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Students' Approaches to Learning in Agricultural Higher Education

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An *Expost facto* research design was adopted to understand the learning approaches of agricultural students (d*eep, strategic, and surface*) and the data were collected randomly from 1514 students of Indian agricultural higher education institutions using the 'Approaches and Study Skills Inventory for Students (ASSIST)' instrument. The predominant learning approach adopted by the agricultural students was found to be 'strategic' (41.1%), followed by 'deep' (40.3 %) and 'surface' (15.5 %) approaches. No significant association (Chi-square statistic = 24.106, p=0.156) was found in the student learning approaches across the disciplines, while significant difference (t-statistic=2.248, p=0.028) was found between graduate and undergraduate students in case of 'deep approach'. Gender had a significant association (Chi-square statistic =14.817, p<0.001) with the students' learning approaches, especially in 'strategic' and 'surface' approaches. The paper calls for more systematic and effective teaching-learning and assessment strategies to enhance agricultural higher education quality.

Keywords: Agricultural education; students' learning approaches; higher education.

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1. INTRODUCTION

The agricultural higher education in India encompasses different faculties *viz*. agriculture, horticulture, veterinary science, fisheries, dairying, *etc*. and aims to produce knowledgeable graduates with problem-solving and analytical/critical thinking abilities. Learning is a process of behavioural change through experiences and the teachers strive to facilitate effective student learning so as to enable them to solve real-world problems, which is also influenced by their learning approaches. The students' preference for a learning approach depend on several contextual factors Dinsmore [1]. These can be described in terms of students' intentions, study habits, and attitude to a learning task and are categorized as deep, surface, strategic approaches Entwistle and Ramsden [2]. The studies on approaches to learning have been done in different fields of sciences but not in agricultural sciences. The agricultural sciences are highly diversified, contextual, location specific, experiential in nature. The study on student learning approaches contributes to enhancing the quality of education through designing appropriate strategies *viz*. curriculum, assessment methodologies, pedagogy, *etc*. It is also important for the teachers and educational administrators of universities to understand the students learning approaches so that they can help students to develop their academic shortcomings and recommend methods to improve their learning. Given the importance of students' learning approaches and their effect on the students' academic achievement, the present study seeks to measure the students' learning approaches of different disciplines across the State Agricultural Universities (SAUs) in India.

2. REVIEW OF LITERATURE

Empirically proved that students' preference for a learning approach is influenced by different contextual factors such as gender, interest or goals, assessment methods, and educational contexts, motivation [1,3,4]. Type of assessment determined the approach viz. in case of summative assessment students preferred surface approach and adopted deep approach in case of formative assessment (Al-Kadri et al. (2012). However, Izabella et al. [5] concluded that interest-to-effort ratio is central to students' preference for deep or surface learning. Which drew the support of Coertjens et al. [6] who reported that that student who had a high level of interest, exhibited a low level of surface learning. Perceptions of interest and relevance were positively related with shift in organised studying from the first to the second semester, according to Coertjens et al. [6] however, perceptions of interest and relevance were adversely connected with the surface approach to learning. Receiving peer help was linked to a more in-depth approach to learning and more organised studying.

Undergraduate occupational therapy students' study methods tend to be influenced by their culture and educational background. Academic and practical educators must be aware of the methods used to study the children with whom they work [7]. The Approaches and Study Skills Inventory for Students was used to assess medical students' learning styles at the start of year four, and the results were matched to Clinical Success Examination scores, revealing that learning style was linked to performance on a high-stakes Clinical Performance Examination [8].

3. RESEARCH METHODOLOGY

3.1 Sample

The study adopted an *Expost facto* research design and a purposive sampling method followed in selection of Agricultural Universities covered under the National Agricultural Research and Education System (NARES) and random sampling in selection of students from different disciplines. The study included 1,514 students from 30 State Agricultural Universities (SAUs) across 18 states of India. The students belonged to different disciplines *viz.* agriculture sciences (n=662), veterinary sciences (n= 206), horticulture (n=173), community science (124), agricultural engineering (n=102), forestry (n=66), food science and technology (n=131), agri-business management (n=20), fisheries (n=11) and other allied departments (n=19). Among the total sample, 84 students (5.5%) were graduate and remaining were undergraduate students (94.5%). The duration of undergraduate degree programme is 4 years except veterinary sciences (5 years) and graduate programme is (2 years). The mean age of the respondents was 21 years (S.D =1.96). Out of 1,514 respondents, 852 were female (56.3%) and 662 were male (43.7%).

