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Engaged Learning Practices of Students in Chemistry Learning

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Abstract

This study aims to investigate engaged learning practices among undergraduate students in the field of chemistry. The study employed quantitative research design with a total of 88 students from two university campuses in the Kathmandu valley. The research employed a 30-item questionnaire with Likert type, developed based on relevant literature on student engagement, to collect data. The results indicated that the students displayed high levels of behavioural engagement such as staying focused on their chemistry studies, following their teachers' instructions, and completing their assignments and projects on time. Moreover, they were also found to be actively engaged in cognitive practices such as setting learning goals, exhibiting curiosity and interest in chemistry, and putting effort into understanding the concepts. Additionally, the students demonstrated high levels of emotional engagement by exhibiting a desire to understand chemistry, enjoying learning new information, and feeling positive and enthusiastic about the subject. The results of this research hold practical significance for decision makers, science instructors, and future investigators in related areas. The findings have added to the knowledge of the engagement of university level students in their chemistry education. These findings can be used by science instructors and decision makers to create more engaging and effective chemistry learning environments. By providing students with opportunities to engage in active and meaningful learning, instructors can help to ensure that students are successful in their chemistry courses.

Introduction

Student engagement is a concept that has gained substantial attention in the realm of effective teaching and learning. It encompasses learners' enthusiasm, desire, requisite, and dynamism to actively participate and excel academically (Bomia et al., 1997). Engaged students demonstrate behavioural, emotional, and cognitive dimensions, reflecting their actions, thoughts, and emotions in the learning process (Bedell, 2012; Marx et al., 2016). In the classroom, engagement is characterized by vibrant participation and meaningful dialogue (Marx et al., 2016). Thus student engagement encompasses learners' active participation, enthusiasm, and dedication to excel academically in the learning process, including vibrant participation and meaningful dialogue in the classroom.

Recognizing and understanding student engagement within specific courses provides teachers with valuable evidence to describe and assess students' behaviours in the classroom (Mandernach et al., 2011; Svanum & Bigatti, 2009). Marks (2000) identifies student engagement as a psychological process involving focus, curiosity, dedication, and effort devoted to learning. In recent times, engaged learning has emerged as a vital aspect of effective classroom pedagogy, receiving considerable attention in educational circles (Handelsman et al., 2005; Bond et al., 2020).

A comprehensive understanding of engagement encompasses multiple dimensions, including behaviours, thoughts, and emotions (Bedell, 2012). Engaged students exhibit enthusiasm, interest, and excitement for learning. They willingly embrace complex responsibilities and find pleasure in their actions (Fredricks et al., 2004). The significance of student engagement within the classroom is widely recognized in the field of education, as it plays a key role in fostering effective teaching and learning environments (Farmer & McKinney, n.d.). Willms (2003) asserts that student engagement measures a student's positive attitude towards school, while student disconnection refers to significant disengagement from educational institutions. Research consistently demonstrates that student engagement promotes positive learning outcomes (Sinatra et al., 2015), with engaged learners more likely to experience academic success (Bulger et al., 2008; Willms et al., 2009). The concept of student engagement underscores the notion that optimal learning occurs when students are actively involved, motivated, and enthusiastic about the subject matter (Hidden Curriculum, 2014). However, when learning becomes dull and emotionally disengaging, students are prone to disengagement (Aloka & Odongo, 2018). Therefore, improving student engagement stands as a common educational objective, as engagement and attachment to school significantly predict academic success (Aloka & Odongo, 2018). Effective student engagement is thus critical for fostering academic progress and achieving positive outcomes.

Student engagement encompasses various dimensions, including behavioural, emotional, and cognitive aspects (Fredericks et al., 2004; Parsons & Tylor, 2011). Behavioural engagement involves adherence to rules and regulations, while emotional engagement reflects personal values, interests, and emotions. Cognitive engagement entails active involvement in learning through focused, strategic, and self-regulating approaches (Fredericks et al., 2004; Parsons & Tylor, 2011).

The significance of student engagement for academic success has been widely emphasized in educational research (Marx et al., 2016). It is also acknowledged that teachers' understanding of engagement plays a crucial role in creating classroom environments that support educational objectives . While studies have examined student engagement practices internationally, there remains a dearth of research on college students' engagement, particularly in Nepal. Furthermore, limited studies have explored student engagement in the Nepalese context, specifically regarding engaged learning practices in science education. Therefore, this study aims to uncover the perspectives of engaged learning practices among undergraduate students in Nepal, addressing the following questions: Do Nepalese undergraduate students actively practice engaged learning? What modes of engagement do Nepalese undergraduates employ?

