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The Impact of Blended Learning in Mathematics teaching at Rural Higher Educational Institutions

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ABSTRACT
Blended learning is a new strategy for meeting the current needs of the teaching and learning process. Blended learning meets the need for online learning in cyberspace, particularly during the period of disruption caused by COVID-19 last year. Because blended learning incorporates various learning strategies, learners have a better learning experience and make academic progress. Students can advance at their own pace. This strategy's learning outcomes are assessed using standard assessment tools. Swayam Portal assists the learning community in gaining knowledge in a variety of disciplines. This portal incorporates subjects from all fields, such as Science, Social Science, Engineering, and so on. This study focuses on the impact of various pedagogies that rely on technology and how we use them effectively in mathematics teaching.
Keywords: blended learning, assessment tools, strategies

1.INTRODUCTION

Blended Learning is an emerging strategy in the contemporary needs of the teaching learning process today. Blended learning fulfills the scarce of online learning in cyberspace, especially, during the period of breakdown due to Covid-19. Since blended learning incorporates various strategies of learning, learners have a better learning experience and get progress in academic achievement. Learners may learn the content at their own pace. The learning outcome of this strategy is evaluated by normal assessment tools. Swayam portal supports the learning community to earn knowledge in different disciplines. This portal integrates various subjects from all the fields like Science, Social Science, Engineering, and so on. This study emphasizes the different types of learning, the strategies, and the methods behind those learning types. This study gives a clear idea about the different pedagogies which depend on the technology and how we work on it. The main aim of this study is to investigate how blended learning supports teaching Mathematics.

In higher education institutions, infrastructure is needed which supports to learn technology, since nowadays we need the help of technology even for 10 rupees transaction. Techno pedagogy rules the educational field because of its innovative features. Even though teacher is a moderator in blended learning, with out their help learners would learn basic concepts and nuances in that particular field. The moderators should be able to work with the technology as well as they should update their selves periodically. The learners who have registered themselves on SWAYAM portal should participate in the respective live sessions that will fulfill one module of blended learning. The content writers need not follow the same package which involves one presentation, one video capturing, and one quiz. Blended learning supports a number of modules that incorporate many teaching methodologies. The invention of educational Apps will make blended learning more effective.

Due to the limitations of classical mathematical tools, Zadeh[2], Modolstov[4], and Pawlak [3]developed fuzzy sets, soft sets, and rough sets, respectively. Rough sets have been used to unlock the complexities in social studies, medicine, forensics, and many other fields.

This study focuses on the impact of various pedagogies that rely on blended learning and how we use them effectively in mathematics teaching by using Rough Topological space [6].

2.PRELIMINARIES

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Let's go over some basic definitions that we'll be using in the following chapter.

Definition 2.1[3] Let U be a non-empty finite set of objects called the universe and R be an equivalence relation on U named as the indiscernibility relation. Then U is divided into disjoint equivalence classes. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (U,R) is said to be the approximation space. Let $X \subseteq U$.

(i) The lower approximation of X with respect to R is the set of all objects, which can be for certain classified as X with respect to R and it is denoted by $\pounds_R(X)$. $\pounds_R(X) = \{x \in U / R(x) : R(x) \subseteq X\}$, where $R(x)$ denotes the equivalence class determined by x.

(ii)The upper approximation of X with respect to R is the set of all objects, which can be possibly classified as X with with respect to R and it is denoted by $U_R(X)$.

$\tilde{U}_R(X) = \{ x \in U \{R(x) : R(x) \cap X \neq \varphi\}$.

(iii) The boundary region of X with respect to R is the set of all objects, which can be classified neither as X nor as not X with respect to R and it is denoted by $B_R(X)$. That is, $B_R(X) = \tilde{U}_R(X) - \pounds_R(X)$.

Definition 2.2 [] An information system is of the form $(U, A, \{V_a\}, f_a)$ where U is a non-empty finite set of objects, called the universe, A is a finite non-empty set of attributes, V_a is the attribute value set of an attribute $a \in A$ and $f_a : U \rightarrow V_a$ is called the information function. If $f_a(x)$ is equal to a missing value for some $x \in U$ and $a \in A$, then the information system is called an incomplete information system (IIS) Otherwise it is a complete information system(CIS).

Definition 2.3[6] Let U be an universe and R be an equivalence relation on U and $\tau_R(X) = \{\varphi, U, B_R(X)\}$, where $X \subseteq U$. Then $\tau_R(X)$ is called the rough topology on U and it satisfies conditions:

(i) $\varphi, U \in \tau_R(X)$

(ii) The union of the elements of any sub collection of $\tau_R(X)$ is in $\tau_R(X)$

(iii) The intersection of the elements of any finite sub collection of $\tau_R(X)$ is in $\tau_R(X)$. In this case, $(U, \tau_R(X))$ is called the **rough topological space** on U with respect to X. It is obvious that $\tau_R(X)$ for a topology on U with respect to the equivalence relation R.

