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A Study on Predictive Modeling for Early Intervention of Students' Performance in Mathematics

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ABSTRACT

Students' Mathematics performance is one of the main concerns in Mathematics Education. Many students perceive Mathematics as one of the difficult core subjects to be learned. This negative thinking can be due to many factors that hinder their Mathematics learning. This study was conducted to explore the challenges and difficulties experienced by students in the process of Mathematics learning. Finally, this research will provide an appropriate predictive modelling for early intervention of SRCAS student performance in Mathematics for first-year level. The early intervention can improve SRCAS students' performance in Mathematics course and will identify alternative Mathematics pedagogy for students who are weak in Mathematics. It also can improve the students' progression to the next level of their programme and help to increase the student retention. The qualitative primary data has been collected from SRCAS- Sri Ramakrishna College of Arts and Science, Coimbatore through Google forms.

Keywords: Bridge Course, Mathematics, SRCAS,

2020 MSC: 62-04; 62-11; 62M10; 62P12.

INTRODUCTION

In recent years, significant number of academics from the mathematics disciplines have found that their students lack the appropriate 'Mathematical' background to cope with Pre-University and first-year Mathematics subjects. Students' Mathematics performance and the need for work-ready graduates to be Mathematically competent is a core issue for many universities. Pre-University Mathematics skills were identified as significant in student retention and Mathematics success at university, and a specific focus on students' pre-university Mathematics skill level was found to be more effective in providing help, rather than simply focusing on a particular at-risk group. Consequently, failure rates are on the increase in these subjects.

According to Nordin (1992), some prominent factors that contributed to difficulties in learning Mathematics are as follow:

i. Students' dislike in Mathematics may have stemmed from psychological incidences such as fear, endurance, perseverance and other associated factors.
ii. The Mathematics curriculum may have failed to show much relevance to real life application.
iii. Mathematics teachers' lack of interest in the subject, and consequently, did not help students by way of catering to individual differences.

The lack of understanding of basic Mathematical principles can result in an inability to solve numerous subjects such as chemistry, engineering, and other important scientific problems (Bursal and Paznokas, 2006). Bursal and Paznokas (2006) providing a specific recommendation to schools that take the responsibility for training teachers. This is to develop positive attitudes toward Mathematics and teaching Mathematics. Difficulties in Mathematics are often caused by lacking Mathematics skills. The understanding of the issue, knowledge, skills and commitment of teachers are keys of success in Mathematics (Suthar, Tarmizi, Midi and Adam, 2009).

One of the main aims of Mathematics is to solve a problem in a systematic way so that similar problems can be solved more easily in the same way. Mathematics is very important every day, it is used to solve problems in such areas as astronomy, business, computer science, economics, navigation, physics, and statistics. Mathematics equips students with a uniquely powerful set of tools to understand and change the world. These tools include logical reasoning, problem-solving skills, and the ability to think in abstract ways. The common core standards in Mathematics stress the importance of conceptual understanding as a key component of mathematical expertise. Conceptual Mathematics understanding is a knowledge that involves thorough understanding of underlying and foundational concepts behind the algorithms performed in Mathematics. Thus, it involves a situation where students are allowed to make choices and apply their understanding through active engagement. A student must have both, if they were to understand Mathematics in depth. Teachers will more confidently recognize when students are prepared for standard-based testing and can demonstrate true understanding of concepts. They should be intrigued about the relationship between concept in Mathematics and learning.

A Bridge Course is conducted for newly added students of the first semester classes every year. The major effect of the Bridge Course, they gained confidence in Mathematics. The Bridge Course stressed like motivation, individual attention and development of the self-confidence and special methods of teaching. Bridge Course helps students to open-up, think creatively and become responsible and independent students. During this interaction of few days with the faculty, the students will come out of their hesitation and it will be the best platform for the students to interact

with the faculty members, making it responsible for them to build strong relationships with faculty advisers and other students.

LITERATURE REVIEW

Teachers are always interested in pupil's attitudes towards the subject they are teaching, but teachers of Mathematics are particularly concerned about students' feelings about their subject because Mathematics has a reputation for being unpopular. It is for that reason that extensive research has been conducted in Mathematics in Bridge Course.

This is supported by a research by Hanitaet. al. (2017), the findings showed that higher percentage of the international students (60.1%) had poor academic performance (CGPA below 3.00). It also showed that one-third of them scored below grade B for Mathematics-based subjects which was 37.7%. According to study by Izyanet. al. (2015), discovered that students whose upper secondary education background was non-science are more likely to get lower achievement. This variable had the highest impact on Mathematics achievement. The results of the study also revealed that students who are taking Mathematics course for the first time tend to achieve lower results in Mathematics compare to those taking it for the second time in higher education level.