3.2 Data Collection

Students' Learning approaches (SLA) of agricultural students in this research were measured by using the Approaches and Study

Skills Inventory for Students (ASSIST) of Tait et al. [9] which was designed to demonstrate the relative strengths of the approaches of students in three main dimensions: deep, surface, and strategic approaches. The quantitative data were collected through a questionnaire and administered both in online and offline modes during 2019-2020. The involvement of students in the survey was voluntary and based on prior consent. The anonymity of respondents was maintained during all phases of the study. Pilot testing carried out among the 46 students of the graduate degree in Agri-Business Management before the final data collection. The students responded their degree of agreement with all the items on a five-point continuum Likert scale (where 1 = strongly disagree; 5 = strongly agree).

3.3 Statistical Analysis

The primary data collected through the survey were analysed using appropriate statistical methodology. A confirmatory factor analysis was performed to determine the factor structure of the study inventory [10]. Cronbach's alpha coefficient was calculated to measure the internal consistency of the student learning approaches [11]. The Pearson's correlation coefficients were calculated to check the extent of linear association between the sub-measures [12]. The chi-square test was performed to check the association between different student learning approaches with gender and type of degree [13]. The student's t-test was used to compare the mean scores [14]. The multinomial logistic regression was also carried out to predict the relationships between dependent and independent variables. All statistical analyses were carried out using R statistical programming language. Cronbach's α values measured to know the internal consistency of the instrument and confirmatory factor analysis also performed to determine the factor structure of the study inventory.

4. RESULTS

4.1 Consistency of the Study Instrument

The Cronbach alpha coefficient which measures the internal consistency of the learning approaches was found to be >0.60 for all the three approaches (Table 1). Even the sub-measures under each learning approaches reported good reliability coefficients indicating the strong interrelatedness of the test questions. Therefore, the study offers a statistically validated framework for analysing student learning approaches and developing effective teaching strategies based on them.

4.2 Confirmatory Factor Analysis

A confirmatory factor analysis was carried out to get indications of a set of sub-scales that represent the three different approaches of learning (Deep, Strategic, and Surface). Factors generated consisted of the variables that were highly correlated among them. The factor loadings are presented in Table 2. Five sub-scales were found to be loaded on the first factor (deep approach), followed by four sub-scales each loaded on the second factor (surface approach) and the third factor (strategic approach). These results are in line with the ones reported by Bonsaksen et al. [15].

Table 1. Cronbach's alpha coefficients

Variables	Coefficient
Deep Approach	0.88
Seeking Meaning (SM)	0.67
Relating Ideas (RI)	0.64
Use of Evidence (UOE)	0.73
Interest In Ideas (III)	0.70
Monitoring effectiveness	0.76
Strategic Approach	0.86
Organised Studying (OS)	0.73
Time Management (TM)	0.77
Alertness to Assessment Demand (AAD)	0.75
Achieving (AAA)	0.82
Surface Approach	0.79
Lack of Purpose (LOP)	0.70
Unrelated Memorising (UM)	0.73
Syllabus-Boundness (SB)	0.79
Fear of Failure (FOF)	0.83

Table 2. Factor loadings for different variables

Variables	Factor 1	Factor 2	Factor 3	Approach
Seeking meaning (SM)	0.77	-0.03	-0.01	Deep
Relating ideas (RI)	0.81	0.03	-0.06	Approach
Use of evidence (UOE)	0.85	0.02	-0.03	
Interest in ideas (III)	0.51	0.03	0.28	
Monitoring effectiveness (ME)	0.60	0	0.27	
Alertness to assessment demands (AAD)	0.38	0.07	0.38	Strategic
Organised studying (OS)	0.07	0.01	0.79	Approach
Time management (TM)	-0.09	0.03	0.86	
Achieving (Motivational aspect) (AAA)	0.33	-0.02	0.54	
Lack of purpose (LOP)	0.02	0.65	0.06	Surface
Unrelated memorising (UM)	0.03	0.78	0.01	Approach
Syllabus-boundness (SB)	-0.07	0.69	-0.01	
Fear of failure (FOF)	0.02	0.68	-0.06	
Proportion Variance (%)	25.07	15.40	17.97	
Cumulative Variance (%)	25.07	40.47	58.44	

Since there is a variation in the number of representative sub-scales under the deep approach (5 number) and strategic (4 number) and surface approaches (4 number), the mean values were used for classification of student learning approaches.

