents through PowerPoint slides, make some inputs on a peer's presentation, and conclude the main ideas of each lesson. The excerpts extracted from the interviews with the participants demonstrate how teachers engaged the students in e-learning. One of the participants, Mahima, says, “...if I do not understand the questions, I ask the friends who know more.” Another participant, Sharmila, in the interview, expresses, “After joining the NOU classes, I have maximally learned how to engage in group works, group discussion, and presentation. Our teachers divided the tasks among us to present after a few demonstration classes.” In the use of teaching strategies in the classes, Sonam shares his experiences, “... in my class, too, my teachers asked us to do the group work and present the conclusion in the class. I think many activities

we have been doing in the classroom will increase the application, analysis, synthesis, evaluation, critical thinking, problem-solving, and higher order thinking.” However, all the participants were not satisfied with the classes as their expectations were not met. Sonam’s expectation was to learn about research and practical activities. He says, ... “this course, Educational Sciences by the name educational sciences, I expected much research-based and practical work in the classes. But, in the long run, to be frank, research-based and practical work remained less.” He realized that he was learning HOTS and transferring in his profession. All participants, including Nayan, agreed they were allowed to learn HOTS. He says, “I learned... content analysis through creative assignments, presenting my own views, thinking, critical analysis, and collaboration with my friends.”

The strategies adopted by the teachers in e-learning seemed to be developing students’ autonomy and self-exploration. Group discussions or group work assignments, particularly using breakout rooms in MS Teams, supported the participants in interacting with each other and forming their consolidated ideas on the subject matter. Some other activities, such as video-enabled discussion sites as explored by [Clark et al. \(2015\)](#), can enhance HOTS. Similarly, some practices such as group interaction, creative writing, self-learning, and discussion through e-learning in the university enhance their HOTS ([Heron and Palfreyman, 2021](#); [Natarajan, 2006](#)). Moodle, developed based on a social-constructivist model, helps learners and tutors create collaborative interaction ([Kotzer and Elran, 2012](#)). As discussed by [Edwards \(2016\)](#), new pedagogies through technology enhance the learners’ creativity, provide a source for critical thinking, or enable them to demonstrate higher-order thinking skills.

5.2.2 HOTS learning through tutor’s instruction to self-direction

The e-learning context offers different opportunities, transitioning from teacher-centered to learner-centered roles, which reflect the realities of both success and failure in e-learning ([Dahal and Manandhar, 2024](#)). In the university, as shared by the participants, tutors regularly support the learners, and the participants are given the opportunity to self-direct and reflect on their work. One of the participants, Sharmila, expresses, “...I had to read the materials, download myself from Moodle, digest them, and prepare slides for presentations that were challenging.” To make slides, I would read for hours and search on Google. The presentation among the friends and defending the friends’ questions after the presentation was my most difficult task. Nayan, a student of Bachelor level, was involved in the activities that would support him to enhance his HOTS. He says, “... but in the online class, the teacher provides the task and asks us to read the materials, prepare the presentation, and present in the class. This compelled us to self-explore and self-study. I have learned presentation, self-learning, and self-exploration.” Another participant, Nayan, shares other friends’ experiences and says, “Friends also say that they have developed self-confidence. We talk to each other sometimes in our free time.”

The participant learners are engaged through both andragogical and pedagogical approaches, including group-based work, cooperative and collaborative learning, project-based tasks, and debates that enhance higher-order thinking skills ([Gupta and Mishra, 2021](#)). [Khadka \(2020\)](#) states that their tutor’s instruction still guides the learners, and the teacher’s regular presence supports

their learning, helping them to be independent if the teaching is oriented to enhance HOTS. To a greater extent, they are self-directed and self-motivated. All the participants did some individual work such as slide preparation and presentation, assignment searching, and reading materials. They learn how to offer, defend, or address others’ comments on their presentation or work. The contextual role of participants instructed to be self-directed and self-motivated helps them enable, empower, and engage in learning ([Khadka, 2020](#)). An empowered learner can independently engage in discourse and critical reflection, and it helps to solve problems independently, cooperatively, and creatively ([Cranton, 2016](#); [Chinedu et al., 2015](#)).