Many Colleges have instituted a summer bridge program—a program for first-year students—to help with the academic transition to College. Many researchers conclude that summer bridge programs are one of the best remedies to increase College readiness among underrepresented students as they provide an opportunity to involve and educate families about college expectations. According to study by Cabrera, Miner & & Milem (2013) described the summer bridge programs have positive impacts on the participants' performance in college placement tests, first year GPA, retention, persistence, graduation rate, and overall college academic performance.

Thus, the purpose of this research is to identify students who are weak in Mathematics earlier before they start their class in the first semester, and thereby taking early actions to improve students' performance in Mathematics course. Another aim is to reduce failure rate by helping students to predict their likelihood of success in a Mathematics course before they start their lessons in the first week of the semester. To improve SRCAS students' performance in Mathematics course, it is necessary for the educators to understand better about the factors that may contribute student's success in a Mathematics course. This will identify the weak students earlier before they start commencing the class. By this, early actions will be taken to help the students by giving an alternative Mathematics pedagogy for students with weak Mathematics, additional special classes and other relevant activities to improve SRCAS students' performance in Mathematics course in their pre-university and first-year degree level. Therefore, it can improve the student progression to the next level of their programme and help to increase the student retention.

In this research, we will analyse data based on the SRCAS students' Mathematics diagnostic test that will be conducted during the orientation week, secondary school Mathematics performance, demographic and social background of students, English language test score, and other relevant factors will be taken into consideration. Besides, diagnostics tools were found to be important in identifying student background and appropriate intervention for the analysis. This research will highlight the importance of appropriate and validated interventions in Mathematics teaching and learning, and the need to improve the learning model for Mathematics-based subjects including communication and technology innovations in Mathematics.

OBJECTIVE OF THE STUDY

- To leverage the learning skills of slow learners with different learning ability, academic standards and academic performance.
- To help slow learners who have fallen behind to learn to the best of their ability and to bring them back into the mainstream classes as far as possible.
- To gradually increase the self-confidence to face questions/exams and create awareness about incremental learning.
- To increase opportunities to monitor student progress and comprehension prior to a final or summative assessment.
- To help the students to open up, think creatively and become responsible and independent students through the Bridge Course
- To make them to plan and study more Mathematics in future.
- To enjoy the learning of Mathematics.

Data Source

In this study, Primary data collections are made. Responses were collected using Google forms.

Sample Size

This study was among the student's mentality about Mathematics class of Sri Ramakrishna College of Arts and Science, Coimbatore.

Sampling Technique

Convenience sampling is used for this study.

Limitations of the Study

- The study is confined to SRCAS students.
- The size of the sample is limited.
- The time is limited; convenience sampling technique was used to select the students.

RESEARCH METHODOLOGY

- To find how students feel about Mathematics class.
- To find whether the students are satisfied with the content of Mathematics class.
- To find whether the students have difficulties in Mathematics class.
- To find how much the students are comfortable in Mathematics class.
- To find the students opinion about Mathematics class.
- To find students' rating for teaching tools.

DIAGRAMATIC PRESENTATION & ANALYSIS

Percentage Analysis

Simple percentage analysis is used by the researcher for analysis and interpretation of the collected data.

$$simple\ percentage = \frac{Actual\ \ Value}{Total\ \ Value}\ x\ 100$$

Diagrammatic Presentation

Diagram analysis is used to present our data in visual form, as it gives the clear picture for easy understanding and is also very attractive.

Chi-Square Analysis

In Chi-Square analysis, we test whether the two characteristics are independent or not. In other words, the Chi-Square test is used to test whether one of the factors has significant influence over the other factor.

$$\chi^2 = \sum \left[\frac{(O_i - E_i)^2}{E_i} \right] \sim \chi^2_{(r-1)(c-1)}$$

where O_i= Observed frequency & E_i = Expected frequency

Spearman Rank Correlation Co-efficient

Spearman's correlation coefficient, (ρ, also signified by r_s) measures the strength and direction of association between two ranked variables.

$$\rho = 1 - \left[\frac{6 \sum d_i^2}{n^3 - n} \right]$$

Where ρ = Spearmans rank correlation co-efficient

d_i = difference between the two ranks of the each observation

n = number of observations

Percentage Analysis & Diagrammatic Presentation

1.1 Distribution of Students based on Gender

The following table and diagram shows the distribution of Students based on Gender.