Thus, this study aims to assess the level of engagement of undergraduate students in science education across the three dimensions of engagement. Therefore, the study will find student alignment toward those three dimensions of engagement. This research seeks to assess the level of engagement among undergraduate students in science education, focusing on the three dimensions of engagement: behavioural, emotional, and cognitive. By exploring the alignment of Nepalese undergraduate students with these dimensions, this study will shed light on their engagement practices and provide valuable insights into the current state of engaged learning in science education. The findings of this study will also contribute to the existing literature on student engagement and provide valuable insights for educational practitioners, policymakers, and researchers. Understanding the engaged learning practices of Nepalese undergraduate students will inform the development of effective pedagogical strategies, curriculum design, and support mechanisms that foster greater student engagement. By enhancing student engagement in science education, this research has the potential to improve academic outcomes and contribute to the overall educational experience of undergraduate students in Nepal. Furthermore, the advancement of engaged learning practices in chemistry classrooms relies on science teachers actively participating in relevant professional development activities. In order to enhance students' learning outcomes, chemistry teachers should explore and implement diverse approaches or dimensions of student engagement (Upadhyaya, 2023).

In conclusion, this study aims to uncover the engaged learning practices among undergraduate students in Nepal, focusing on science education. By exploring the alignment of Nepalese undergraduate students with the three dimensions of engagement, this research will offer insights into their engagement practices and contribute to the existing literature on student engagement. The findings will inform educational practices, policies, and future research endeavours, ultimately promoting effective teaching and learning in Nepal's higher education institutions.

Materials and Methods

This study employed a survey research design within the post-positivist research paradigm to explore engaged learning practices among undergraduate science students in the Kathmandu Valley. The focus of the study was on students enrolled in the B.Ed. Science program at Tribhuvan University in the Kathmandu district. Due to time and resource constraints, the study was conducted in two campuses that offered B.Ed. Science courses, and the final sample consisted of

88 undergraduate students who regularly attended classes at these campuses.

A well-structured survey questionnaire was designed to collect data on students' engaged learning practices. The questionnaire drew from previous literature on student engagement and encompassed three dimensions: behavioural, cognitive, and emotional engagement. To ensure the questionnaire's reliability and validity, it underwent a thorough review by experts, followed by a pilot test with a sample of 30 students. The Cronbach's Alpha coefficient was calculated to determine the questionnaire's reliability, and its values exceeded 0.70 for all three dimensions of engagement. Expert feedback and suggestions were incorporated to enhance the questionnaire's validity. The finalized version was then administered to the selected sample of students, and data was collected for analysis.

Data collection involved numerical values obtained through the survey, which were subsequently analyzed using the Statistical Package for Social Science (SPSS-2018). Descriptive statistics, including mean and standard deviation, were calculated to assess the levels of behavioural, cognitive, and emotional engagement. Face validity was ensured by substantiating the data collected, while content validity was confirmed through verification of respondents and data sources. Construct validity was established by comparing the findings with related literature, and criterion validity was confirmed by aligning the results with established theories and prior research.

Results of the study

The aim of this study was to evaluate the levels of engagement among undergraduate students in their learning of chemistry. To accomplish this, a questionnaire was developed to measure three facets of student engagement: behavioural, cognitive, and emotional. The questionnaire consisted of a total of 30 statements, 9 related to behavioural engagement, 13 related to cognitive engagement, and 8 related to emotional engagement. The data was collected from students and analyzed to determine the mean and standard deviation values for each dimension of engagement. The findings of this study provide insight into the engaged learning practices of undergraduate students in the field of chemistry.

Practices of Undergraduate students on Behavioral Engagement

This study analyzed the practices of undergraduate students on different aspects of behavioural engagement. Nine aspects of behavioural engagement in learning chemistry were considered. The areas of behavioural engagement practices, along with their mean and standard deviation, are listed in Table 1.