5.3 Transformation of HOTS into practice through e-learning

Higher-order thinking skills (HOTS) empower learners to transform their learning into their real life and intend to bring desirable change. Some teaching approaches, such as relational, connected knowing over individuals, and autonomy in learning, play the role of learning transformation ([Cranton, 2016](#)). Transforming HOTS into practice through e-learning might be challenging for the learners. To explore the transformation of HOTS learning, the participants were asked a leading question: How would they use the knowledge and skills they learned in their real-life practice? The participants have different experiences. They highlighted the transformation brought by the online classes, especially in their thinking process, communication skills, socialization, digitalization, and social networking. After joining the online classes, they said they learned to reason with evidence, facts, logic, and critical evaluation. The analysis of the interviews demonstrated changes in the students. They confidently shared the changes they experienced and realized through the teachers’ online facilitation. In addition to digital literacy, the learners develop some skills such as critical thinking and problem-solving, group work, communication, and social networking skills.

5.3.1 HOTS at critical thinking and problem solving

The participants expressed that they developed critical thinking skills more after joining the online classes at the university. Their sharing resembled their self-learning, argumentation, and critical perspectives. They realized the changes in their overall understanding of the phenomena. For example, one of the participants, Sharmila, expressed, “I understood critical theories, such as pedagogy of the oppressed and other critical theories which have changed my perspectives to understand society.” Similar to Sharmila’s views, other participants also expressed that their critical perspectives were enhanced after the online classes. Nayan also shared that he changed his teaching methodologies. He mentioned, “I have changed my own style of teaching in my school. For example, after this university class, I invite students to understand why this formula is used in solving this problem. I let them share their logic, but before, I used to write formulas on the board and ask the students to write and solve the problem.” He continues sharing experiences, “We used to read the teacher’s note, listen to the teachers’ lectures passively ... I felt the difference between before

and now after joining NOU. But in the online class, the teacher provided the task and asked us to read the materials, prepare the presentation, and present it in the class.” Nayan brought changes in his teaching by providing opportunities to the students for critical thinking skills through asking questions and evaluating the problem from multiple perspectives. To enhance HOTS, his students are given the opportunity to think on their own or see an event or subject of discussion from the pros and cons.

Sonam, a community schoolteacher, realized that he had learned many skills in pedagogy and technology from the university e-learning classes via MS Teams and Moodle, which helped him improve his teaching–learning activities. He says, “For example, ... it has developed the skills to see based on bad and good aspects. To talk about HOTS, Nepal’s education is based on rote learning *Ghokante Bidhya* (considered rote learning) in the present times. In the present day, I have brought changes in my school classes. For example, I was teaching Economics in grade 9, and there was the theory of Ricardo, and there was criticism, too. One student asked me if everything was wrong and why we should study it again. I realized that students have developed a questioning habit.” Sonam also uses his digital skills with their school children. He has taught them how to search for answers through various internet sites. Good listening and responding skills help develop critical thinking. In this line, one of the participants, Mahima, says, “I cannot say to the point, but we learned how to listen to others, decide which is wrong and right, and maintain the notes from the online classes.”

The often-pronounced term in the participants’ interview was “Critical Thinking and Problem Solving (CTPS).” Critical thinking is the disciplined process of actively and skillfully conceptualizing, analyzing, synthesizing, and evaluating information to reach an informed conclusion. Problem-solving is the systematic process of identifying, analyzing, and resolving issues through logical and creative approaches. The participants used the term CTPS synonymously in place of HOTS. Even in literature, critical thinking is highlighted as the core skill of HOTS that involves disposition, problem-solving, creative thinking, and decision-making, which can be enhanced through problem-based learning (Miterianifa et al., 2020). This CTPS skill is described as the foundation of a strong education that aims to enable learners to interpret, analyze, and evaluate ideas and arguments (Fisher, 2011) as the higher-order thinking stage of Bloom’s taxonomy of cognitive domain. These skills under critical thinking can be transferred to students’ other areas and real life (British Council, 2015; Heron and Palfreyman, 2021; Fisher, 2011; Pishchukhina and Watson, 2021; Saifer, 2018).

