An adaptive e-learning architecture: An experimental model for implementation and personalization of regional and English medium learners

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Abstract

Traditional e-Learning system displays the same content to all the learners irrespective of their knowledge level and relevance. This paper enumerates insight into the learner's perspective and expectation on medium of study such as regional language verses English language at education institute in fathoming the core subject or e-content provided to them in English and proposes a design for developing an adaptive e-Learning system personalized to the learner. To investigate into the learner's individual desire the best cutting edge practice of applying statistical tools along with a plausible framework is being adapted. The results implied that the medium of instruction (Regional language / English) at school has greater impact on the performance compared to the region (Rural / Urban) the students hailed from, when the same content is given to them in English using traditional e-Learning. However, often there exists a widespread difference among regional language as a medium of learning in rural area and English as a medium of learning in urban area. Therefore, this study intend to develop e-learning content based on individual student capability to understand using systematic decision making and customized rules. The social implication of this study reveals that adaptive e-learning based on individual personal capacity and customized e-learning content has been successfully implemented and effectively established a balanced trade-off between regional language as a medium students and English as a medium of learning student's knowledge and performance.

Key Words: Traditional e-Learning, Adaptive e-Learning, Medium of Instruction, Multiple Regression, Urban / Rural Capacity gap

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1. Introduction

Adaptivity is an important issue in e-Learning, but very few learning systems incorporate adaptivity in today's e-education. E-Learning platforms such as Moodle and WebCT provide lot of simple features to administer and create courses. As such, they have become very successful in e-education. Adaptive e-Learning system creates a personalized environment for the learner. Personalization helps to display required content in understandable and desirable form and prevents unwanted or unrelated content being displayed, thus saving cost and time. The focus of this research is primarily on countries offering school education both in English medium and in their regional languages. In countries like India, English is the medium of instruction primarily at urban places, and the regional languages are the medium of instruction primarily at rural places. This study is also applicable to English-speaking countries with student immigrants from across the globe.

It is generally believed that the urban / rural exposure to the student has more impact than the primary medium of instruction at school, while understanding the content given to them in English. To test this hypothesis, two experiments were performed with a heterogeneous group of considerable number of first year engineering students both from Urban and Rural backgrounds and with a combination of regional language and English as their primary medium of instruction at school, but with similar pre-requisite subject knowledge. Section 2 deals with an experiment offering an English language test using traditional e-Learning to the students to evaluate their understanding of English. Section 3 deals with an experiment offering 30 minutes of Technical content and a Technical subject test in English using traditional e-Learning to evaluate the impact of foreign language knowledge in understanding a technical subject. A Statistical Regression Model is used to validate the above hypothesis. Subsequently, an adaptive e-Learning system using Moodle with decision procedure rules for providing personalized content to the learner was developed and successfully implemented to bridge the gap in performance between the regional language medium students and English medium students.

2. Impact of medium of instruction in understanding English

The hypothesis of this experiment is that the urban / rural exposure to the student has greater impact than the primary medium of instruction at school, while understanding the content given to them in English.

2.1 Participants

A heterogeneous group of 219 Undergraduate first year Engineering students both from Urban and Rural backgrounds (116 Urban and 103 students hailing from Rural areas) and with a combination of regional language and English as their primary medium of instruction at school (148 Regional Language and 71 English medium students), but with similar pre-requisite subject knowledge (all of them scored entry level Cut-Off marks between 170 to 190 marks out of 200 marks to get admitted into the Engineering degree programme). Even students, who did their schooling in regional language medium, had English as one of their subjects throughout their schooling. The other factors considered were the economical and educational background of their families and if the student was a boy or a girl.

2.2 Evaluation Procedure

The participants were seated in the computer laboratory and given two reading comprehensions in English through traditional e-Learning engine which shows uniform content to all the users. They were given a total of 40 minutes to go through the contents and answer 20 questions about the contents.

2.3 Results and decisions

Table 1 summarizes the task performance of the impact of medium of instruction in understanding English. The findings from this experiment indicates that the medium of instruction at school plays a major role compared to the region the student hailed from, as the rural English medium students performed better compared to urban regional language medium students. The maximum gap is noticed between rural regional language medium students and urban English medium students. The Cut-Off marks, economical and educational background of their families and the sex of the student have minimal impact.

