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Influence of Metacognition on Academic Achievement and Learning Style of Undergraduate Students in Tezpur University

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Abstract: A Descriptive-correlational study was sought to investigate the influence of metacognition on the academic achievement and learning style of undergraduate students. Using the survey method, data was collected from a sample of 150 undergraduate students selected through a stratified random sampling technique which includes 50 students each from the three schools namely School of Humanities and Social sciences (HSS), School of Engineering (SOE), and School of Sciences (SOS) of Tezpur University. The tools used are five-point Likert-type Metacognitive skills scale and five-point Likert-type Learning Style Inventory. Academic Achievement of the students was measured based on the semester grade point average SGPA obtained in the semester examination. The data were analyzed using percentage, simple regression, multiple regression and one-way ANOVA. The result showed that only 34-36% of the undergraduate students have above-average metacognitive skills. The undergraduate students have equal preferences in all the five learning styles rather than focusing on one learning style. There is a significant difference between metacognition levels and academic achievement of the undergraduate students of SOS, HSS and SOE. The metacognitive skill explicates only 43% variability of academic achievement of the undergraduate students which implies that the undergraduate student's metacognitive skills influence and determines their academic achievement to some extent. However, the undergraduate student's learning style doesn't account for variation in metacognitive skills. Thus, it is suggested that metacognitive skills should be integrated into curricular components and learning strategy which will help the students to monitor and regulate their own learning to meet the challenges of academic society.

Keywords: *Metacognition, learning style, academic achievement and undergraduate students.*

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Introduction

The frontiers of higher education institution HEI's of any nation aims at expanding academic learning with the optimal utilization of cognitive abilities of the students to monitor and regulate their own learning to meet the challenges of academic society. Students are expected to be competent and efficient enough to think effectively and take responsibility for their own learning progress. The major aim of higher education level is to achieve the learning goals and outcomes through the transfer of the learned skills in a varied task, situation and context. The students must be self-reliant in taking proper decisions of identifying, selecting and applying the appropriate learning strategies. The learning includes many aspects of the cognitive process including planning, understanding, analysis, application and evaluating. The knowledge of being aware of one's own learning process and the ability to understand, control, manipulate and regulate these cognitive processes is known as metacognition. The term "metacognition" which was first introduced to the field of educational and cognitive psychology by Sir John Flavell (1976) refers to an individual's awareness of thinking and learning. According to Flavell, "Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in service of some concrete goal or objective"†. Research indicates that metacognition is a powerful predictor of learning achievement and academic success (Dunning et al., 2003). Metacognitive skills influence one's intellectual ability to support self-regulated learning. Metacognitive strategies enhance academic performance

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† *Metacognition: Fundaments, Applications, and Trends: A Profile of the Current State-Of-The-Art*, by APeña-Ayala,2014, Springer, p.42

across the range of ages, cognitive abilities, and learning domains including reading and text comprehension, writing, mathematics, reasoning and problem solving, and memory (Dignath et al., 2008). The students having metacognitive skills are aware of their learning process and can adopt required learning styles to these processes accordingly. As each student has a distinct and unique learning style, it results in differences in learners' metacognitive skills and abilities. Oxford (1990) provided a detailed, systematic and comprehensive taxonomy of learning strategies suggesting meta-cognition strategies as learner's method to coordinate their own learning process‡. The metacognitive competencies enhance the learning process and the learning styles according to obtained metacognitive knowledge (Ulieru et al., 2008). Metacognition helps students to discover their own individual learning preferences and abilities which are adjusted depending on the nature of the task, situation and context. Thus, the study aims to explore how metacognition influences the academic achievement and learning style of undergraduate students**.**