5.3.2 HOTS at intercultural communication and social networking

A theme that emerged from the data analysis was intercultural communication and social networking skills. Social networks helped the participants interact with peers, teachers, and others beyond the constraints of school or college boundaries. One of the participants, Sonam, says, “...Oh yes, with Sambidhan Ji (his classmate), once I had discussed how to create Google Forum and Google Docs in class. He shared with me from his mobile phone that even in Messenger, we could share the screen like in Zoom, which I did not know before.” In addition to the regular content of learning, the participants expressed that they got the opportunity to collaborate

with other friends from distinct locations and cultural backgrounds. Nayan’s experience was like these statements. He shared an example that was really surprising and unique. He says, “...in Western Mountain region, in a culture, if someone dies, they take the dead body to the top of a hill, cut it into pieces, and feed it to the vultures. I was shocked to learn this because I had not known it before. I also shared the unique *Bhutya* culture (influenced by Tibetan culture) of Sankhuwasabha (Eastern Mountain region).” Mahima brings an example, “I cannot remember the exact moment. However, friends from Karnali (a very remote area of the country), spoke quite differently. They used to share a unique culture, such as worshipping the stone before starting Ropai (paddy plantation).”

Like Mahima, other participants shared their joy in communicating and exchanging ideas, understanding each other’s perspectives, and respecting them. In addition to their regular classes, they discussed various issues using other means of online communication, such as Zoom, Google Meet, or Messenger. Sharmila gives an example of how she was praised in her college. She says, “There was a training program on our campus. In the training, the facilitator provided us with group work and presents. I presented all the ideas at that time, so other participants praised me. They said, Madam, you studied MPhil so you could perform well.”

The participants shared that the e-learning platform and other exposure during the study offered the opportunity to exchange cultural heritages, peculiarities, and people’s lifestyles. Social media platforms like Viber, WhatsApp, and Messenger groups play a crucial role in open, distance, and digital education. They help learners develop intercultural communication skills, collaborate in online learning communities, stay motivated, engage in learning, and improve their skills (Bozkurt, 2023). Synchronous online discussion or social networking helps the participants to develop their social skills and promote their critical thinking skills on peoples’ language, social lives, culture, values, and beliefs as well (Kriemadis et al., 2021; Sherman, 2013; Yang and Ahn, 2007).

6 Conclusion and implications

This study intended to explore higher-order thinking skills (HOTS) learning in the e-learning platform of Nepal Online University. Major three concerns: use of digital tools and technology, the use of strategies to develop learners’ HOTS, and the transformation of skills in their real life, were focused. The study highlights that e-learning at Nepal Online University (NOU) effectively combines both blended synchronous and asynchronous learning modes. It uses platforms such as Moodle and MS Teams to promote HOTS. Participants engaged in collaborative activities, including group discussions, project work, and self-directed tasks such as presentations and peer reviews. They also used interactive tools such as Kahoot and Google Docs, which enhanced their critical thinking, problem-solving abilities, digital literacy, and intercultural communication. Teachers implemented strategies such as collaborative learning, peer assessments, and self-exploration to shift from teacher-centered to learner-centered approaches. Participants reported significant improvements in their skills, including better teaching practices, increased cultural awareness, and greater confidence in applying HOTS in both professional and personal

contexts. These findings align with social-constructivist theories (Anderson, 2010) and underline the importance of technology in modern pedagogy.

Although higher-level distance education using electronic platforms in Nepal is relatively new—having been established for less than a decade—participants believe that e-learning in higher education holds significant value. This is evident in the technology used, the implementation of e-learning strategies to develop higher-order thinking skills, and the transformation of skills applicable to real-life situations. The university can adopt digital platforms to cater to higher education in social sciences. The participants mainly used Teams as a synchronous learning platform, whereas Moodle was used for asynchronous learning. In addition to this, other supportive software and apps provided opportunities for learners to develop their HOT skills. The participants learned through group/collaborative or problem-based learning that can enhance their analytical, creative, critical thinking, problem-solving, or communicative skills leading to HOTS. In addition to HOTS learning, intercultural communication or social networking among the participants in e-learning shed light on the importance of learning transformation in their real lives. The e-learning practices followed by the university faculty might be transferable to other faculties and similar contexts. In the e-learning platform, tutors used limited options such as breakout rooms in MS Teams, uploading reading material, and providing written assignments, quizzes, or discussion forums in Moodle, which are very limited activities. This shows either unwillingness to use other activities or lacking skills to use them where a needful intervention is needed in the university. Furthermore, research or practical skills they wanted to learn were not prioritized in e-learning platforms. Considering the curriculum's intent and learners' interests, tutors might adopt/adapt the teaching strategies to address the learners' needs. Despite some participatory teaching approaches, some other strategies such as project-based learning, dialectical methods, case studies, and field-based studies might enhance learners' HOTS and transformation skills.