Table 1: English Test Performance

Medium of Study	Residence	No.of Students	English Test Score - Avg %
Tamil	Rural	90	46.39%
Tamil	Urban	58	51.29%
English	Rural	13	61.92%
English	Urban	58	70.52%

Hence it can be concluded that the hypothesis of urban / rural exposure to the student having greater impact than the primary medium of instruction at school is reversed and the primary medium of instruction has greater impact on the performance in an English Test, than the urban / rural exposure.

3. Impact of medium of instruction in understanding Technical Content

The hypothesis of this experiment is that the primary medium of instruction at school has greater impact than the urban / rural exposure to the student, while understanding the technical contents given to them in English.

3.1 Participants

The same set of 219 participants who were tested in the previous experiment participated in this experiment as well.

3.2 Evaluation Procedure

The participants were given Technical content (Lecture on Pointers in ‘C’ programming) through traditional e-Learning engine which shows uniform content to all the users. At the end of the learning session, they were asked to answer questions from the contents they had learnt. They were given a total of 50 minutes to go through the contents and answer 20 questions about the contents.

3.3 Results and decisions

Table 2 summarizes the task performance of the impact of medium of instruction in understanding technical content in English. The findings from this experiment indicates that even in the case of technical content given in English using traditional e-Learning, the medium of instruction at school played a major role compared to the region the student hailed from, as the rural English medium students performed better compared to urban regional language medium students. The maximum gap is noticed between rural regional language medium students and urban English medium students. The

Cut-Off marks, economical and educational background of their families and the sex of the student have minimal impact.

Table 2: Technical Test Performance

Medium of Study	Residence	No.of Students	Technical Content Test Score - Avg %
Tamil	Rural	90	54.00%
Tamil	Urban	58	56.12%
English	Rural	13	65.38%
English	Urban	58	74.48%

The hypothesis that the primary medium of instruction at school has greater impact than the urban / rural exposure to the student, while understanding the technical contents is validated.

4. Statistical Regression Model

From Table 1 and 2 it is observed that the performance gap between English Medium students and Regional Medium students are high to the extent of 10% difference in both English Test and Technical Test. When Rural Tamil Medium students' performance is considered, they are on par with Urban Tamil Medium. This observation leads to the apparent decision that the performance of Rural / Urban English Medium students is far better than rest of the categories irrespective of the English Test or Technical Test.

In order to understand the gap, significant evidence is required. Hence, a Statistical Regression Model is developed to test the above hypothesis. In this study, performances of students in English and Technical tests were considered dependent variable. The Cut-off mark scored by the student impacts the performance and is considered to be an independent variable. The impact of the economical and educational background of their families and the sex of the student are found to be negligible. So the model is developed as: Performance of Student = f(Cut-off Marks). The impact of Medium of Instruction of the student and their Place of Study on the performance in the test is analyzed by introducing them as dummy variables. Hence the equation becomes:

In mathematics, statistics, and the mathematical sciences, a **parameter** (G: *auxiliary measure*) is a quantity that serves to relate functions and variables using a common variable (often *t*) when such a relationship would be difficult to explicate with an equation.

$$Y = a + b(X)+c(D_1)+e(D_2)$$

Parameters Required:

Y = Performance on English Test
X = Cut-off Marks
D_1 = Dummy Variable (Place of Study)
D_2 = Dummy Variable (Medium of Instruction)

When the inputs are fed into the SPSS tool, we get the values for a, b, c, e and also the coefficient of determination R^2 and F value. The coefficient of determination (R^2) explains the extent of explained variability of Y caused by X. The F denotes the significant effect of the ratio of variation due to the independent variables and the variation due to chance causes.

4.1. Regression (English Test – Effect of Cut-off Marks, Place of Study and Medium of Instruction)

This model analyses the effect of Cut-off Marks and the combined effect of Place of Study and Medium of Instruction on the performance in the English Test.

The values obtained for a, b, c and e is incorporated in the equation to form the following equation.

Equation: $\mathbf{Y = 14.252 + (-0.028)X + 1.248\ (D_1) + 3.528\ (D_2)}$

The 't' value obtained for Place of Study, Medium of Instruction and for the Cut-off Marks and its level of significance are given below.

D_1 (Place of Study) = (2.517)**
D_2 (Medium of Instruction) = (6.673)***
X (Cut-off Marks) = $(-0.732)^{NS}$

*** - 1% Significance Level; ** - 5% Significance Level; * - 10% Significance Level; NS - No Significance

The regression equation is significant, since F = 25.513***. The capability of Cut-off Marks,

Place of Study and Medium of Instruction is explaining the performance to the extent of 56.3% since $R^2 = 0.563$.