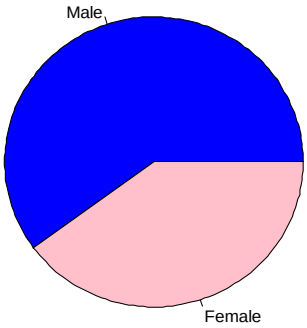
1.1.1 Shows the Gender of Respondents

Gender	No. of Respondents	Percentage of Respondents
Male	278	60
Female	185	40
Total	463	100

The above table reveals that out of 463 respondents, 40% of the respondents are Female and 60% of the respondents are in the Male.

Majority of the respondents are Male.

1.1.2 Shows the Gender of Respondents



1.2 Distribution of students reasons for not interested in Mathematics

The following table and diagram show the distribution of students' reasons for not interested in Mathematics.

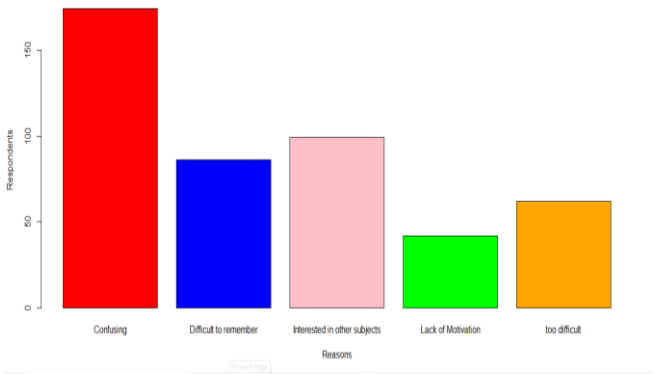
1.2.1 Shows the Reasons for not interested in Mathematics

Reasons	No. of Respondents	Percentage of Respondents
Confusing	174	38
Difficult to remember	86	19
Interested in other subjects	99	21
Lack of Motivation	42	9
too difficult	62	13
Total	463	100

The above table reveals that out of 463 respondents, 38% of the respondents felt confusing , 19% of the respondents feel difficulty in remembering , 21% of the respondents are interested in other subjects, 9% of the respondents say, lack of motivation and 13% of the respondents felt Mathematics is too difficult .

Majority of the respondents felt confusing in Mathematics.

1.2.2 Shows the Reasons for not interested in Mathematics



1.3 Distribution of students facing the major problems of learning Mathematics in classroom

The following table and diagram show the distribution of students facing the major problems of learning Mathematics in classroom.

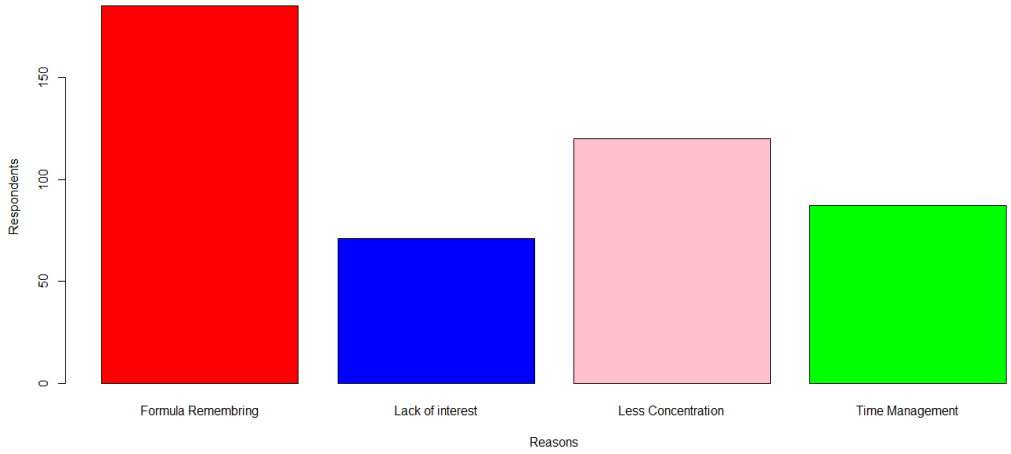
1.3.1 Shows the major problems of learning Mathematics in classroom

Reasons	No. of Respondents	Percentage of Respondents
Formula Remembering	185	40
Lack of interest	71	15
Less Concentration	120	26
Time Management	87	19
Total	463	100

The above table reveals that out of 463 respondents, 40% of the respondents are confused in remembering formula, 15% of the respondents lack interest , 26% of the respondents say less concentration, 19% of the respondents feel lack of time management in Mathematics class.

