Implementing a Real-Time Feedback System in Classroom

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Abstract

The proliferation of technology has re-defined the traditional learning environment, the classical classroom model of a teacher to student delivery is changing as technology becomes more pervasive in educational environments. In addition, the availability of technology and the breadth of difference device categories and platforms is a stark contrast to the traditional classroom, and the pervasiveness of low-cost devices provides opportunities to significantly re-define the learning environment. In this paper, we have developed a real-time feedback mechanism supported by technology to allow students and educators to assess comprehension in the teaching environment. Real-time feedback is input that is acquired whilst a teaching practice is ongoing, and the outcomes derived from the feedback mechanism have provided a strong pedagogical value to the learning environment. These benefits have been clearly elicited by the academic staff who trailed the system. This research work addresses issues of providing real-time feedback as the lecture is ongoing without disturbing other students, thus upholding effective class participation and interaction without the need of voicing own concerns loud to the lecturer, and in turn the lecturer is able to view the students’ interactions and address them. The real-time concept feedback system was used to test student comprehension of concepts, improve participation, engagement and attendance. The study identified many factors affecting students’ participation and interaction in a traditional class which inhibits understanding of concepts; hence, the development of a application to address such. It concluded that real-time concept feedback systems are vital in addressing students’ understanding in lecture sessions, thus upholding the importance of ICTs in education.

Keywords: Feedback, Realtime, Lecture, Technology, Classroom, Learning, Students’ Performance, Understanding.

1. Introduction

How to foster meaningful engagement among students in a long-standing question in large lecture halls. In effort to address this issue, electronic classroom response system has been tested and used in higher education classroom since the 1960’s. For many years, the teaching-learning process has always been delivered in a traditional mode. The instructor talks and the students take the notes. Periodically, the instructor will either call on a number of students to answer questions or use volunteers (Caldwell, 2007). Although these means may help move towards the active learning to promote an interactive learning environment in the class, the small sample size or volunteers are
normally dominated by the better and candid students. This may mislead the instructor into believing that the majority either understands, or misunderstands, the concept being taught (Caldwell, 2007). The term ‘feedback’ emerged around the start of the 20th century. It was coined to describe mechanisms that would allow a well-engineered system to regulate itself (e.g., when a heating system exceeded a certain temperature it turned itself off and could restart when the temperature got below certain level).

There is an inherent sense of control and automation within its original conceptualization. In reviewing the history of the social sciences, it is apparent that early behaviourists used feedback ideas extensively when attempting to analyse iterations in behavioural rates and probabilities. They conceived feedback as stemming from reinforcers (positive feedback) or in avoidance of punishment (negative feedback). The consequence of present actions would regulate changes in the rate of future action, in accord with the goal of servicing an organism’s motivational requirements, be they biological or socially defined. Irrespective of such uses, the term ‘feedback’ began to be used widely, becoming an aspect of everyday vernacular well aside from its original derivation in engineering theory and practice.

Classroom-based research has disclosed three curious facets about feedback. First, lecturers allege they dispense much helpful feedback to their students at relatively high levels and claim they do so routinely. Second, trained classroom observers, in studies into interaction patterns in classrooms, disclosed that feedback occurred in most classrooms at relatively low levels, and barely at all in many locations. Even studies with highly expert lecturers indicated strangely low level of feedback observed during classroom instruction (Ingvarson & Hattie, 2008). Third, when students were asked what feedback they experienced in classrooms, many reported the level as being low to virtually nil.

Although, much research has gone into improving the level of feedback in lecture rooms, many authors have even dedicated most of their time researching about how to change the traditional method of teaching and learning in the classroom with digital means, fostering teaching and learning with technological means to improving and facilitating the teaching-learning process, both for the lecturers and the students, but not so much has been achieved since then as the level of technological advances varies from one country, university, educational institutions to the other. Hence, the reason for this research work, developing a real-time concept feedback in lectures such that students will come to lecture, open the handbook/curriculum in digital form on their various devices, iPad, tablet, laptop, smart phones and follow along with the lecture. Not leaving a place for the lecturer to receive feedbacks from the students showing how the concepts being taught are being understood.

2. Related Works

Feedback is conceptualized as information provided by an agent (e.g. teacher, peer, book, parent, self-experience) regarding aspect of one’s performance or understanding. Real-time is a term relating to a system in which input data is processed milliseconds so that it is available virtually immediately as feedback to the process from which it is coming. Online feedback system is a web portal designed to collect feedback from the college students about the lecturer and the course regarding the quality delivered by the lecturer vis-à-vis a particular course.