From the analysis it can be concluded that the effect of Medium of Instruction is significantly higher than that of Place of Study, even though the Place of Study also plays a vital role.

4.2. Regression (Technical Test – Effect of Cut-off Marks, Place of Study and Medium of Instruction)

This model analyses the effect of Cut-off Marks and the combined effect of Place of Study and Medium of Instruction on the performance in the Technical Test.

The values obtained for a, b, c and e is incorporated in the equation to form the following equation.

Equation: $\mathbf{Y = 14.694 + (-0.046)X + 0.605\ (D_1) + 1.685\ (D_2)}$

The 't' value obtained for Place of Study, Medium of Instruction and for the Cut-off Marks and its level of significance are given below.

D_1 (Place of Study)	= (1.817)*
D_2 (Medium of Instruction)	= (4.745)***
X (Cut-off Marks)	= $(-1.782)^*$

*** - 1% Significance Level; ** - 5% Significance Level; * - 10% Significance Level; NS - No Significance

The equation is significant since F = 13.783*** and the capability of the independent variables to explain the variation in dependent variable is 46.1% since $R^2 = 0.461$.

From the above equation it can be concluded that the Medium of Instruction is playing significant role in contributing to the performance than the Place of Study, and the Place of Study has minimal impact.

4.3. Proposed Adaptive e-Learning Model

Addressing the limitations of current e-learning platforms, we propose a model for adaptive e-learning. The primary motto lies in the hands of authors where they are supposed to create a plethora of individual learning criteria with objectives set according to the capability of individual learner. According to this model, learners are characterized based on their primary medium of instruction at school and their knowledge level of English.

The proposed adaptive e-Learning model is developed using Moodle Learning Management System. Learner's enthusiastic feedback along with commitment provides us tremendous knowledge on customizing the content based on learner's perspective. The developed content thus distributed to learners for further decision. Figure 1 present us the variety and classification of modules designed with fundamental functions that is being proposed in the adaptive e-learning framework.

Figure 1

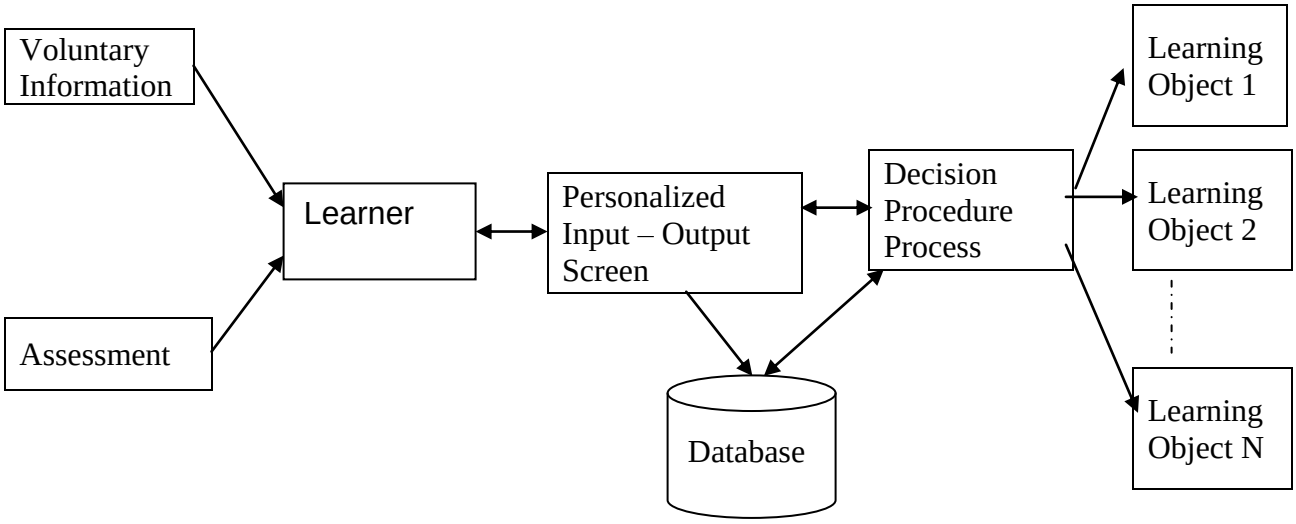

Figure 1 present us the variety and classification of modules designed with fundamental functions that are being proposed in the adaptive e-learning framework. The following information is voluntarily obtained from the learner: Age, Educational qualification, Urban / Rural, Medium of Instruction at School, familiarity with English language, sex, etc. Prior to start of a course the learner's proficiency of English is tested. On completion of the course, a post-test is given to assess the knowledge level gained.