Literature Review

Academic learning and academic achievement are the core variables of research studies at the higher education level. The relationship between metacognitive strategies and achievement is as significant as the relations between socioeconomic status and achievement (Callan, 2016). In the past few years, studies show a significant growth of interest in metacognition studies in relation to academic achievement and other psychological traits across the different higher education academic areas. Students having mastery goals are found to have good metacognition also and are considered better learners than students with performance goals (Coutinho, 2007). There is a positive relationship between metacognitive awareness and academic achievement (Abdellah, 2015; Al-oqleh et al., 2019; Akpur, 2017; Amzil et al., 2013; Gaylo & Dales, 2017; Mohammadi et al., 2015; Pudiquet, 2019; Rum et al., 2016; Sawhney et al., 2015; Zulkiply, 2009) and metacognition with teaching performance of college professor which recommends adoption of teaching technique and strategies to encourage the use of metacognitive skills. The medical students have higher levels of metacognitive abilities and usually have high skills of metacognition and academic achievement than nonmedical or other professional students (Iqbal et al., 2019). The studies in the field of medical sciences revealed that metacognitive awareness has a crucial role in the academic outcome of medical students (Panchu et al., 2017) as medical students use more metacognitive and self-regulation strategies that are helpful in the meaningful organisation of information, creating a logical relationship with the previous information and create an appropriate learning environment that increases their academic performance (Saeedzadeh et al., 2018). The studies also show that the relation between metacognition and academic achievement is affected by locale and academic field of study (Nongtodu et al., 2017). Research studies also indicate that training in metacognition or teaching metacognitive strategies has positive effects on academic achievement (Naseri et al., 2017; Rezvan et al., 2006). The students tend to achieve a higher level of metacognition who have a strong belief that their academic success (mastering specific skills in a specific context) depends on them (Hrbáþkováa et al., 2012). The use of metacognitive strategies and metacognitive-based contextual learning has a positive effect on students' academic learning (Ahdhianto et al., 2020; Vrugt et al., 2008). The performance of students who adopt a metacognitive learning strategy is better than the students who use conventional strategy (Buba et al., 2016). Implementation of metacognitive strategies will significantly contribute to enhanced learning across the courses and curricula (Zhao et al., 2014). However, some studies show that the relationship between metacognition and academic achievement is very weak (Eriyani, 2020; Gul & Shehzad, 2012), sometimes negative (Justice and Dornan, 2001), and even not significant (Cubukcu, 2009; Sarwar et al., 2009).

Several studies also explored the relationship between metacognition ability and learning styles. The expectations and quality of the higher education learning process can be monitored by creating and practicing the meta-cognitive competencies of the students through optimization of the different characteristics of learning styles (Ulieru et al., 2008). In a pilot study conducted by Corbitt (2017) found that learning style of student's (in foreign language programme) preferably the visual learning style significantly affect the planning and evaluation components of metacognition. Rahimia and Katal (2012) suggested that those learners who use metacognitive strategies are aware of what they are doing and adopt different strategies for successful language learning. The findings of several such studies on EFL learners support that there is a strong and positive correlation between learning style with metacognitive reading strategy (Jafarpanah et al., 2016) and metacognitive listening awareness (Zarrabi, 2020). Shetty (2014) found that "student teachers with the learning styles introversion and thinking were found to be significantly higher in metacognition as compared to student teachers with the learning styles extraversion and feeling". It's not only the learning styles that have an impact on cognitive strategies rather knowledge of cognition is also related to learning style. According to Abu-Ameerh (2014) "The knowledge of cognition is positively related to the concreteness, reflective, abstractness and experimentation learning styles. And the cognition processing is positively related to the concreteness, reflective, abstractness and experimentation learning styles". This supports that metacognitive strategy has a positive correlation with learners learning styles preferences (Martínez-Bernal et al., 2016) which suggests teaching metacognitive strategies could be an effective skill to help students to think about "how they learn" and "what type of learning style" they have to adopt to become more self-directed learners (Shannon, 2008). The metacognitive

‡ *Practice and Theory for Materials Development in L2 Learning* by H. Masuhara, F. Mishan, B. Tomlinson, 2017, Cambridge Scholars Publishing, p. 133

skills of students need to be developed through the learning process (Palennari et al., 2018) which suggests the teachers assess the variations on the preferences of learning styles to create self-directed learners.

