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Open Ended Tool for Self Paced Learning

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Abstract

Advances in science and technology have impacted the field of education in manners unthought-of in the past. Information and Communication Technology based systems have resulted in ubiquitous learning becoming a reality, where classrooms are not restricted within boundaries or four walls. Self-paced learning is now the order of the day, which requires the learner to be aided in his learning endeavors at times that suits him. The present paper proposes a system that gives the learner an automated tool to learn a subject at his own pace. The preparatory stage includes feeding in a couple of model answers to every question which the learner has to answer. Thereafter, the learner tries to answer the questions with aid in the form of hints available and is evaluated based on his response. Results show that learners taking help from this system performs better than those using traditional methods.

Keywords: *Learning Assistance, Automatic evaluation, Learning aid, learners response, keyword, expression association*

1. Introduction

Ensuring that learners learn the intended material or gain knowledge has always been an unending endeavor. Tapping a human brain to explore and absorb the maximum knowledge is a challenge to human beings as humans ail from fatigue, lack of motivation, laziness, improper method of learning and so many such other factors. There have been many techniques and teaching aids to help a learner learn better, faster and at his or her own pace. With the onset of e-learning system education has become easily accessible which has made it possible for human beings to gain unlimited knowledge. Man has always been trying to use full potential of human brain in learning process but with less success using classical Natural Language Processing and other such Adaptive techniques. If one is able to develop such a system, the solution will not only redefine e-learning but open up newer avenues in Human Computer Interaction as well.

The learning assistance which has been developed uses a system that relies on automatic evaluation of factoid [5]based questions for the evaluation part. The major problem to implement the evaluation part was that each student has his/her own way of answering and it is difficult to determine the degree of correctness [6]. The assessment of the correctness of an answer involves the evaluation of grammar and knowledge woven using the conceived interpretation and creativity of a human mind[6]. Implementation of the system developed would provide a learning assistance to a student who can calibrate himself/herself and at the same time get a feedback on his/her weakness[1]. The added advantage is that he/she can do at his/her own pace and convenience.

The base of the current work is the method proposed by Chakraborty, Roy and Chowdhury, (2014)[2]wherein a method has been prepared using keyword and expression association which aids a learner by providing self paced learning. The current work is aimed at developing a fully functional model that will assist the learner in answering questions through continuous evaluation aided by hints.

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The evaluation part of the learning system is based upon the understanding that, an answer to a question is a collection of keywords and supporting logical expressions. Keyword reflects on the fact or the point whereas the words appearing before and after the keyword strengthen the point. These words are termed as pre and post expressions. In the current work, the pre and post-expression is based on the position of its occurrence in respect to the keyword and also stop word is not removed. Figure 1 presents the idea of how the answers are perceived by the model

Figure 1. Schematic Diagram[2] of the models perception of a response

1.1. Organization of Paper

The contents of this paper are organized as follows: Section 2 discusses about the proposed methodology, Section 3 provides experimental results and analysis. Conclusion and acknowledgment are given in Section 4 and 5 followed by references in Section 6.

2. Proposed Methodology

2.1. Based on Chakraborty, Roy & Choudhury

The Learning Assistance module heavily relies on automatic evaluation of learner responses. It consists of modules for teacher and student. Teacher and student are allowed to access the system as per their privileges. The teacher can build up question bank, its multiple model answers and provide hints. The students can submit their answers and also use hints as per their needs for which marks will be deducted from their total marks. The method of evaluation of the student answer is as follows. (Taking into consideration that there is no grammatical mistake)

The following steps are performed prior to the evaluation of the student answer[2]:

Step 1: The model answers to a question Q is framed and stored.
Step 2: For each M_i:
Step 2.1: Important keywords KW are extracted from M_i.
Step 3: For each KW, weightage is assigned.
Step 3.1: Synonyms of KW are listed. (WordNet is used to obtain all the synonyms for the keyword. The teacher is allowed the privilege to enter other synonyms)
Step 4: For every KW the relational expression are identified and stored.

WordNet:
WordNet has been used to get synonyms for the keywords. It is basically a large lexical database of English. Nouns, verbs, adjectives and adverbs are grouped into sets of cognitive synonyms (synsets), each expressing a distinct concept. Synsets are interlinked by means of conceptual-semantic and lexical relations. The resulting network of meaningfully related words and concepts can be navigated with the browser. WordNet is also freely and publicly available for download. WordNet's structure makes it a useful tool for computational linguistics and natural language processing.