Input is obtained for the learner through the “Personalized Input-Output Screen” and recorded in the “Database”. The Database acts as the central repository on the Web for the Adaptive e-Learning. Based on the information available in the Database about the learner, the “Learning Objects” to be presented is automatically determined by the “Decision Procedure Process” and presented to the Personalized Input-Output Screen. The lessons of a course are split into various learning objects and they can be customized to the regional language students as follows:

- Prior to start of the actual content, present additional content for the regional language medium students to understand: (i) Phrases and Idioms, (ii) Grammar and (iii) Phonetics in English.
- The Learning Objects will display the regional language translation of English words on mouse over to a particular word.
- Present the Learning Objects comprising of glossary of English words and Technical terms in the regional language. As and when the regional language medium students don’t understand a certain word, they can refer to the glossary and understand its meaning in regional language.
- Present additional pages of course content for better understanding.

The Learning Objects can be presented in any permutation and combination as needed. For example, a course in Computer Networks with extensive content can be created. Depending on whether the learner’s primary medium of instruction is English / Regional Language, and is an Undergraduate / Post-graduate / Research Scholar the lessons will be personalized.

The above indicated adaptive e-Learning platform has been developed using Moodle and implemented.

4.4. Adaptive e-Learning as a tool to overcome the medium of instruction barrier

The hypothesis of this experiment is that adaptive e-Learning can be successfully used to bridge the gap between regional language medium students and English medium students, while understanding the technical contents given to them in English. The same set of participants who were tested in the previous experiment participated in this experiment as well.

4.5. Participants

The same set of heterogeneous group of 219 Undergraduate first year Engineering students both from Urban and Rural backgrounds (116 Urban and 103 students hailing from Rural areas) and

with a combination of regional language and English as their primary medium of instruction at school (148 Regional Language and 71 English medium students), but with similar pre-requisite subject knowledge.

4.6. Evaluation Procedure

The participants were divided into 3 groups. The Group-1 comprises of 71 students from English medium, the rest of the 148 students from regional language medium were equally divided into Group-2 and Group-3 irrespective of their Urban and Rural backgrounds. The Course was divided into 2 Learning Objects. The Learning Object-1 comprises of 15 pages of Physics subject content in English only. Learning Object-2 comprises of the same Physics subject content in English with the regional language translation of English words on mouse over to a particular word and a glossary of English words and Technical terms in the regional language.

The Group-1 and Group-2 participants were shown Learning Object-1 and Group-3 participants were shown Learning Object-2. All participants were given a total of 60 minutes to go through the contents and answer 20 questions about the contents.

5. Results and decisions

Table 3 summarizes the task performance of the impact of adaptive e-Learning in improving the performance. The findings from this experiment indicates that the performance gap between the English medium students and Regional language medium students can be narrowed down by translating the English content in Regional language as and when needed. Thus adaptive e-Learning enhances the performance of the students.

Table 2: Technical Test Performance

Group	Course	No.of Students	Test Score - Avg %
Group-1 (English)	Learning Object-1 (English Only)	71	70.28%
Group-2 (Tamil)	Learning Object-1 (English Only)	74	40.81%
Group-3 (Tamil)	Learning Object-2 (Help in Regional Language)	74	60.74%

Conclusions and further work

The findings from the above two experiments indicated that when content is offered in English, the medium of instruction at school is more significant compared to the region the student hailed from. The primary objective of this research in progress is to bridge the gap between the two extreme sets of sample so that regional language medium students will perform as good as English medium students. This is expected to be achieved by developing an adaptive e-Learning model (as detailed above) to personalize the content based on the profile of the student and other relevant factors. Sample content with glossary of words in regional language and additional content to train students on (i) Phrases and Idioms and (ii) Grammar is also being developed.

Future research can be expanded to include for example, adaptive e-Learning content for students from non-English speaking countries to perform on same level with students from English speaking countries, when the contents are offered to them in English.

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