Wells et al. (2008) investigated the effectiveness of the virtual learning environment in an accounting graduate program. More specifically the virtual tool used was Blackboard (i.e. an online proprietary virtual learning environment), where the views of a group of students who used it were studied. The main goal of the research was to evaluate the usefulness in terms of the provision of lectures, additional information and notes, exercises as well as forum discussions. The student’s views were positive about the integration of the virtual learning environment for teaching accounting; indeed teacher-student interaction was strengthened as well as the process of learning.

More recently, Basioudis and DeLange (2009), studied student views regarding student interaction with the aforementioned tool called Blackboard. The results showed that the former tool influenced students’ mental effort and participation to the course.
Kay and LeSage (2009) suggested that, without the use of a tool similar to an SRS, it is difficult for faculty to assess the overall student comprehension of topics discussed and presented in a lecture. With the use of an SRS, each student is encouraged to provide a response to every question and, as a result, there is an increase in the number of opportunities to respond to questions designed to assess their comprehension. Blood (2012), also found evidence that supported that review and feedback supported by SRS had a positive effect on long-term retention of information. Laaounou and Artino (2010) reported that such results were evident due to the “unique affordances” that SRS contributed to classroom pedagogy.

Terrion and Aceti (2012) in their implementation of classroom feedback system which they called Student Response Systems (SRSs) also known as clickers, allowed communication in a two-way pattern (instructor-student). The SRS “offer feedback to both instructors and students as to how well concepts are being understood”. This real-time feedback can prompt instructors to provide further instruction and discuss any misconceptions in a quick and timely manner, reassess, and, if satisfied with the level of understanding (Stav, Nielsen, Hansen-Nygard, & Thorseth, 2012).

Chen et al. (2012) in their paper posited that “providing feedback to students of their current level of understanding of concepts is critical for effective learning”. The majority of students surveyed in their study wanted rapid feedback on their level of comprehension and felt that their overall performance in the course would be affected negatively without it. The authors found that, for students, there was a lack of timely feedback and opportunities for review to improve learning before graded examinations. For faculty, the challenges related to identifying which concepts were being understood and which were proving to be more difficult to comprehend.

Oleksiy Khriyenko (2015) while analyzing the feedbacks given by customers on product reviews and customer satisfaction, posited that “the digital economy requires services be created in nearly real time while continuously listening to the customer”, therefore, the paper reviewed digitalized customer feedback strategies, highlights challenges of a feedback gathering and further computation. Allen J.F. et al., (2008), in Gamon M., (2004) among the various NLP techniques, opinion mining and sentiment analysis. One of such solutions is to design and develop methods that enable the automated annotation of plain text with ontology concepts Cherfi H. et al., (2008). The paper tackled some of the challenges of customer feedback gathering and its automated processing. Therefore, discussed and proposed an approach of semantic enhancement of customer feedback system. Involvement of customers in collaborative product review and feedback provisioning process will provide a deeper understanding of their needs and increase the likelihood that the new product will meet customer’s needs.

Prof. Phani et al. (2017) developed an Online Student Feedback System for the Institute of Technology and Management, Ballari, India. The reason for their implementation is the fact that students give feedback about the lecturers and the quality of lectures manually, hence, the need for an Online Student Feedback System which served as an automatic feedback generation system that provides the proper feedback to the lecturers. Their aim for the implementation of Online Feedback system is to save time for staff in academic departments.

3. Statement of the Problem

Up till this moment, many researches have gone into integrating feedback into the learning process that takes place in lecture rooms. The most recent and effective of these digital implementations in enhancing teaching-learning process in the lecture room is the Classroom Response System (CRS), to engage students, and have real time assessment of student’s understanding, “clickers”, have been seen with increased use in many engineering classroom (Petr, 2005; Premkumar & Coupal, 2008; Siau, Sheng, & Nah, 2006; Trees & Jackson, 2007).

A classroom response system (CRS) is any system used in a face-to-face setting to poll students and gather immediate feedback in response to questions posed by instructors. A non-technical example of
A CRS is an instructor asking students to raise their hands or agree or disagree with a given question. A slightly more sophisticated practice involves the use of colored flashcards, with each color corresponding to a possible response in a multiple-choice question.

Over the past 30 years, technologists have developed and refined electronic response systems and refined electronic response systems that allow students to key in responses using transmitters (also called “remotes” or “clickers”). Students key in responses using small remote transmitters. These transmitters send signals to a receiver that is connected to the instructor’s laptop or lectern PC. Software on the instructor’s machine instantly tabulates and graphs can be displayed on the presentation slide.