Part of Speech Tagging:
Part of Speech (POS) Tagging is the method of marking each word present in a sentence with a particular part of speech tag. POS Tagging is mainly performed to resolve ambiguity. POS tagging algorithms are of two types: rule based and stochastic [3]. As

stated in [3] the rule-based tagger uses a set of rules to assign tags to ambiguous words and stochastic tagger resolves tagging ambiguities by using a tagged or an untagged corpus to determine the POS tags for a word. An example of rule-based tagging is Brill's tagger [4] and an example for stochastic tagging is a tagger using the Hidden Markov Model technique [3].

Link Grammar:

The link grammar developed by Daniel D Sleator and Davay Temperly [7] works as follows. When a sentence is provided to the link grammar parser, the parser parses the sentence and performs part of speech tagging identifying the noun, verb, adjective, prepositions and adverb present in the sentence. In addition to part of speech tagging the parser also generates multiple links between the words present in the sentences known as connectors [7] using a predefined set of rules. The nouns and the verbs tagged in the sentence during part of speech tagging are identified as the keywords (nodes) and the links provided by the parser are used for identifying the relationship, as shown in Figure 1.

Sentence 1: OS provides an environment for a user to execute programs on computer hardware.

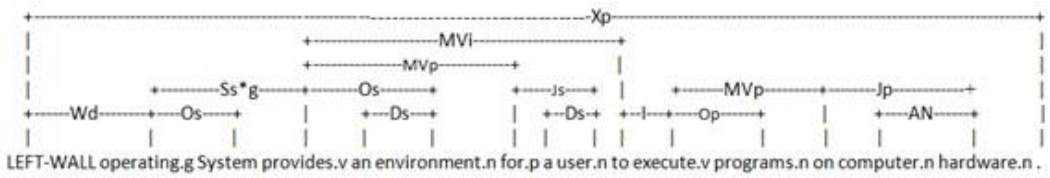

Figure 1.1. Output Generated on Parsing Sentence 1

The following list explains the significance of some of the important linkages of the link grammar system which have been used in our scheme:-

A: Can be considered as an attribute of the noun. Connects an adjective (.a) to a noun (.n)

AN: Can be considered as an attribute of the noun. Connects a noun (.n) to another noun (.n)

S: Helps in identification of subject. Connects a subject (S) to a verb (.v)

O: Helps in identification of object. Connects a verb (.v) to an object (O)

D: Helps in the identification of determiners like a, the. Connects a noun (.n) to determiners (D)

I: Helps in identification of infinitive verbs. Connects verb (.v) to words such as to

J: Helps in identification of prepositions. Connects prepositions (.p) to a noun (.n)

MV: connects verbs and adjectives to prepositions present in the sentence.

The suffixes s and p associated with these links imply singular and plural [7].

2.2. Evaluation of the Learners Response

The user sits for the examination for which he/she submits his/her answer. The evaluation of the answer is done in following steps:

Variables:

SA(Learner's Response),n(Number of Answer set), i (Counter), MA[n](Set of n Model Answer), MP[n](Set of n Model Phrase), Kw (keywords), PrE(PreExpression), PoE(Post Expression), Kw_S(Score from a Keyword), Kw_Weight(Weight of a Keyword), PrE-S(Score of a Pre Expression), PoE-S(Score of a Post Expression),X(Local variable), Marks[n](Marks obtained in n model Answer), max_Mark(Marks given to student),H[i](Hints used)

STEP 1: For each Model Answer MA[i] i=1 to n Repeat step2 to step7.

STEP 2: SET X =0

STEP 3: String compare (SA,MA[i])
STEP 4: IF(SA=MA[i]) X=1
STEP 5: ELSEIF (Search(SA,MP[i])=SUCCESS) //Search the learner response for model phrase
X=Assigned wt for the keyword
STEP 6: ELSE For every KW in MP[i] Search(Kw,SA)//Search for the keyword in SA
STEP 6.1: if Kw found: Evaluate(PrE,PoE) //Evaluate both pre & post expression
Kw_S=PrE-S*Kw_Weight*PoE-S //Score for keyword is calculated
STEP 6.2: Else Search every synonym of current Keyword in SA. If synonym match found Go to Step 6.1
ELSE Kw_S=0
STEP 6.3: X=X+Kw_S
STEP 7: Marks[i]=X
STEP 8: if hints is used X-H[i]
STEP 9: Search Maximum Marks from set of n Different marks
max_Mark=Search(max_Mark ,Marks[n])
STEP 10: Stop.