Definition 2.4 [6] Let (U, A) be an information system. Where U is an universe, A is the set of attributes is divided into a set of C of condition attributes and and a set of D of decision attribute. A subset B of C is said to be a **CORE** if $\tau_{R(B)(X)} = \tau_{R(C)(X)}$ and $\tau_{R(B)(X)} \neq \tau_{R(B-\{r\})(X)}$ for all $r \in B$ where $X \subseteq U$, $\tau_{R(B)(X)}$ is the rough topology corresponding to $B \subseteq C$. It is not necessary that all condition attributes in an information system depict the decision attribute. That is the decision attribute depends not on the whole set of condition attributes but on a subset of it is called the CORE.

3.APPLICATIONS

Mathematics is a subject that is all around us. Mathematics is difficult to teach and study due to its nature. We use various types of pedagogy to teach mathematics beginning with primary school. In this chapter, we investigate the impact of blended learning in mathematics teaching at rural higher education institutions.

In this information table, we take graphic usage, self-pace, study material, tech ambience and individual growth as the conditional attributes, and impact of blended learning is the decision attribute. Let us an universal set U = {G1, G2, G3,……,G10}as the set of all student groups those who involved in the survey.

CASE 1: Consider X1 to be the group of staff members who recognised the positive impact of blended learning. Here X_1={G1,G3, G4,G5, G8}. Let R represent the equivalence relation on U with respect to the condition attributes C ={ Graphic Usage, Self-pace, Study Material, Tech Ambience and Individual Growth } ={ GU, SP,SM,TAM,IG}. The equivalence classes determined by R corresponding to $\hat{C}$ are given by $U/R(\hat{C})$ ={{G1,G10}, {G2}, {G3},{G4,G8},{G5},{G6}, {G7, G9}}. The Upper Approximation, Lower Approximation Spaces and Boundary region are as follows,

$\tilde{U}_C(X_1)$ = {G1, G10, G3, G4, G8, G5},

$\pounds_C(X_1)$ = {G3, G4, G5, G8}, $BC(X_1)$ = {G1, G10}.

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Then the rough topology with respect Ʀ is given by $\tau_{R(C)} = \{\Phi, U, \{G1, G10\}\}$

Attributes Reduction in Case 1:

If Graphic Usage is removed from the set of condition attributes then the equivalence classes corresponding to C1 = {SP,SM,TAM,IG} is given by U/Ʀ(C1) ={ {G1,G10}, {G2}, {G3 ,G7, G9},{G4,G8},{G5}, {G6} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C1)}(X) = \{G1, G3, G7, G9, G10\}$ and $\tau_{R(C)}(X) \neq \tau_{R(C1)}(X)$. Therefore, GU is **indispensable**. If Self Pace is removed from the set of condition attributes then the equivalence classes corresponding to C2 = {GU, SM,TAM,IG } is given by U/Ʀ (C2) = { {G1,G10}, {G2}, {G3},{G4,G8},{G5}, {G6}, {G7, G9} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C2)}(X) = \{G1,G10\}$ and $\tau_{R(C)}(X) \neq \tau_{R(C1)}(X)$. Therefore, SP is **dispensable**.

If Study Material is removed from the set of condition attributes then the equivalence classes corresponding to C3 = { GU, SP,TAM,IG } is given by U/Ʀ (C3) = { {G1, G4,G8,G10}, {G2}, {G3},{G5}, {G6}, {G7, G9} }.The boundary region corresponding to this equivalence relation is given by $B_{R(C2)}(X) = \{G1, G4, G8, G10\}$ and $\tau_{R(C)}(X) \neq \tau_{R(C2)}(X)$. Therefore, SM is **indispensable**. If Tech Ambience is removed from the set of condition attributes then the equivalence classes corresponding to C4 = {GU,SM,SP,IG } is given by U/Ʀ (C4) ={{G1,G10}, {G2},{G3},{G4,G8},{G5}, {G6}, {G7, G9} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C3)}(X) = \{G1,G10\}$ and $\tau_{R(C)}(X) = \tau_{R(C3)}(X)$. Therefore, TAM is **dispensable**. If Individual Growth is removed from the set of condition attributes then the equivalence classes corresponding to C5 = { GU,SM,SP,TAM } is given by U/Ʀ(C4)={{G1,G10}, {G2},{G3},{G4,G8},{G5}, {G6}, {G7, G9} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C4)}(X) = \{G1,G10\}$ and $\tau_{R(C)}(X) = \tau_{R(C1)}(X)$. Therefore, IG is