4.3 Linear Association

The Pearson's correlation matrix indicated that there is a positive correlation among the sub-measures within a learning approach. However, the sub-measures under deep and strategic learning approaches showed a better linear association (r >0.4) between them compared to the surface learning approach (Fig. 1).

4.4 Learning Approaches of Agricultural Students

The learning approaches of agricultural students (Table 3) indicated that most of the students adopted the strategic approach (41.1%) closely followed by deep approach (40.3%). About 15.5 per cent of the students were found to follow the surface approach. It was also found that a few students (3.2%) used combination of two approaches to learning, while none used all the three approaches simultaneously.

4.5 Variations in Student Learning Approaches

The relationship of students' learning approaches with the gender and under graduation–graduation programmes was also studied.

4.5.1 Gender-based

Higher number of female students were found to follow the strategic approach (44.8%) followed by a deep approach (39.9%), while 40.8% of male students followed the deep approach. The surface approach was found to be followed by male students in comparison to female students (Table 3). The results of chi-square test (chi-square value = 14.817, $p<0.001$) indicated a significant relationship between students learning approaches and gender at a significance level of 5%. Similar to the study of Bataineh, [16] the agricultural students also had different mean scores for learning approaches among males and females (Table 4). However, the results of the t-test (Table 4) for comparison of mean scores between male and female students established a significant difference in respect of strategic and surface approaches only.

The violin-cum-box plots (Fig. 2) gives the distribution of scores obtained by male and female students following different learning approaches. The violin plots suggest that the distribution of marks is similar for both the genders which is slightly negatively skewed with more extreme values among females. Box plots on the figure suggest that the female students following the strategic and surface approach scored more than the male students whereas male students scored more in the case of the surface approach. Both male and female students scored more under the strategic approach.

Table 3. Distribution of agricultural students based on their learning approaches

Variable	Category	Students' Learning Approach			
		Deep	Strategic	Surface	Combination
Gender	Female	340 (39.9)	382 (44.8)	110 (12.9)	20 (2.3)
	Male	270 (40.8)	240 (36.3)	124 (18.7)	28 (4.2)
Degree	Graduate	41 (48.8)	31 (36.9)	8 (9.5)	4 (4.8)
	Undergraduate	569 (39.8)	591 (41.3)	226 (15.8)	44 (3.1)
Overall Total		610 (40.3)	622 (41.1)	234 (15.5)	48 (3.2)

(Values in parenthesis indicate percentage)