3. Implementation & Result

To initiate the process the teacher or the paper setter needs to enter multiple model answers. It is not necessary that all questions will have multiple answers. The keywords, its pre and post expression along with a weightage will add upto 1 or any marks the teacher assigns .The teacher can also assign synonyms to the keywords.

The results given in the respective tables were obtained after evaluating the answers of 18 final year diploma level students comprising of boys and girls who did not have the subject as a part of their semester programme. A set of 5 questions were given to these students and over a period of 4 week they were evaluated under different evaluation system. Firstly the students were evaluated manually. After a week's time the same examination was conducted on the same set of students but was done with the help of the learning assistance system. This process was repeated twice and the result is stated in the Table 2.

Data Set I

Question: What is software engineering?
Model Answer 1: It is the study and application of engineering to the design development and maintenance of software.
Model Answer 2: An engineering discipline that is concerned with all aspects of software production.
Model Answer 3: Application of systematic, disciplined, measurable approach to the development, operation and maintenance of software.

Table 1. Comparative Result Obtained over a Period of 4weeks

Stud_ID	Answer	Marks
A6(1stweek)	It is the process of development, also helps to study the software.	0.10
A6(4th week)	It is the study of application of the engineering to design, development and maintenance of the software.	0.79
A14(1st week)	It has a list of life cycle model which helps the developer to develop their project.	0.10
A14(4th week)	It is a study in which we can develop software and design the software in a phase wise or systematic manner	0.39

Table 2. Analysis Table

StudID	Manual Evaluation (1st Week)	System Evaluation(2nd Week)	Hints Used	Manual Evaluation(3rd Week)	System Evaluation (4th Week)	Hints Used
A1	1.6	1.61		1.45	2.34	
A2	1.8	3.01		2.5	3.01	
A3	2.25	2.39	1	1.85	1.99	
A4	1.95	3.41		2.95	4.31	
A5	1.2	-0.71	4	1.6	2.23	
A6	1.45	3.02		2	3.57	
A7	2.2	1.67	2	2	1.63	
A8	1.45	1.49		1.95	2.72	
A9	1.25	-5	8	1.45	2	1
A10	2.35	2.62		4	4.70	
A11	2.1	1.93	2	2.8	2.81	
A12	1.75	1.77	1	1	0.49	3
A13	1.2	3	2	2	3.38	
A14	1.5	1.33	1	2.6	2.81	
A15	1.75	2.12		2	2.23	
A16	3.5	2.18	3	2.2	3.02	
A17	1.25	0.05	1	2.25	2.39	
A18	1.95	0	2	1.95	2.52	