After an extensive study of review, it was found that many research studies have been conducted on metacognition in relation to academic achievement and learning style at higher education level and very few studies reflect on the variation of metacognition across different academic disciplines. Thus, this study sought to explore the influence of student's metacognition on academic achievement and learning style across different academic disciplines in Tezpur University. The findings of this study would be of immense benefit to the teachers, students and educational researchers to rethink assessment, planning the instruction, and conducting classroom research in the education sector**.**

Research Objectives

1. To describe undergraduate students' metacognition level, learning style and academic achievement.
2. To determine the relationship between undergraduate students' metacognition and academic achievement.
3. To determine the relationship between undergraduate students' metacognition and learning styles.

Research Hypothesis

$H0_1$: There is no significant difference between the metacognition levels of SOS, HSS and SOE undergraduate students.

$H0_2$: There is no significant difference between the academic achievement of SOS, HSS and SOE undergraduate students.

HA_1: There is a significant relationship between metacognition and the academic achievement of undergraduate students.

HA_2: There is a significant relationship between metacognition and the learning style of undergraduate students.

Methodology

The study employed the Descriptive-correlational research design using the survey as a data collection method. The selected method was suitable as it gives an opportunity to describe, analyze and interpret the data and conditions existing in the target group. Using this method, descriptive information is obtained from the target population, namely a group of undergraduate students. The main and independent variable for the study is "metacognition "and dependent variables are "academic achievement "and "learning style". The target population of the study comprises of the students pursuing undergraduate courses enrolled in three schools of Tezpur University located in Sonitpur District. The samples were drawn from the students studying in the undergraduate course under the School of Humanities and Social sciences (HSS), School of Engineering (SOE) and School of Sciences (SOS). This includes both male and female students. In this study, the stratified random sampling technique was used to select a sample of 150 undergraduate students consisting of 50 students each from HSS, SOE and SOS. The age of the students ranges from19-22 years.

Data Collection Tools

In the study two tools namely Meta-Cognitive Skills Scale (MCSS-GMS) developed by Gupta and Suman (2017) and Learning Style Inventory developed by Mishra (2012) were used. The semester grade point average SGPA obtained in the semester examination was considered as the academic achievement of undergraduate students.

Meta-Cognitive Skills Scale (MCSS-GMS) developed by Gupta and Suman (2017) was used to assess the level of metacognitive skills of undergraduate students. It is a Likert type five-point scale with 42 items under four dimensions: Planning Skill (12), Implementation Skill (9), Monitoring Skill (9), and Evaluation Skill (10). Each item is a statement that is followed by a five-point scale - Strongly agree, Agree, Undecided, Disagree, and Strongly disagree. The dimension-wise reliability coefficient was calculated using the test-retest method and was found to be 0.859, 0.795, 0.902, and 0.885 for Planning Skill, Implementation Skill, Monitoring Skill, and Evaluation Skill respectively.

The Learning Style Inventory developed by Mishra (2012) was used to measure six learning styles. It has 42 items on a five-point Likert scale under 6 dimensions: Enactive Reproducing - ER (7), Enactive Constructive - EC (7), Figural Reproducing - FR (7), Figural Constructive-FC (7), Verbal Reproducing-VR (7), and Verbal Constructive - VC (7). There are five response alternatives for each learning behaviour - Very much, Much, Normal, Less and very Less. These responses are scored by awarding score of 5, 4, 3, 2 and 1 respectively. Scores on the seven items belonging to each learning style are added together to find scores for each of the six learning styles i.e. ER, EC, FR, FC, VR and VC. Scores on ER and EC are added to get the score for 'Enactive Learning Style' (ELS). Scores on FR and FC are added to get the score for 'Figural Learning Style' (FLS). Scores on VR and VC are added to get the score for "Verbal Learning Style' (VLS). Scores on ER, FR and VR are added to get the score for 'Reproducing Learning Style' (RLS). Scores on EC, FC and VC are added to get the score for 'Constructive Learning Style' (CLS). Alpha reliability of the Learning style inventory

was calculated and the values for the three learning styles namely Enactive, Figural and Verbal are 0.682, 0.742 and 0.903 respectively.