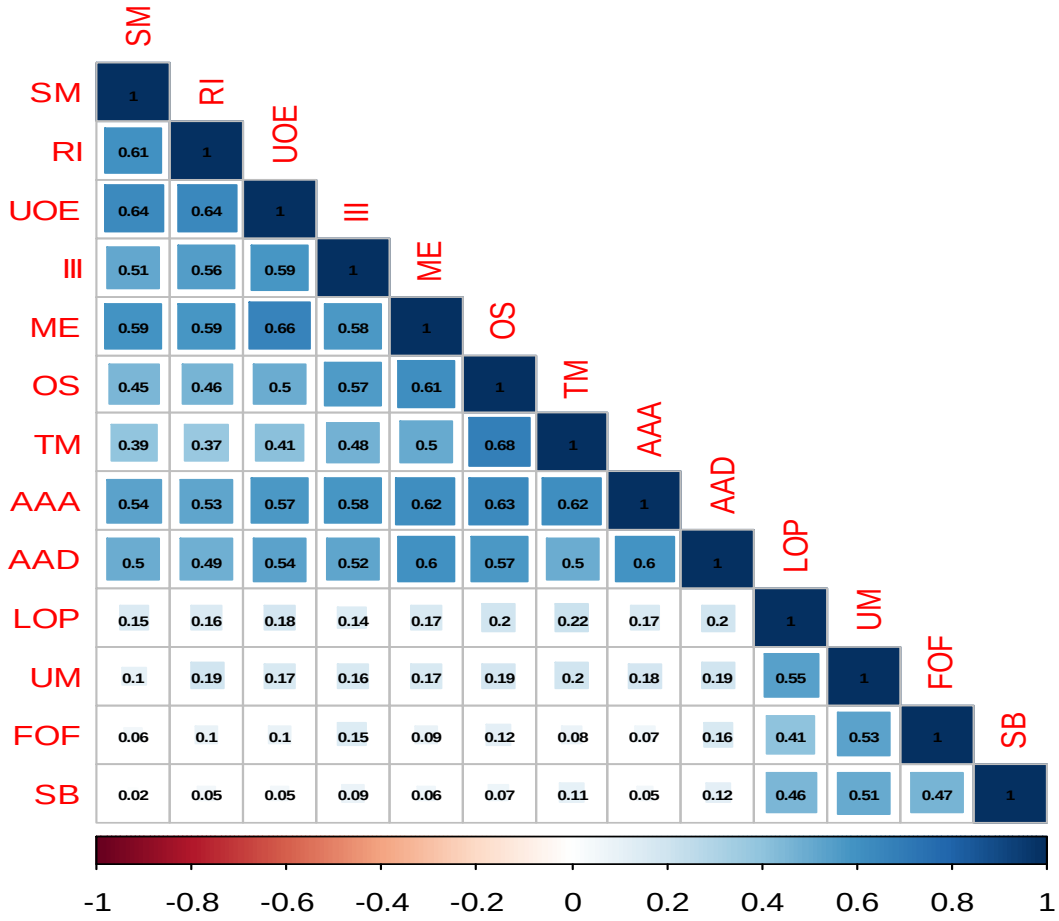

Fig. 1. Pearson's correlation coefficients showing the extent of linear association among the different measures

Table 4. Gender-based comparison of students' learning approaches

Gender	Deep	Strategic	Surface
Male	15.48	15.72	15.60
Female	15.78	16.20	14.84
t statistic	1.60	2.42	2.32
p-value	0.109	0.015	0.021