The pros about the “clickers” implementation of Classroom Response System is that lecturers get feedback as to what the students understand and what not, but the cons in this implementation goes thus, students cannot verify from the curriculum if what they are being taught by the lecturer is what is actually in the curriculum. Another down side of this implementation is the need for devices like clickers and transmitters which when not available to all students as a result of finance or unforeseen factor will still result in the traditional mode of teaching. Hence, the need for a more responsive and flexible system. This research work, “Implementing a real-time concept feedback in lectures,” will cater for the down sides of the previous implementations of Classroom Response Systems.

4. Aim and Objectives

Aim

The aim of this research work is to develop a web application that will be used by students and lecturers to help determine how concepts are being understood by the class, not leaving the aspect of doing a back check as to whether the lecturer is following what is in the curriculum for the particular course being taught as the students have access to the curriculum to substantiate in the course of the lecture.

Objectives

The objective that this research work aims to achieve is to replace the traditional method of lecture feedback system used currently in many institutions with a web-based system that can be accessible in any smart phone, tablet, desktop computer and laptops.

i. To achieve the set aim, the research work will cater for these objectives:

ii. To make classroom feedback a two-way process, as students can also get feedback and compare what they are being taught by the lecturer from the curriculum in their various electronic device.

iii. To make classroom feedback more flexible and cheaper in terms of cost as compared to the previous implementation which depends solely on the use of special devices like clickers and transmitters.

5. Research Method

To help the Instructors/Lecturers in prompt decision making as the lecturers get contiguous and rapid feedback from students, base his judgement of the students’ understanding by the immediate feedback from the students and determine whether to move on or re-emphasize what is currently being taught, Object-Oriented Analysis and Design (OOAD) shall be adopted as methodology for this study.

The following procedures will be taken:

i. System Requirement: Feedbacks will be gathered from students and processed by the application and sent to the faculty for decision-making.
ii. **Specification:** The system’s functions (operations) shall include, but not limited to; providing curriculum for students to verify what the lecturer is teaching, getting feedback from students based on what they learnt during lectures, allowing lecturers a read-only access to these feedbacks, sending a report of the feedbacks given to the faculty for decision making.

iii. **System Model:** The system shall be modelled in relation to the specification provided above.

iv. **System Development:** ASP.NET Core MVC with C# Object-oriented Programming Language shall be used for system development.

![System Methodology](image)

**Figure 2:** System Methodology

6. **System Model**

**Mathematical Model**

The system was modelled mathematically using the proposed model below:

**constraints:**

A student does not have access to other students’ feedback
A lecturer has a read – only access to students’ feedback
A lecturer cannot teach outside what is in the curriculum

**Representing Objects using set Notations**

Let $S = \{s_1, s_2, ..., s_n\}$ be the set of Students
Let $L = \{l_1, l_2, ..., l_n\}$ be the set of Lecturers
Let $C = \{c_1, c_2, ..., c_n\}$ be the set of Courses
Let $D = \{d_1, d_2, ..., d_n\}$ be the set of Departments
Let $F = \{f_1, f_2, ..., f_n\}$ be the set of Feedbacks
Let $M = \{m_1, m_2, ..., m_n\}$ be the set of Modules
Let $K = \{k_1, k_2, ..., k_n\}$ be the set of Curriculum

**Mathematical Equation**

For $\forall S = \{s_1, s_2, ..., s_n\} \in D = \{d_1, d_2, ..., d_n\}$ offering $C = \{c_1, c_2, ..., c_n\}$ gives

$F = \{f_1, f_2, ..., f_n\}$ | $\exists M = \{m_1, m_2, ..., m_n\}$ in $K = \{k_1, k_2, ..., k_n\}$

and $L = \{l_1, l_2, ..., l_n\}$ is a lecturer from $D = \{d_1, d_2, ..., d_n\}$ sees $F = \{f_1, f_2, ..., f_n\}$
Symbols used

∀ – for any / for all
| – such that
∃ – there exists
∈ – element of / is contained in

7. System Flow

- **DATABASE**
  - Contains Curriculum and other Data Resources for Storage and Retrieval for the Application

- **API**
  - Fetches Resources from the DB Based on requests from the client
  - And generates a UI for the client respectively
  - Has access to feedbacks report Generated by the API for decision making
  - Sees Curriculum, gives feedback on concept being taught and takes assessment
  - Has read-only access to feedback Given by students

- **FACULTY**
  - Has access to feedbacks report Generated by the API for decision making

- **STUDENT**
  - Has read-only access to feedback Given by students

- **LECTURER**
  - Sees Curriculum, gives feedback on concept being taught and takes assessment