Statistical Techniques

Before employing the statistical techniques, the missing values, the outliers and the normality of the distribution were examined using skewness and kurtosis values. For medium-sized samples ($50 < n < 300$) to be considered as normally distributed, the z values for skewness and kurtosis should be less than 3.29 (Kim, 2013). The computed z scores ($Z_{skewness}$) for metacognition, learning styles and academic achievement range from (-2.58 to 0.65), (-1.52 to 0.72) and (-0.55 to 1.70) respectively. The computed z scores ($Z_{kurtosis}$) for metacognition, learning styles and academic achievement range from (-1.86 to 0.46), (-2.28 to -0.57) and (-1.40 to -0.21) respectively. The z values for skewness and kurtosis for each variable are found to be less than 3.29 which suggests each variable is normally distributed. From the boxplot, it is observed that there are no potential outliers in the observed values for each variable. As the assumption of normality of data is fulfilled, descriptive statistics like z scores, mean, standard deviation and percentile rank were used to study the metacognition levels, learning styles and academic achievement levels of undergraduate students. One-way ANOVA was used to test the significant differences in the mean scores of metacognition and academic achievement. Simple regression and multiple regression analysis are used to determine the relationship of metacognition with academic achievement and learning style.

Ethical Considerations

The investigator obtained permission from the department to collect the information from the respondents. All respondents are assured of the confidentiality and anonymity of their information by providing a formal consent letter. All sources of information in the study including research works and citation are duly acknowledged through proper referencing.

Results

Metacognition level, Learning Style and Academic achievement of undergraduate students.

The first objective was studied by calculating the percentage of students falling under each level (representing a particular range of z score) of each dimension of the metacognition and learning style.

Table 1: Metacognition level of SOS Undergraduate Students (dimension wise)

Schools	Metacognition Dimensions	Levels							Mean	SD	PR
		VH	H	AA	A	BA	L	VL			
SOS	P	4	6	18	44	16	12	0	48.28	4.60	59.4
	I	0	8	26	38	16	10	2	39.94	2.75	44.7
	M	0	16	16	30	30	8	0	44.22	5.04	57.5
	E	0	14	24	28	18	16	0	40.44	4.79	51.9
	T	2	10	22	26	36	4	0	172.9	10.74	52.8
HSS	P	4	10	10	42	34	0	0	45.06	4.32	59.3
	I	0	4	36	30	16	12	2	37.54	2.79	43.9
	M	2	12	18	36	28	0	4	41.08	5.01	55.2
	E	0	4	28	42	18	4	4	40.28	4.62	49.5
	T	0	8	28	28	24	10	2	163.96	11.42	44.8
SOE	P	0	12	24	28	30	4	2	49.48	3.86	45.8
	I	0	14	16	40	14	12	4	40.12	2.14	59.4
	M	0	8	20	38	24	10	0	43.02	4.06	46.9
	E	0	10	20	42	18	8	2	41.42	3.95	46.3
	T	0	12	24	26	24	12	2	173.76	9.68	44.4

P=Planning, I= Implementation, M= Monitoring, E=Evaluation, T=Total score
VH=Very high, H=High, AA=Above average, A=Average, BA=Below average, L=Low, VL=Very low

The result from table 1 shows that the mean scores range between 37.54 to 49.48 which indicates an average metacognition level of undergraduate students across all dimensions. Percentile-rank of mean score figures shows that 44 to 59.5% of students lie below the mean value. 28-44% students Planning skills, 30-40% students Implementation skill, 30-38% students Monitoring skills and 28-42% students Evaluation skills are of average level. This suggests that maximum undergraduate students (more than 40%) are not equally competent in all four dimensions of metacognitive skills. Comparing the total metacognition score shows that only 34% of SOS students, 36% of HSS students, 36% of SOE students possess above-average metacognition level. From this, it is inferred that 34-36% of undergraduate students of

Tezpur University have above-average metacognitive skills. More than 64% of undergraduate students of Tezpur University are not equally competent in all four dimensions of metacognitive skills.