Table 1
Students practices on Behavioural Engagement

Behavioural engagement	N	Mean	Std. Deviation
I interact with my teachers during my chemistry class.	88	3.66	0.90
I participate in chemistry-related activities that occur on campus	88	3.67	1.34
I stay focused on chemistry learning	88	4.64	0.57
I keep trying even though chemistry is hard for me	88	4.04	0.97
I complete my assignment or project on time	88	4.61	0.70
I follow the instruction given by my teachers	88	4.64	0.63
I put my effort into chemistry learning	88	4.35	0.95
I do not participate in chemistry classroom activity	88	2.09	1.07
If I do not understand, I give up the right way	88	2.77	1.51
Total	88	4.06	0.36

This study aimed to analyze the behaviourally engaged learning practices of undergraduate students in the subject of chemistry. Nine areas of behaviourally engaged learning practices were evaluated by computing their mean and standard deviation. The results of the analysis are presented in Table 1, which shows the mean and standard deviation scores for various aspects of behaviourally engaged learning practices among undergraduate students. The study found that the mean score for the statement "I participate in chemistry-related activities on campus" (3.67) was the highest, while the mean score for the statement "I did not participate in chemistry classroom activity" (2.09) was the lowest. The students were found to be more engaged in areas such as staying focused on chemistry learning, following teachers' instructions, and completing assignments and project work on time, as the mean scores for these areas were 4.64, 4.64, and 4.61 respectively. The overall mean for behavioural engagement was found to be 4.06, indicating that undergraduate science education student's exhibit better behavioural engagement.

Practices of students towards Cognitive Engagement

The engaged learning practices on cognitive dimensions comprised 11 areas, the Mean scores. Standard deviation scores of the areas of cognitive engagement are presented in the below table.

Table 2

Mean and Standard Deviation of areas of cognitive engagement practices of the students

Cognitive Engagement	N	Mean	Std. Deviation
I set goals and self-regulate my learning	88	4.38	0.78
I develop strategy while participating in chemistry classroom activity	88	3.71	1.00
I have a problem understanding the topic; I go over it again until I understand	88	4.06	0.95
I organize my study time well.	88	4.19	0.78
I have an interest and curiosity in learning chemistry	88	4.29	0.74
Even when I do not want to study, I force myself to study.	88	3.52	1.19
When I solve chemistry-related problems, I ask myself questions to help me understand what to do	88	3.83	0.89
I put much effort into understanding the chemistry concept	88	4.21	0.75
I am very clear about what I am trying to accomplish in the class	88	4.00	0.98
When I am studying, I forget everything else around me	88	3.59	1.11
I try to relate ideas(or link various concepts) in this subject to other courses whenever possible to draw a new conclusion	88	3.48	0.80
When I study chemistry, I try to connect what I am learning with my own experience	88	3.99	0.89
When I learn chemistry, I wonder how much the things I have learned can be adapted to real life.	88	3.78	1.05
Total	88	3.93	0.45

The study aimed to examine the cognitive engagement practices of undergraduate students in their chemistry learning. The results showed that the students were better engaged cognitively, with an overall mean score of 3.93. Thirteen areas for cognitive engagement were analyzed by calculating the mean and standard deviation. Table 2 presents the mean and standard deviation scores of various areas of cognitive engagement among the undergraduate students. The highest mean score was found for the statement "I set a goal and self-regulate my learning" (4.38), while the lowest mean score was found for the practice "I try to relate ideas in this subject to other courses whenever possible to draw new conclusions" (3.48). The students were also found to be more focused on areas such

as setting learning goals, showing interest and curiosity, and putting effort into understanding chemistry concepts, which were all reflected by high mean scores. The overall mean for cognitive engagement shows that the students are well engaged in their chemistry learning.

Practices of students towards Emotional Engagement

The engaged learning practices on emotional dimensions comprised eight areas, the Mean scores. Standard deviation scores of the areas of cognitive engagement are presented in the below table.

Table 3

Mean and Standard Deviation of areas of emotional engagement practices of the students

Emotional Engagement	***Mean***	***Std. Deviation***
I look forward to learning chemistry	4.15	0 .78
I enjoy learning new things in chemistry	4.38	0 .78
I want to understand what is to be learned	4.36	0.70
I often feel frustrated in chemistry	2.67	1.23
For me, chemistry is a boring subject	2.14	1.12
I feel positive, optimistic, and excited about learning chemistry.	4.23	0.75
I enjoy chemistry class when the teacher is teaching	4.03	1.04
My stress and anxiety increased in the chemistry classroom	2.60	1.16
Total (with Rev coding)	4.00	0.60

The study aimed to examine undergraduate students' emotionally engaged learning practices in chemistry. The overall mean for emotionally engaged learning was 4.00, which shows that students are better engaged emotionally in their chemistry learning. Moreover, eight areas for cognitively engaged learning practices were analyzed by calculating their mean and standard deviation. Table 3 illustrates the mean and standard deviation scores of various areas of emotionally engaged learning practices of undergraduate students. The mean score (4.36) of the *statement I want to understand what is to be learned* was the highest, while the mean score (3.48) of *practice for me, chemistry is a boring subject* was found to be the lowest. The students were found to be more focused on emotional engagement, such as wanting to understand the chemistry concept, enjoying learning new things in chemistry, and feeling positive, optimistic, and excited about learning chemistry. The overall emotional engagement practices of the students was found to be 4.00 which showed that the undergraduate science education students were better engaged emotionally in chemistry learning.