G	GU	SP	SM	TAM	IG	IMPACT OF BL
S1	YES	YES	YES	YES	NO	***H***
G2	YES	NO	NO	YES	YES	***L***
G3	YES	NO	YES	NO	YES	***H***
G4	YES	YES	NO	YES	NO	***H***
G5	NO	YES	YES	YES	YES	***H***
G6	NO	YES	YES	NO	NO	***L***
G7	NO	NO	YES	NO	YES	***L***
G8	YES	YES	NO	YES	NO	***H***
G9	NO	NO	YES	NO	YES	***L***
G10	YES	YES	YES	YES	NO	***L***

dispensable. Therefore **CORE={GU ,SP,SM,IG}∩ {GU,SP,SM,TAM} = { GU ,SP,SM }**

CASE 2:

Consider X2 to be the group of students who are not much interest to adopt blended learning. Here X2={G2,G6, G7,G9, G10}. Let Ʀ represent the equivalence relation on U with respect to the condition attributes C ={ Graphic Usage, Self-pace, Study Material, Tech Ambience and Individual Growth } ={ GU, SP,SM,TAM,IG}. The equivalence classes determined by Ʀ corresponding to C are given by

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U/R(C) ={{G1, G10}, {G2}, {G3},{G4,G8},{G5}, {G6}, {G7, G9}}. The Upper Approximation, Lower Approximation Spaces and Boundary region are as follows, $U_C(X_2)$ = {G1,G2, G6, G7, G9,G10},L_C(X2) ={G2, G6, G7 ,G9 }
$BC(X_2)$ = {G1, G10}.
Then the rough topology with respect R is given by $\tau_{R(C)}$ = {Φ, U, {G1, G10}}

Attributes Reduction in Case 2:

If Graphic Usage is removed from the set of condition attributes then the equivalence classes corresponding to C1 = {SP,SM,TAM,IG} is given by U/R(C1) ={ {G1,G10}, {G2}, {G3 ,G7, G9},{G4,G8},{G5}, {G6} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C1)}$ (X) = {G1, G3, G7, G9, G10} and $\tau_{R(C)}(X) \neq \tau_{R(C1)}(X)$. Therefore, GU is **indispensable**. If Self Pace is removed from the set of condition attributes then the equivalence classes corresponding to C2 = {GU, SM,TAM,IG } is given by U/R (C2) = { {G1,G10}, {G2}, {G3},{G4,G8},{G5}, {G6}, {G7, G9} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C2)}$ (X) = {G1,G10} and $\tau_{R(C)}(X) \neq \tau_{R(C1)}$ (X). Therefore, SP is **dispensable**. If Study Material is removed from the set of condition attributes then the equivalence classes corresponding to C3 = { GU, SP,TAM,IG } is given by U/R (C3) = { {G1, G4,G8,G10}, {G2}, {G3},{G5}, {G6}, {G7, G9} }.The boundary region corresponding to this equivalence relation is given by $B_{R(C2)}$ (X) = {G1, G4, G8, G10} and $\tau_{R(C)}(X) \neq \tau_{R(C2)}(X)$. Therefore, SM is **indispensable**. If Tech Ambience is removed from the set of condition attributes then the equivalence classes corresponding to C4 = {GU,SM,SP,IG } is given by U/R (C4) U/C={{G1,G10}, {G2},{G3},{G4,G8},{G5}, {G6}, {G7, G9} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C3)}$ (X) = {G1,G10} and $\tau_{R(C)}(X) = \tau_{R(C3)}(X)$. Therefore, TAM is **dispensable**.

If Individual Growth is removed from the set of condition attributes then the equivalence classes corresponding to C5 = { GU,SM,SP,TAM } is given by U/R(C4)={{G1,G10}, {G2},{G3},{G4,G8},{G5}, {G6}, {G7, G9} }. The boundary region corresponding to this equivalence relation is given by $B_{R(C4)}$ (X) = {G1,G10} and $\tau_{R(C)}(X) = \tau_{R(C1)}(X)$. Therefore, IG is **dispensable. CORE={GU ,SP,SM,IG}∩ {GU,SP,SM,TAM} = { GU ,SP,SM }.**Because of GU,SP and SM many teachers wanted to commit Blended Learning

4.CONCLUSION

The implementation of blended learning at the different levels of higher education would provide a better learning experience. Operations of techno pedagogy are not yet derived in a single frame. The awareness over the functions of the educational technological tools should be given to the learners. The research will be conducted on how blended learning helps the novice to study skill-based courses effectively.

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