Table 2: Learning Style of Undergraduate Students (type-wise)

Schools	Learning Styles	Levels									Mean	SD
		EH	H	AA	SAA	A	SBA	BA	L	EL		
SOS	ELS	0	16	8	20	12	12	28	2	2	53.42	5.24
	FLS	0	10	12	28	14	10	14	4	8	56.40	5.12
	VLS	0	14	14	10	24	20	6	4	8	57.76	5.37
	RLS	4	4	22	16	14	14	14	10	2	83.42	5.36
	CLS	4	6	12	24	20	4	22	6	2	83.86	4.73
	T	2	4	22	22	12	4	20	12	2	167.02	8.44
HSS	ELS	8	6	12	12	20	20	14	8	0	52.38	6.01
	FLS	0	10	14	16	20	18	14	4	4	54.46	6.09
	VLS	4	8	16	12	14	26	12	6	2	53.10	5.69
	RLS	2	8	20	14	10	20	16	8	2	79.20	5.76
	CLS	2	4	16	26	16	10	8	16	2	80.40	5.66
	T	0	10	22	12	10	12	20	14	0	159.52	9.74
SOE	ELS	2	12	10	12	26	18	8	8	4	52.86	4.52
	FLS	4	8	14	14	24	12	8	10	6	55.02	5.26
	VLS	2	6	10	24	14	20	16	6	2	54.40	5.31
	RLS	2	8	16	16	16	14	18	8	2	81.68	5.37
	CLS	2	6	16	20	14	16	10	16	0	81.06	5.23
	T	0	10	18	18	14	12	12	16	0	163.00	9.96

ELS=Enactive Learning Style, FLS=Figural Learning Style, VLS=Verbal Learning Style, RLS=Reproducing Learning Style, CLS=Constructive Learning Style, T=Total score
EH=Extremely high, H=High, AA=Above average, SAA=Slightly above average, A=Average, SBA=Slightly below average, BA=Below average, L=Low, EL= Extremely low

The results from table 2 show that the mean scores range between 52.38 to 83.86 indicates broad variation in learning style preferences among undergraduate students. In the School of Sciences, 44% students prefer Enactive Learning Style, 50% students prefer Figural Learning Style, 38% students prefer Verbal Learning Style, and 46% students prefer both Reproducing Learning Style and Constructive Learning Style. In the School of Humanities and Social Sciences 38% students prefer Enactive Learning Style, 40% students prefer both Figural Learning Style and Verbal Learning Style, 44% of students prefer Reproducing Learning Style, and 48% of students prefer Constructive Learning Style. In the School of Engineering 36% students prefer Enactive Learning Style, 40% students prefer Figural Learning Style, 42% students prefer both Verbal Learning Style and Reproducing Learning Style, and 44% of students prefer Constructive Learning Style. From this, it is inferred that Tezpur University undergraduate students are having equal preferences in all the five learning styles with an equal number of representations rather than focusing on a single learning style.

Academic achievement is analyzed by comparing the percentage of students falling under each level (representing a particular level of academic performance).

Table 3: Levels of Academic Achievement (school-wise)

	Academic Achievement levels					Mean	SD
	9 (Excellent)	8 (Very Good)	7 (Good)	6 (Above Average)	5 (Average)		
SOS	10	14	42	28	6	7.42	0.97
HSS	0	8	38	36	18	6.74	0.76
SOE	2	16	36	30	16	7.01	1.02

Table 3 results show that SOS undergraduate students have better academic achievement than HSS and SOE undergraduate students.

$H0_1$: There is no significant difference between the metacognition levels of SOS, HSS and SOE undergraduate students.

Table 4: Mean and Variance among SOS, HSS and SOE Metacognition Scores

Groups	N	Sum	Average	Variance
SOS	50	8645	172.9	115.3571
HSS	50	8198	163.96	130.3249
SOE	50	8688	173.76	93.61469

Table 5: Comparison of SOS, HSS and SOE Metacognition Mean Scores - One Way ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	2945.053	2	1472.527	13.01981	0.00000622
Within Groups	16625.54	147	113.0989		
Total	19570.59	149			

From table 4, it is evident that there is a variance among metacognition scores of SOS, HSS, SOE Groups. From table 5, it is observed that computed F =13.02 is greater than F critical=3.06 at p=0.00<0.05 level. Hence the null hypothesis $H0_1$ is rejected at 0.05 level. This implies that there is a significant difference between metacognition levels of SOS, HSS and SOE undergraduate students.