- **User Interface**
  - Mobile
    - Android
    - Windows
    - iOS
    - Linux
8. System Flow

START

login/register

validate/authenticate form data

USER ROLES

STUDENT
receives lecture
gives feedback
lecture quality
resonates well with the concepts being taught
takes assessment

LECTURER
gives lecture
sees feedback
feedback from students
students are satisfied with the quality of lecture
gives assessment

FACULTY
sees feedback report
generate feedback report
feedback from students
students are satisfied with the quality of lecture
makes decision on how to improve lecture quality and interactivity

OVERALL STATUS
satisfactory
unsatisfactory

END

Student: login/register

Lecturer: Login/register

Faculty: sees feedback report

Feedback Application: generate feedback report for lecture feedback from students

Feedback: feedback from students

Student feedback: satisfactory or unsatisfactory

Lecturer feedback: satisfactory or unsatisfactory

Faculty decision: improves lecture quality and interactivity

System Flow

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9. Relationship Diagram

Figure 1: Entity Relationship Diagram
10. Implementation Pages

![Student’s Input Parameters Registration Page](image1)

![Student’s Input Parameters Completes Registration](image2)

![Student’s Input Parameter Login Page](image3)

![Lecturer’s Input Parameters on Registration Page](image4)
SMART CLASSROOM

Interaction in the classroom has never been so improved. Lecturer-Student relationship has taken a new turn.

GET STARTED

Landing Page of the SmartClassroom Feedback System
11. Findings
The following are the findings from the study:

1. The literatures reviewed showed that there’s been a lot of tremendous work done in developing the different feedback systems being used today.

2. Students are more comfortable with giving feedback systems implemented on digital platforms as opposed to the manual ones.

3. The research improved the participation of students in the teaching and learning process that goes on in the lecture rooms as they have an idea of what they expect to be taught at each lecture.

12. Contributions to Knowledge
The study established:

1. An efficient and effective web platform for getting feedbacks from students on how well they understand the concepts being taught by their lecturers.

2. A close scrutiny of the manual system of classroom feedback to develop the system.

3. A responsive system that student and lecturers can relate not just to send and get feedback but also to improve the relationship between lecturers and students in the teaching and learning activities going on in the classroom.

4. A system that gives access to students to see the curriculum, hence, letting them know what to expect to learn and also lecturers, what to teach, thereby, making them learn the right module at the right time.

Conclusion
Sampling the existing documents from the reviewed literature revealed that students were not always disposed to give feedback on the manual system of using paper and pen, hence, the need to review and implement a more responsive system to achieve the cause. Students’ interest and participation in feedback and other classroom activities increased with the development of classroom feedback system and teaching methods on digital system. This participation and activeness in classroom has increased over the years as technology grew and is being applied to the different classroom activities, more specifically getting feedbacks from students.

The manual method has terribly failed in getting students’ attention and participation due to the different lapses in these systems. One major one being that students have to always fill one form or the other after each classroom activity ranging from the attendance book, to the feedback form and other unnecessary forms every now and then. Another major thing after the introduction of feedback using clickers is the added cost to the student and university system in using and managing these systems. The more hardware system introduced to these systems meant a lot of fixing and maintaining whenever these hardwares and the different parts coupled together to make these systems work fails.

Consequently, feedback system was implemented on a web platform first by Prof. Phan et al. (2017), with limit in scope of just getting feedback from students and no more, however, this research work critically reviewed his work and increased the efficiency of his implementation of the feedback system by making the curriculum with which the students are taught from accessible on the platform to reduce the risk of students being taught the wrong thing. Also, more text fields that discourages students from giving feedback were replaced with graphical elements like number sliders and rating star to help student focus more on less visual elements while giving adequate feedback about the lecture going on.
14. Direction for Further Studies

The feedback system in this research work is scoped to undergraduate programs, hence, the feedback system developed for the purpose of this research work has not been tested in other level of educational institution or other fields in the different walks of life. However, further research can expand the scope of this research work by creating feedback system that is responsive, effective and efficient for the different fields ranging from financial, as to how customers are enjoying the services being offered by these institutions and how employees as to how better they would work if management changed some of their policies, political, as to what services the citizens would want focused more for each community rather than just working on projects that won’t really improve their standard of living.

This scope of this research trend is limitless in providing feedback to the different organization and the different institutions available in the country and beyond. Furthermore, constraints such as data encryption and advanced data security between the different levels or hierarchy where the feedbacks given will pass through should also be implemented to enforce privacy of the respondents and ensure security of data passed between the different layers in that specific system.

References

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