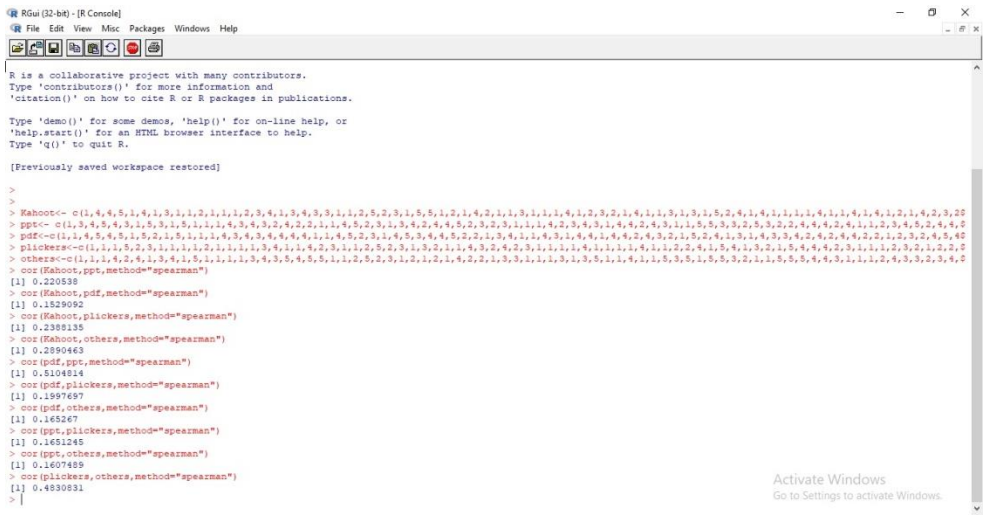
Majority of the respondents are confused in remembering the formula in Mathematics class.

1.3.2 Shows the major problems of learning Mathematics in classroom



ANALYSIS & INTERPRETATION

1.4 Spearman Rank Correlation Co-efficient



1.4.1 Shows the Spearman Rank Correlation

	KAHOOT	PDF	PPT	PLICKER	OTHERS
KAHOOT	-	0.1529	0.2205	0.2388	0.2891
PDF	0.1529	-	0.5105	0.1998	0.1653
PPT	0.2205	0.5105	-	0.1651	0.1608
PLICKER	0.2388	0.1998	0.1651	-	0.4831
OTHERS	0.2891	0.1653	0.1608	0.4831	-

From the above table, the pair of ICT tools of PPT & PDF is nearest to +1 and so the majority of the students rated that PPT and PDF ICT tools were used in learning math.

CHI-SQUARE ANALYSIS

1.5 Gender Vs Major problems of learning Maths in classroom

Null Hypothesis

H_0 : There is no association between gender and major problems of learning maths in classroom.

Alternative Hypothesis

H_1 : There is association between gender and major problems of learning maths in classroom.

Level of Significance

α: Level of significance at 5%.

Test Statistic

	Formula Remembering	Time Management	Less Concentration	Lack of interest
Male	**122**	**47**	**64**	**45**
Female	**63**	**40**	**56**	**26**

```
> gnm
       Formula Remembring Time Management Less Concentration Lack of interest
Female                 63              40                 56                26
Male                  122              47                 64                45
> chisq.test(gnm)

        Pearson's Chi-squared test

data:  gnm
X-squared = 6.5825, df = 3, p-value = 0.08646
```

χ^2 table value at 3 d.f. = 7.815

Interpretation

From the above analysis, we observe that $\chi^2_{cal} < \chi^2_{tab}$, i.e., 6.5825 < 7.815. Since the null hypothesis is accepted at 5% level of significance. Hence there is no association between gender and major problems of learning maths in classroom.

1.6 Non-Maths Students Vs Challenges of learning maths in classroom

Null Hypothesis

H_0 : There is no association between non-maths students and challenges of learning maths in classroom.

Alternative Hypothesis

H_1 : There is association between non-maths students and challenges of learning maths in classroom.

Level of Significance

α: Level of significance at 5%.

Test Statistic

	Formula Remembering	Time Management	Less Concentration	Lack of interest
Yes	**115**	**47**	**70**	**45**
No	**70**	**40**	**50**	**26**

χ^2 table value at 3 d.f. = 7.815

```
> gnim
    Formula Remembring Time Management Less Concentration Lack of interest
Yes                115              47                  70                45
No                  70              40                  50                26
> chisq.test(gnim)

        Pearson's Chi-squared test

data:  gnim
X-squared = 2.1235, df = 3, p-value = 0.5472
```

Interpretation

From the above analysis, we observe that $\chi^2_{cal} < \chi^2_{tab}$, i.e., 2.1235 < 7.815. since the null hypothesis is accepted at 5% level of significance. Hence there is no association between non-maths students and challenges of learning maths in classroom.