$H0_2$: There is no significant difference between the academic achievement of SOS, HSS and SOE undergraduate students.

Table 6: Mean and Variance among SOS, HSS and SOE Academic Achievement Scores

Groups	Count	Sum	Average	Variance
SOS	50	370.9	7.418	0.95613
HSS	50	337.12	6.7424	0.59139
SOE	50	350.42	7.0084	1.0542

Table 7: Comparison of SOS, HSS and SOE Academic Achievement Mean Scores - One Way ANOVA

Source of Variation	SS	df	MS	F	p-value
Between Groups	11.5827	2	5.79136	6.67792	0.00168
Within Groups	127.484	147	0.86724		
Total	139.067	149			

From table 6, it is evident that there is a variance in academic achievement scores of SOS, HSS, SOE Groups. From table 7, it is observed that computed F =6.68 is greater than F critical=3.06 at p=0.001<0.05 level. Hence the null hypothesis $H0_2$ is rejected at 0.05 level. This implies that there is a significant difference between academic achievement levels of SOS, HSS and SOE undergraduate students.

HA_1: There is a significant relationship between metacognition and the academic achievement of undergraduate students.

Tables 8: Simple Regression analysis of Metacognition and Academic Achievement of SOS, HSS and SOE undergraduate students

External Variable	Model	Sum of Squares	df	Multiple R	R^2	Mean Square	F	Sig (0.05)
Academic achievement of SOS	Regression Residual Total	23.445 23.405 46.851	1 48 49	.707[a]	.500	23.445 .488	48.082	.000[b]
Academic achievement of HSS	Regression Residual Total	7.474 21.503 28.978	1 48 49	.508[a]	.258	7.474 .448	16.684	000[b]
Academic achievement of SOE	Regression Residual Total	28.902 22.754 51.656	1 48 49	.748[a]	.560	28.902 .474	60.969	000[b]
Academic achievement Total	Regression Residual Total	60.138 78.929 139.067	1 148 149	.658[a]	.432	60.138 .533	112.764	000[b]

From table 8, it is observed that there exists a positive and significant effect of metacognitive skills on the academic achievement of students at 0.05 level. Hence, the alternative hypothesis HA_1 is accepted at 0.05 level. This implies that there is a significant relationship between metacognitive skills and academic achievement of undergraduate students.

- The correlation between metacognition and academic achievement of SOS students is high and positive. The metacognitive skills explicate 50% variability of the academic achievement of SOS students.
- The correlation between metacognition and academic achievement of HSS students is of moderate level. The metacognitive skills explicate only 25% variability of the academic achievement of HSS students.

- The correlation between metacognition and academic achievement of SOE students is high and positive. The metacognitive skills explicate 56% variability of the academic achievement of SOE students.

As a whole, the correlation between metacognition and academic achievement is above average and positive. The metacognitive skill explicates only 43% variability of academic achievement of undergraduate students. This implies that undergraduate students' metacognitive skills influence and determines their academic achievement to some extent.

HA_2: There is a significant relationship between metacognition and the learning style of undergraduate students.

Table 9: Correlation between Metacognition and Learning Styles (N=150)

Metacognition	Learning Styles				
	ELS	FLS	VLS	RLS	CLS
Planning	.007	.175*	.159	.178*	.169*
Implementation	.206*	.135	.146	.291**	.141
Monitoring	.336**	.350**	.234**	.516**	.459**
Evaluation	.261**	.292**	.085	.371**	.295**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

It is evident from table 9, that there exists a weak and positive correlation between some metacognition dimensions with learning styles. The planning dimension is not significantly related to Enactive Learning Style and Verbal Learning Style ($p>0.05$). The Implementation dimension of metacognition is not significantly related to the Figural Learning Style, Verbal Learning Style and Constructive Learning Style($p>0.05$). The Monitoring dimension of metacognition has a moderate correlation with Enactive Learning Style, Figural Learning Style, Verbal Learning Style, Reproducing Learning Style, and Constructive Learning Style ($p<0.01$). The Evaluation dimension of metacognition is not significantly related to Verbal Learning Style ($p>0.05$).