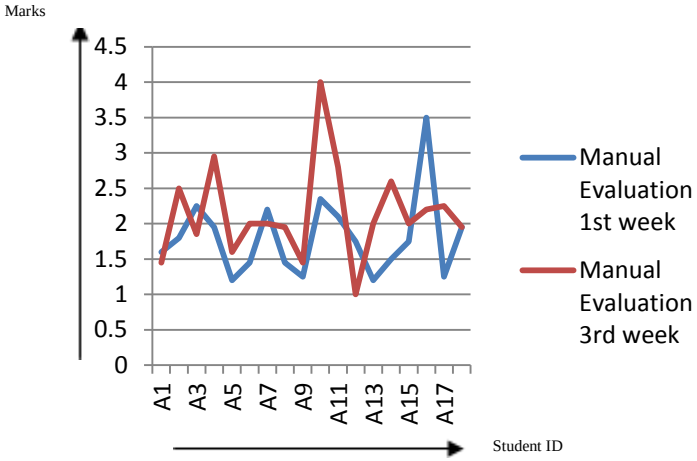

Figure 2. Learners' scores for 1st & 3rd week

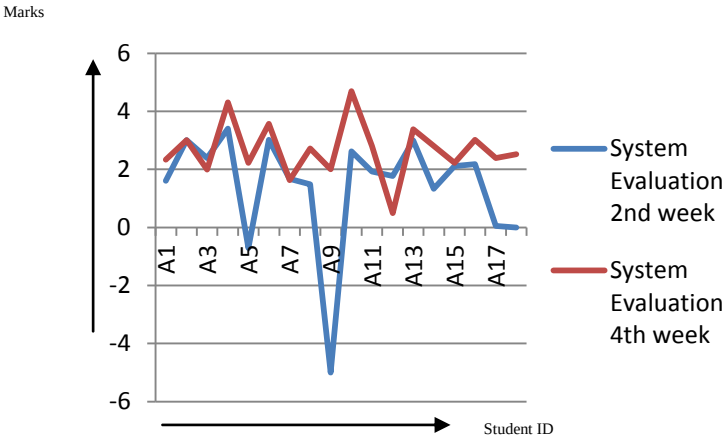

Figure 3. Learners' Scores for 2nd & 4th week

The analysis result of the Table 2 clearly indicates that the majority of the students have improved over the period of time, where they took the help of the teaching assistance to conduct their examination. We can notice that the number of hints used has also decreased considerably.

The Table 1 proves that as the student took the help of the learning assistance, their style of answering improved along with their marks. The learning assistance guided them to bring out the main points or facts of the answer rather than just guessing or giving vague answers which they were doing it in their initial answering week.

The final analysis was conducted on 16 second year diploma students, who were divided into two groups. One group was given a hard copy of a chapter and was asked to study in the traditional manner, the other group studied the same material but with the aid of the learning assistance. A test was conducted for both the groups which were evaluated manually and the result has been given in Table 3.

Table 3. Analysis Table

StudID	Marks for Material Aided Study	StudID	Marks for System Aided Study
A1	8	A9	3
A2	7	A10	4
A3	5	A11	4
A4	6	A12	4
A5	9	A13	4
A6	7	A14	2
A7	10	A15	4
A8	7	A16	4

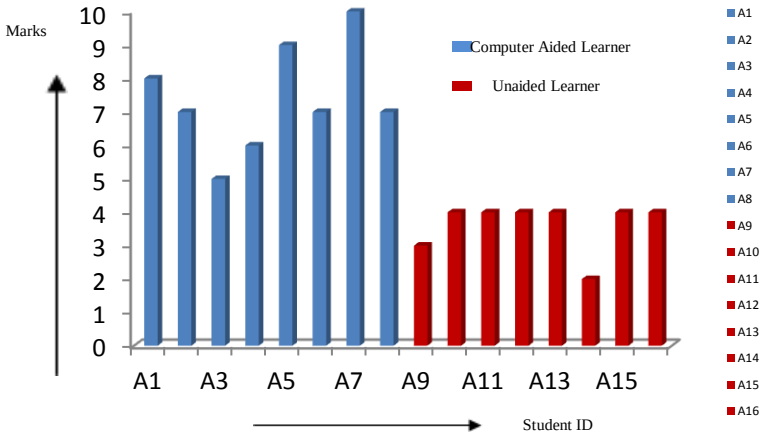

Figure 4. Result for Computer Aided Learner and Unaided Learner

Results from Table 3 and Graph comparison from Figure 4 shows that the group of students who had taken the help of teaching assistance got better marks than the students using conventional methods. Students who were not aided with the learning assistance had average marks of 3.625 whereas students who learned using learning assistance system had average marks of 7.375.

4. Conclusion

This work was aimed at developing a system that is capable of providing learning assistance to learners to learn at his/her own pace and also points towards the learner's weakness. This kind of learner assistance is one of its kinds and its uniqueness lies in the fundamental concept that it employs the learners' response to assist the students to learn effectively. The results of the two extensively carried out analysis shows that the system developed is acceptable to a considerable degree of precision. The analysis have been conducted over factoid based question both of which clearly shows that

1) When the learners are taking the help of learner assistance their level of learning remarkably improved.

2) When compared between learners learning with the help of learner assistance against learners using traditional methods clearly shows that learners using computer aided assistance scored almost double than the other students

3) The answering skill of the students who took the help of the learning assistance also improved over the time which helped them to score better marks. It trained them to focus on the fact of the answer rather than playing with the words.

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