1.7 Non-Maths Students Vs Not interested students in Maths

Null Hypothesis

H_0 : There is no association between non-maths students and not interested students in Mathematics

Alternative Hypothesis

H_1 : There is association between non-maths students and not interested students in Mathematics

Level of Significance

α: Level of significance at 5%.

Test Statistic

	Lack of motivation	Teaching Materials	Dissatisfaction in teaching methodology	Too serious while teaching
Yes	**84**	**99**	**42**	**52**
No	**63**	**74**	**11**	**38**

```
> fnm
    Lack of motivation Teaching Materials
Yes                 84                99
No                  63                74
    Dissatisfaction in teaching methodology Too serious while teaching
Yes                                      42                        52
No                                       11                        38
> chisq.test(fnm)

        Pearson's Chi-squared test

data:  fnm
X-squared = 9.4002, df = 3, p-value = 0.02442
```

χ^2 table value at 3 d.f. = 7.815

Interpretation

From the above analysis, we observe that $\chi^2_{cal} > \chi^2_{tab}$, i.e., 9.4002>7.815. Since the null hypothesis is rejected at 5% level of significance. Hence there is association between non-maths students and not interested students in Mathematics.

1.8 Non-Maths Students Vs Bridge Course can improve the Mathematics skill

Null Hypothesis

H_0 : There is no association between non-maths students and Mathematics skill in Bridge Course

Alternative Hypothesis

H_1 : There is association between non-maths students and Mathematics skill in Bridge Course

Level of Significance

α: Level of significance at 5%.

Test Statistic

	Strongly Agree	Agree	Neutral	Strongly disagree	Disagree
Yes	**34**	**145**	**88**	**5**	**5**
No	**14**	**61**	**90**	**7**	**14**

```
> fnim
    Strongly Agree Agree Neutral Strongly disagree Disagree
Yes             34   145      88                 5        5
No              14    61      90                 7       14
> chisq.test(fnim)

        Pearson's Chi-squared test

data:  fnim
X-squared = 30.497, df = 4, p-value = 3.876e-06
```

χ^2 table value at 4 d.f. = 9.488

Interpretation

From the above analysis, we observe that $\chi^2_{cal} > \chi^2_{tab}$, i.e., 30.497 > 9.488. Since the null hypothesis is rejected at 5% level of significance. Hence there is association between non-maths students and Mathematics skill in Bridge Course.

FINDINGS

By the application of the statistical tools on the data collection, we have obtained the following findings with the suitable objectives designed for the study.

- Majority of the respondents are Male.
- Majority of the respondents have not studied Mathematics in HSC.
- Majority of the respondents felt confusing in Mathematics.
- Majority of the respondents are confused in remembering the formula in Mathematics class.
- Majority of the respondents preferred to solve extra problems.
- Majority of the respondents are attending the Bridge Course.
- The pair of ICT tools of PPT & PDF is nearest to +1 and so the pair of PPT and PDF of ICT tools were used in learning math.
- There is no association between gender and major problems of learning maths in classroom.
- There is no association between non-maths students and major problems of learning maths in classroom.
- There is association between non-maths students and not interested students in Mathematics.
- There is association between non-maths students and Mathematics skill in Bridge Course.

CONCLUSION

This study was conducted to explore the challenges and difficulties experienced by students in the process of Mathematics learning and to provide an appropriate predictive modelling for early intervention of students' performance in Mathematics for first-year level. We also would like to identify alternative Mathematics pedagogy for students who are weak in Mathematics to improve the students' progression to the next level of their programme & help them to reduce the student retention.

Based on our findings, we recommend the following points for the improvement

- That the college should conduct the Bridge Course for the non-maths students
- Usage of the ICT tools in an effective manner
- By complete practice with more examples and problems
- Regular monitoring of their learning by conducting mini class tests
- Sharing video lectures

As, Mathematics performance is one of the main concerns in students' Education. Effective implementations of our recommendations surely will lead to improve many students & this will also

help to increase the student retention. Also, the new way of teaching by ICT tools will improve the math, logical skill, and academic performance. Thus, this study describes the development of the Bridge Course and demonstrate statistically that this course continues to prepare the non-maths students to explore themselves and stand up to next level of performance in Education.

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