Table 10: Multiple Regression Analysis on Learning Styles as Predictor of Metacognition.

Metacognition	Learning Styles	R	R^2	F	B	T
Planning	ELS	.251	.063	1.935	.124	1.018
	FLS				.074	.653
	VLS				.048	.444
	RLS				.111	.880
	CLS				.064	.514
Implementation	ELS	.325	.106	3.412	.109	1.506
	FLS				.047	.697
	VLS				.096	1.509
	RLS				.090	1.196
	CLS				.112	1.516
Monitoring	ELS	.543	.295	12.045	.027	.246
	FLS				.018	.176
	VLS				.016	.162
	RLS				.299	2.588
	CLS				.181	1.587
Evaluation	ELS	.389	.152	5.147	.034	.303
	FLS				.061	.588
	VLS				.035	.354
	RLS				.207	1.782
	CLS				.069	.602

Results from Table 10 shows that Enactive Learning Style, Figural Learning Style, Verbal Learning Style, Reproducing Learning Style and Constructive Learning Style are not predictors of the Planning dimension of metacognition. ($F=1.935$, $p>0.05$). Enactive Learning Style, Figural Learning Style, Verbal Learning Style, Reproducing Learning Style and Constructive Learning Style are predictors of Implementation, Monitoring and Evaluation dimension of metacognition ($p<0.05$). But only 10.6 % of variance of the Implementation dimension, 29.5 % of variance of the Monitoring dimension, and 15.2 % of variance of the Evaluation dimension were predicted by the learning styles. Hence the alternative hypothesis HA_2: There is a significant relationship between metacognition and learning style of undergraduate students, is rejected at 0.05 level.

Discussion

The following discussions are made on the findings related to each objective: From the findings of objective 1, it is revealed that undergraduate students lack competency in planning, implementation, monitoring and evaluation skills of metacognition. At the undergraduate level, students join different courses keeping its career prospects in mind. They are at the initial or preliminary stage of making decisions for the selection of career objectives, the learning content, strategy and techniques to achieve those objectives. The students need to be self-regulated to monitor, assess and modify their own learning through the process of metacognition (Mendez Hinojosa et al., 2020). The effective implementation of planning skills needs rigorous exercise and thoughtful insights. The monitoring and evaluating skills require the periodic assessment of the achievement of set goals and objectives to make decisions based on careful judgments on one's own plans. In this case, undergraduate students may be unaware, least aware, or completely lack one or combination of metacognitive skills. Since the undergraduate students under study belong to three different schools which differ in discipline-specific knowledge and skills resulting in a significant difference in the metacognition levels.

In all three different schools (SOS, HSS and SOE), it is found that there are equal preferences in all the five learning styles with an equal number of distribution of students in different learning styles. This correlates with the fact that there is a normal distribution of learning styles in undergraduate students of all three schools. This also confirms equal representation of undergraduate students in all the five learning styles rather than narrowing or constricting to a particular learning style.

Comparing the academic achievement of all three different schools, of Sciences, Humanities and Social Sciences and Engineering undergraduate students, it is found that School of Sciences (SOS) undergraduate students have better academic achievement than School of Humanities and Social Sciences (HSS) and School of Engineering (SOE) undergraduate students. Since students are from three different schools which differ in the nature of curricular and co-curricular means of engagement and involvement based on discipline-specific knowledge and skills, a significant difference in academic achievement is observed.

From the findings of objective 2 it is revealed that there is a positive correlation between metacognition and academic achievement that correlates with the theoretical facts and previous research studies (Abdellah, 2015; Al-oqleh et al., 2019; Akpur, 2017; Amzil et al., 2013; Mohammadi et al., 2015; Pudiquet, 2019; Rum et al., 2016; Sawhney et al., 2015; Zulkiply, 2009). But the metacognitive skill of students explicates only 43% variability of academic achievement of undergraduate students which is the outcome of 34 to 36 % of students possess above-average metacognitive skills and 64% students possess below-average metacognitive skills. Thus, undergraduate students' metacognitive skills influence and determine their academic achievement to some extent. This finding support that of Nongtodu and Bhutia, (2017) who found that the relation between metacognition and academic achievement is affected by locale and academic field of study.