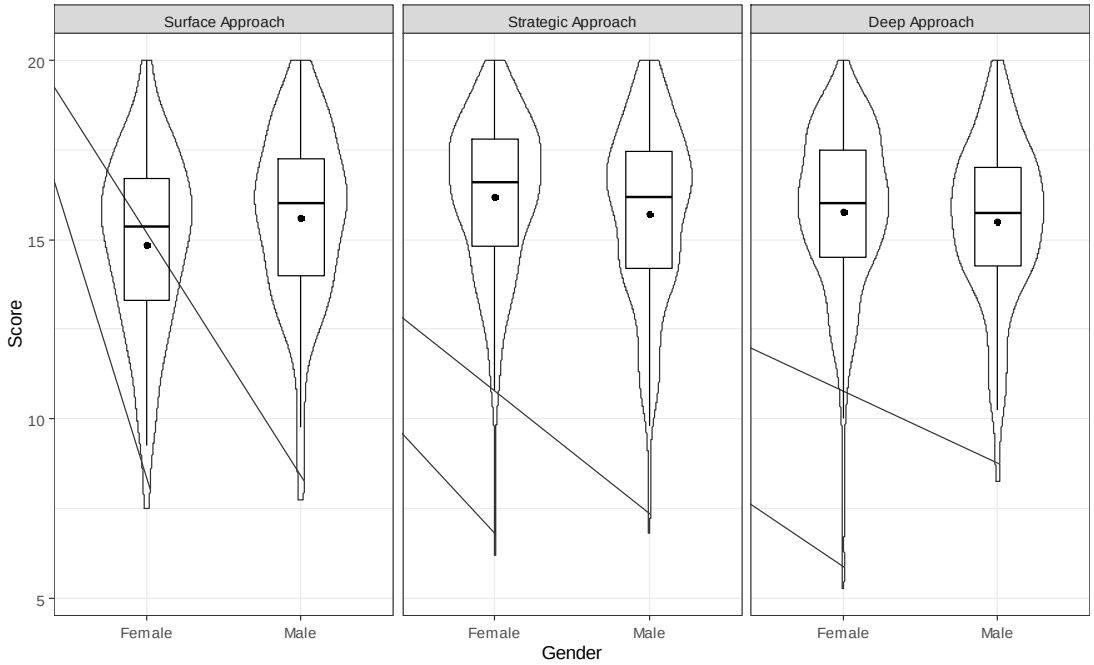

Fig. 2. Distribution of scores obtained by male and female students

From the result of multinomial logistic regression, it was found that male students are more likely to be under deep approach compared to strategic approach than female students with a significant odd ratio of 0.71 ($p<0.05$). It means a male student is approximately 0.71 times more likely to have a deep learning approach than a female counterpart.

The majority of the sample were female students and from the four-year agriculture degree programme. The finding is in contradiction with Wilson et al. [17] who reported that no gender differences were found between the responses on the deep and surface learning approaches of respondents.

The students who adopted the deep approach of learning in the present study feel curious and have a passion for the learning process. In their studies, students use a deep approach to know the significance of the materials they were studying and internally inspired, to appreciate the learning task they were given. In conclusion, agricultural students have been found to set goals, plan their time and research the learning environment in line with these goals, and accept evaluation criteria for academic success. The deep approach is visible among those students who are inclined more towards research and education as a career option. Many studies have reported that student learning approaches are related to the teaching-learning environment and student's experience, and these are context-specific.

4.5.2 Level of Graduation

The result of the chi-square test (chi-square value = 4.044, $p=0.139$) showed that there is no association between graduation and learning approaches in general. However, on comparing the mean scores of graduate and undergraduate students among different learning strategies, a significant difference ($p < 0.05$) was found only for the Deep Approach (Table 5).

However, the mean scores of learning approaches were higher among graduate students than undergraduate students in respect of deep and strategic approaches, while the mean score is higher among undergraduate in respect of surface learning approach. More number of undergraduate students used the strategic approach (41.3%) closely followed by the deep approach (39.8%). In the case of graduate students, a higher proportion followed deep approach (48.8%). Students following the surface approach were found to be more among undergraduates (15.8%) than graduates (9.5%).

Table 5. Level of graduation-based comparison of students learning approaches

Degree	Deep	Strategic	Surface
Graduate	16.25	16.60	15.21
Undergraduate	15.60	15.98	15.24
t-statistic	2.248	1.652	0.030
p-value	0.028	0.107	0.976