Discussions

This study aimed to examine the engaged learning practices of undergraduate students across the dimensions of behavioural, cognitive, and emotional engagement. Within each dimension, the study identified nine areas for behavioural engagement, thirteen for cognitive engagement, and eight for emotional engagement. The findings revealed that students exhibited stronger practices of behavioural engagement in the context of their chemistry learning.

Drawing upon Vygotsky's concept of the "zone of proximal development" (1978),

which emphasizes the level of understanding learners can attain when actively engaged in a task, the study observed that students prioritized behavioural engagement in their chemistry learning. This included behaviours such as staying focused, following teachers' instructions, and completing assignments and projects within the specified timeframe. The significance of behavioural engagement is well-established in the learning process, aligning with the work of Christenson et al. (2012), who identified students' identification with educational institutions as encompassing a sense of belonging, valuing, and perceiving the importance of school, as well as gratitude for academic success.

Promoting behavioural engagement is crucial for students' overall success, underscoring the need for policymakers to design classroom activities that enhance engagement and make chemistry learning more exciting and interesting. Furthermore, providing professional development opportunities for science teachers can further facilitate the promotion of engaged learning practices in the chemistry classroom (Devito, 2016). The findings of this study hold relevance for teachers, educators, and policymakers in the development of educational programs that foster engaged learning practices among students.

Regarding cognitive engagement, the study found that students exhibited a stronger focus in areas such as goal setting, self-regulation, curiosity, and putting effort into understanding chemistry concepts. These findings align with the study by Van der Meijden et al. (2014), which emphasized that students who are cognitively engaged in their learning process tend to display higher levels of motivation, interest, and intrinsic motivation in their subject. Additionally, the study revealed that students who demonstrate a sense of control over their learning, set goals, monitor their progress, and employ effective learning strategies are more cognitively engaged. This finding is consistent with Skaalvik and Skaalvik's (2017) research, which established a positive relationship between student engagement, including cognitive engagement, and academic achievement. To enhance cognitive engagement, teachers can create opportunities for critical thinking, problem-solving, and self-regulation in the classroom.

Emotional engagement also emerged as a focal point for students, as they expressed a strong desire to understand chemistry concepts, demonstrated enjoyment in learning new information, and exhibited positive and enthusiastic emotions towards the subject. This finding aligns with the notion put forth by Christenson et al. (2012), which posits that emotional engagement involves feelings of belonging, valuing, and importance to the educational institution, as well as gratitude for academic success. Devito (2016) further highlights the measurement of emotional engagement through students' positive or negative responses to instructors, peers, and the educational environment.

In conclusion, this study sheds light on the engaged learning practices of undergraduate students, highlighting their focus on behavioural, cognitive, and emotional engagement. By understanding and fostering these dimensions of engagement, educators can create an environment that promotes student success. Behavioural engagement sets the foundation for learning, while cognitive engagement enhances critical thinking and self-regulation. Emotional engagement, in turn, cultivates a positive and enthusiastic learning experience. By integrating these

findings into educational practices, teachers can effectively support students' engagement in their chemistry learning journey, ultimately facilitating their academic growth and achievement.

Conclusion and Implications

The study aimed to find the students' engagement practices at secondary level science in the dimensions of behavioural, cognitive, and emotional engagement. Students of undergraduate level studying science education showed better engagement practices to learn chemistry. Among the three dimensions, students were shown to be more behaviourally engaged than in the cognitive and emotional dimensions.

The practice of engaged learning is crucial for undergraduate students to learn chemistry effectively. However, this aspect of learning has received little attention in previous studies. Engaged learning is a combination of behavioural, cognitive, and emotional engagement in chemistry learning, making it more intriguing and captivating. The development of curiosity, interest, and a deeper understanding of chemistry concepts can be fostered through engaged learning practices. Therefore, educational policymakers should prioritize the design of classroom activities that promote engaged learning, focusing on the behavioural, cognitive, and emotional dimensions. These dimensions must be considered when planning teacher training and support programs, which can contribute to an increase in engaged learning practices in chemistry classrooms. Science teachers' professional development plays a vital role in improving engaged learning practices and making chemistry lessons more engaging. Further research exploring engaged learning practices in other subjects can provide useful comparisons and insights. These practices are not limited to chemistry and have applications across various subjects.

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