From the findings of objective 3, it is revealed that there is a weak and positive correlation between metacognition and learning style. This finding contradicts previous studies (Abu-Ameerh, 2014; Jafarpanah et al., 2016; Martínez-Bernal et al., 2016; Zarrabi, 2020) which found that metacognitive strategy has a positive correlation with learners learning style preferences. The undergraduate student's metacognitive skills are not predicted by their learning style. This suggests students' metacognitive strategies may not be guided by "how they learn" and "what type of learning style". This finding signifies with Oxford (1990), that the learner preferably selects those strategies which reflect their learning styles. So instead of focusing on learning styles, research on metacognition can provide significant solutions on learning strategies that can be adopted and applied based on the learning environment and task.

Conclusion

The study provides evidence that undergraduate students of Tezpur University are not equally competent in all four dimensions of metacognitive skills namely planning, implementation, monitoring, and evaluation skills. The difference in the nature of the discipline-specific knowledge and skills and student engagement resulted in a significant difference in academic achievement levels of undergraduate students from the three different schools. Since the study findings show a positive correlation between metacognition and academic achievement which seeks the integration of metacognitive skills into curricular components and learning strategy. This will help the students to monitor, regulate, reflect, evaluate, justify, and make decisions based on careful judgment. The undergraduate students have equal preferences in all the five learning styles rather than focusing on one learning style. But the undergraduate student's learning style doesn't account for variation in metacognitive skills. However, conscious metacognitive skills and awareness of one's metacognitive knowledge are more favourable in the context of learning style.

Recommendations

Based on the findings the study recommends that,

1. Meta-cognitive skills are the strongest predictor of academic achievement. Thus, more emphasis should be given to the integration of metacognitive skills in curriculum transactions for better improvement of students' academic performance.

2. The use of Metacognitive skills enables the students to understand and transfer their learning in different tasks, situations and contexts effectively. For attaining learning goals, students should be motivated to use metacognitive skills for better information management, planning and monitoring activities.

3. Students with high meta-cognitive skills show better academic performance than students with low meta-cognitive skills. Performance-based, problem solving, fieldwork, and research activities should be integrated into all core subject areas for developing metacognitive skills. The major focus should be on how tasks are accomplished rather than on the task outcome.

Suggestions for Further Research

4. The present study was undertaken on undergraduate students. A similar investigation may be carried out on post-graduate and other higher-level courses.

5. The present study was conducted on a sample of only 150 undergraduate students from three different schools. It is suggested that a comparative study with a large sample can be conducted in respect of gender, locality, and different socioeconomic status.

6. Metacognitive skills of undergraduate students may be compared with the secondary level and postgraduate level students.

7. The present piece of research is confined only to study the influence of metacognition on academic achievement and learning style. The same study can also be conducted by taking the variables like intelligence, creativity and study habits.

Limitations

Since the research is conducted in the selected area of the topic yet the study has some limitations which are ought to be the focused area for further research.

- The first limitation is the study has been confined to the Tezpur University which state that undergraduate students of other degree colleges and university could be variables for comparisons as curriculum, syllabus, teaching methods, instructions and assessment varies from university to university and university to degree colleges.
- The second limitation is about theoretical sampling. The undergraduate students are selected from those departments only that are offering undergraduate courses. For example, in the School of Humanities and Social Sciences undergraduate students are selected from English and Foreign languages and Commerce departments only. Thus, undergraduate students from each department from each school could act as a variable for comparative analysis of the relationship of metacognition with academic achievement and learning style of students.
- The third limitation is regarding data collecting methods. As compared to other studies researcher has used one tool for collecting data for each variable. So, in subsequent researches, more methods like participant observation and interview can be used to collect data to support previous study findings.
- The fourth limitation is the tools used for studying metacognitive skills and the learning style of undergraduate students. Some more projective techniques and psychological tests based on metacognition and learning style can be used to assess metacognitive knowledge and metacognitive awareness in further studies to validate previously collected data.

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