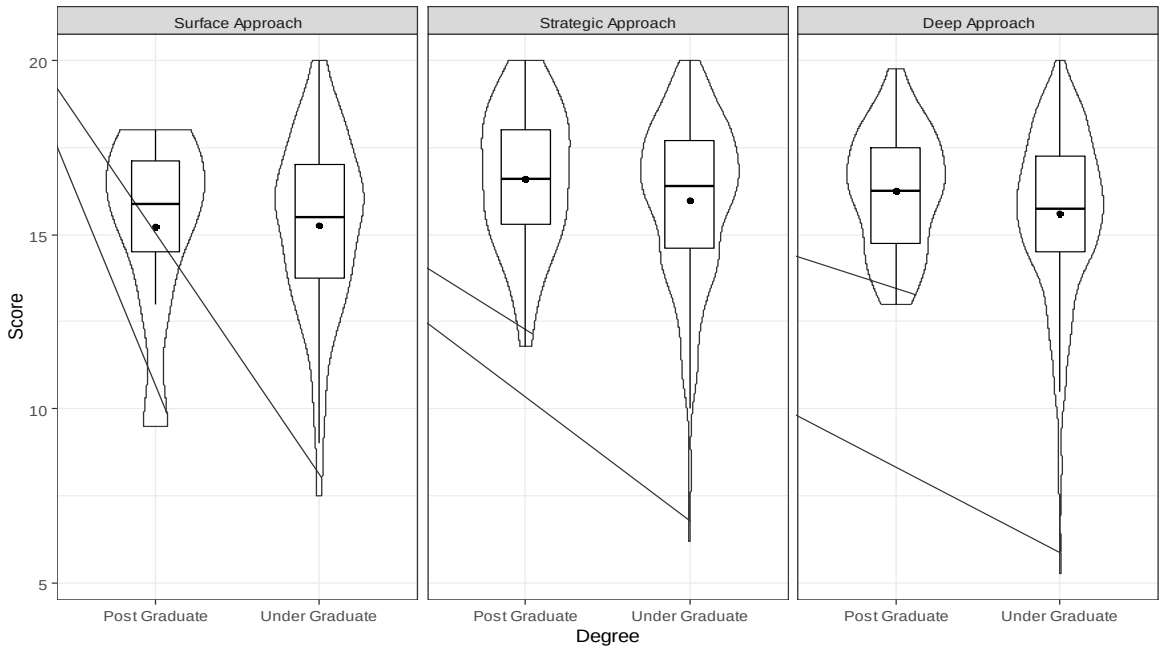

Fig. 3. Distribution of scores obtained by graduate and under-graduate students following different learning approaches

The violin-cum-box plot (Fig. 3) depicts the distribution of scores obtained by graduate and undergraduate students following different learning approaches. The violin plots indicate that the marks scored by post-graduates have narrow range compared to under-graduates. The box plots clearly indicate that the average scores obtained by post-graduate students are more than that obtained by undergraduate students for all three learning approaches.

Use of strategic approach of learning by undergraduate students implies that they effectively plan their time and workspace and choose suitable reading material and tasks that they think will help them to get good grades. Undergraduate students who adopted a strategic approach are fully aware of the evaluation requirements and criteria needed. Graduate students were using more of a deep approach as compared to other approaches. It means that graduate students concentrate more on the meaning of what they learned. Graduate students, opted for the field of study of their choice, have an intrinsic interest and enjoyment in carrying out the learning tasks, and have a genuine curiosity in the subject and connections with other subjects and with building on their current learning. It was also observed that in the graduate category, more students were using the deep approach of learning over other approaches. This may be the fact that learners can use the deep approach when more time is available and gain a deeper understanding of the subject [18].

The most common student learning approach followed by agricultural students was the strategic learning approach and less of deep and surface approaches and followed by a combination of two learning approaches in their studies. This portrays that agricultural student had the primary motive to secure higher academic grades and thus maximum academic success. The assessment methodologies for undergraduate courses in all the state agricultural universities across the country are similar and rated on a 10.0 scale of OGPA

(Overall Grade Point Average). The Indian Council of Agricultural Research (ICAR) ensures the uniform implementation of V Deans Committee Recommendations, which is the basic framework for agricultural education. The evaluation systems generally consist of external theory examination (50% weightage), Internal Theory + Practical examination (50% weightage) with fixed assessment methodology. They are well versed with evaluation criteria and the learning effort needed to accomplish the task to score maximum grades in the given time. The credit load for any student of undergraduate ranges from 170-183 during four years. So, the students are well-tuned to this type of formative and summative assessment and hence students are following the strategic approach. The academic score is of high value in employability. It also reflects the effective time management and organization of material and methods for study. Further, the tendency of securing admission for higher studies and better placements, which are heavily based on higher academic performance (grades) also likely to lead to a more strategic learning approach. It is believed that deep learning is closely associated with graduates' learning approach. This finding is in line with the one reported by Shaaria et al. [19] that the level of deep learning approach used by graduate students is high.

4.5.3 Discipline

The study could not establish significant differences among different disciplines of agricultural education (Chi-square value = 24.106, p=0.1559) (Table 6). The medical students were inclined to use Deep Approach initially and use of Deep Approach decreased while their use of Strategic Approach increased over time. Learning approaches during early study years, characterized by engagement and meaningful learning, predicted later academic performance. Deep Approach should be promoted during the early years of medical studies to foster student learning and to improve academic performance [20].