The implications of this study are unique and significant. In educational practice, institutions should prioritize blended learning models and invest in digital infrastructure, such as Learning Management System (LMS) platforms and interactive tools, to support collaborative, self-directed, and self-motivated learning. Professional development programs are essential for teacher training to equip educators with strategies for fostering HOTS. This includes utilizing breakout rooms, gamification, and peer review systems. In terms of curriculum design, integrating real-world tasks—such as case studies and research projects—along with intercultural exchanges can greatly enhance critical thinking and problem-solving abilities. From a policy perspective, governments and universities should work together to expand access to digital tools and address technical disparities to ensure equitable participation in e-learning to ensure higher learning outcomes.

7 Limitations of the study

The scope of the study was confined to a single university in Nepal, which may restrict the generalizability of the findings to

other contexts with varying technological or cultural landscapes. In addition, the reliance on participant interviews and self-reported experiences introduces self-reporting bias, potentially overlooking objective measures of higher-order thinking skills (HOTS) development. Technological constraints, such as internet reliability and accessibility, were not accounted for, which disproportionately affects remote learners. Moreover, the emphasis on Nepali educational practices and cultural exchanges may limit the relevance of the findings to global e-learning environments. Similarly, as researchers and tutors, we employed strategies such as breakout rooms, quizzes, traditional lectures, and PowerPoint. These activities were primarily designed to meet course objectives first and then explicitly develop higher-order thinking skills (HOTS). This raises concerns about whether the reported growth in HOTS results from intentional pedagogical strategies or broader educational interactions. So, it is important to consider the generalizability of our study findings. This means asking whether the research outcomes and insights can be applied to a larger population or other situations. Levitt (2021) argues that qualitative generalization should be made not to the population but to the phenomenon being studied. So, the goal of our study was to understand higher-order thinking skills in e-learning in higher education in-depth, and the findings of our study can be applied to other similar phenomena, even if our findings are not generalized.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Research Committee at Nepal Open University, Nepal. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

JK: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. ND: Conceptualization, Formal analysis, Funding acquisition, Methodology, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. UA: Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. GP: Formal analysis, Investigation, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing. NS:

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Appendix

Interview questions

1. Could you please tell us about your personal, family, and professional/business background?
2. Why and how did you come to study at the University you are currently studying? What were your expectations? Could you tell us about the background?
3. What is your opinion about higher-order thinking skills in learning? Can you also explain your understanding of this? (If students are not aware of this, then in teaching and learning, application, analysis, synthesis, evaluation, creativity, CTPS, and metacognition should be briefly explained so that there is a comfortable environment for the questions ahead.)
4. Can you tell me about your instructors' main learning activities in teaching and learning?
5. Can you tell me about the main online or electronic software or materials your instructors use in these teaching and learning activities?
6. How have you experienced how your instructors' teaching and learning activities have helped you develop higher-order thinking skills? Could you share some examples of how they have helped you? Could you share some examples of how you have found something different from studying this subject or level?
7. In which of the higher-order thinking skill levels - Application, Analysis, Synthesis, Evaluation, Creativity, CTPS, Metacognition - have you felt you have made the most progress? And in which areas have you felt you have achieved relatively little?
8. Could you share some activities or other suggestions that could be added to online media to develop higher-order thinking skills through the teaching-learning activities your instructors do?
9. Do you have any suggestions for additional software or materials that instructors can use in teaching-learning activities other than online or electronic software or materials?
10. How are these learning activities that promote higher-order thinking skills applicable to your personal and professional development?
11. Finally, the interview closes with a thank-you note, asking if participants have any other comments or suggestions.