The curriculum also determines the adoption of appropriate approach among the students. However, the waning interest of agricultural students in the deep approach needs to be assessed by the curriculum developers. Thammi-Raju et al. [21] reported that the majority of the members of Broad Subject Matter Area (BSMA) Committees for curriculum development on graduation in agricultural education in India found that 'the context for change' (64.6%); 'quality and excellence' (63.6%); 'enhancement of knowledge, skills and attitudes' (63.3%), 'student-centred approach' (54.54%), 'multidisciplinary approach' (54.54%), 'value-based education' (54.54%) and 'inclusiveness in the curriculum' (54.54%) are highly relevant criteria for curriculum development. It was also found that teacher-student interaction (63.6%) and curricular materials availability/development (54.5%) *etc*. are highly relevant student's attributes in curriculum development followed by student learning approaches (81.8%); learning styles (81.8%), technology-enhanced learning in learning/teaching/assessment (63.6%); diversity of experiences (54.5%) and 'students background in the light of socio-cultural context (54.5%)' *etc*. very relevant students attributes in the curriculum development process.

Table 6. Approaches to Learning among disciplines of Agriculture

Stream	Deep	Strategic	Surface	2 approaches
ABM	2 (10.5)	17 (89.5)	0 (0)	0 (0)
Agri. Engg.	4 (3.8)	99 (95.2)	1 (1)	0 (0)
Agri & allied	49 (7.1)	602 (87.2)	30 (4.3)	9 (1.3)
Community Science	6 (4.8)	115 (92.0)	4 (3.2)	0 (0)
Diary	3 (4.7)	58 (90.6)	1 (1.6)	2 (3.1)
Food	5 (7.4)	61 (89.7)	2 (2.9)	0 (0)
Forestry	3 (4.3)	63 (90)	2 (2.9)	2 (2.9)
Horticulture	11 (6.4)	152 (88.4)	8 (4.7)	1 (0.6)
Veterinary	21 (10)	168 (80.4)	16 (7.7)	4 (1.9)
Others	3 (17.6)	14 (82.4)	0 (0)	0 (0)
Total (n)	107 (7)	1349 (87.7)	64 (4.2)	18 (1.2)

Chi-square value = 24.106, p=0.1559

5. DISCUSSION

The students' success is influenced by the learning environment and the student learning approaches. The high student-teacher ratio in Indian Agricultural Universities [22] is an important factor that contributes to the selection of appropriate teaching methodology that directly influences the learning approaches of the students. Ramesh et al. [23] indicated that the combination of academic achievement and teaching aptitude is superior for teaching achievement. The study on the training needs of faculty of State Agricultural Universities indicated that competencies related to attitudes and values need to be accorded the highest priority followed by teaching strategies and communication skills [24].

Besides, teachers should be alert of their teaching methods and the course content design, as it may influence the students' intentions to learning. Surface approach usage among agricultural students must be discouraged by teachers. The curriculum should be structured in such a way that students think critically, seek meaning, and appreciate the content of their study and can connect ideas to their experience. Hence teachers should promote the deep learning approach among the students as it is intrinsically driven and involves a personal commitment of the students to learning. A high degree of student interaction with the learning topic is the first step in a deep learning process such that students are inspired to understand. Thus, it is suggested that the use of the surface approach to learning can be minimized by promoting the use of a deep approach to students learning. So, a more student-centric approach to teaching-learning is recommended to promote a deep learning approach among students. Strategies like creating participative learning environments for the students, student profiling, personalized counselling, coaching and mentoring, reflective analysis by students, feedback management, and higher student engagement in the classroom environment are suggested.

Thammi-Raju et al. [25] suggested that there is a need for a paradigm shift in agricultural education from traditional technology to a modern blended approach with technology. Access to digital education to students can enhance their interest and achievement. It provides flexibility, efficiency, and accessibility of time and place to students. It can suit any learning style of students and help to increase the deep learning approach among the students.

6. CONCLUSION

The present study reported student learning approaches used in various streams in agricultural universities and their association with different demographic variables of students such as gender and degree. The findings of the study offer important practical implications for agricultural university faculties in designing, planning, and implementing appropriate teaching strategies for the effective learning and assessment methodologies. Despite of all the efforts on the methodological rigour, the study has some limitations such as the self-rating method of measurement of student learning approaches rather than evaluating their actual actions. The research was carried out in a particular country with a unique socio-cultural context. Hence, the generalization of results is restricted to countries with similar socio-cultural context.

CONSENT

The involvement of students in the survey was voluntary and based on prior consent.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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