IU-EVAL
IMPLEMENTING AN OPEN-SOURCE ELECTRONIC COURSE EVALUATION SYSTEM

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ABSTRACT
Anonymous course evaluation is an important instrument for assessing teaching effectiveness and maintaining the quality of academic programs. At many universities a significant amount of resources and staff time is spent on preparation, distribution and collection of confidential end-of-semester evaluations. To minimize manual processing and improve the speed, accuracy, and effectiveness of this task, the authors have developed an open-source, web-based electronic course evaluation system called IU-EVAL. The system was tested by approximately 19,500 students between August 1, 2004, and May 30, 2006. In this paper we describe some of the design principles and strategies behind the development of IU-EVAL as open-source software.

KEY WORDS
Web-based applications, web-based course evaluations, assessment, open source software development.

1. Introduction

Course evaluation is an important component in the overall assessment of academic programs. At IU South Bend, each academic unit designs and administers its own unique set of assessment instruments. Furthermore, each unit has its own method of scaling and analysing the data that it collects. In our campus alone (one of eight IU campuses), there are over 40 distinct evaluation forms used by the academic units. Discussions to develop a unified evaluation form [1] have actually reinforced the need for more customized and targeted assessment tools instead of a uniform and simple evaluation form.

Aside from the cost and complexity of developing and maintaining a large number of distinct evaluation forms, there is the cost of administering, collecting, analyzing and archiving the results. Furthermore, there are other challenges such as maintaining anonymity of students and privacy of faculty. Finally, there is the issue of accuracy and timeliness of reports. The above challenges have provided the motivation for our effort to develop the IU-EVAL system.

IU-EVAL has made several contributions in addressing the above challenges. First, the data model and the relational database system developed by our group have proven to be extremely flexible in accommodating the unique and varied requirements of our academic units. Second, as indicated by the adoption rate of our system, IU-EVAL's process model and intuitive user interface have been a source of strength in attracting the user community. Third, IU-EVAL's user-friendly report generator has increased the accuracy and simplified the task of collection and analysis of evaluation data.

From the software engineering point of view, the web-based development approach employed by our team has allowed a very efficient and distributed software engineering development cycle. A three tiered development environment allowed us to expedite the implementation and testing phases, and facilitated the bug tracking and quality control aspects of the system. Finally, using existing open-source tools has paved the way for the future open source release of IU-EVAL.

2. Background and Related Work

Before embarking upon the design and implementation of IU-EVAL, we examined the potential usefulness and cost efficiency of a number of off-the-shelf solutions that could potentially address our course evaluation needs. Early in 2002, we began using an electronic evaluation system known as Free Assessment Summary Tool (FAST) [2][5]. FAST is primarily designed for individual instructors. It provides instructors a user friendly tool for developing web based assessment instruments. FAST provided some limitations on how many questions could be placed on a survey or what answer-types could be associated with the survey questions. Also, during one evaluation period, the FAST server became unavailable or sporadic for a brief period of time. This was later

determined to be due to load and was addressed promptly. Overall, the developers of FAST were very willing to work hard to make the system both user-friendly and available to the user community. For us, perhaps the most major issue of concern was our inability to scale up and use FAST for our entire campus.

Another system that was evaluated (but never used) was the CoursEval system developed by Academic Management Systems [3]. An advantage of CoursEval over the FAST system is its ability to collect and analyze longitudinal survey results. Also, CoursEval has placed great emphasis on user authentication, security, and anonymity of responses.

Another system reviewed was SurveyMonkey [4]. One advantage of SurveyMonkey is its ability to create 'Skip Logic' (Conditional Logic), allowing the survey designer to customize the path a respondent takes. This may not be a significant issue in the design of most course evaluations, but it adds a nice feature for general purpose surveys. Another nice feature was SurveyMonkey's ability to incorporate images and logos in the surveys.

A more comprehensive review of stand-alone as well as on-line survey and evaluation systems may be obtained from our IU-EVAL project web site at www.eval.iusb.edu.

IU-EVAL is designed to address a number of areas in which the above systems did not meet the specific needs of our academic units. These include:

a) Flexible report generation
b) Control, privacy and ownership of data
c) Variety of questions and/or answer-types
d) Templates that can be applied to one or more evaluations or surveys
e) Ability to interface with existing campus systems (batch loading of data)

3. Design and Implementation

In this section we will discuss the design and implementation of IU-EVAL. The data mode, database schema, and the process model are discussed. Finally, IU-EVAL's overall design architecture is explored. We will also note the distributed development approach used by our group to facilitate the implementation, testing, bug tracking, and quality control of the IU-EVAL system.

3.1 IU-EVAL Design

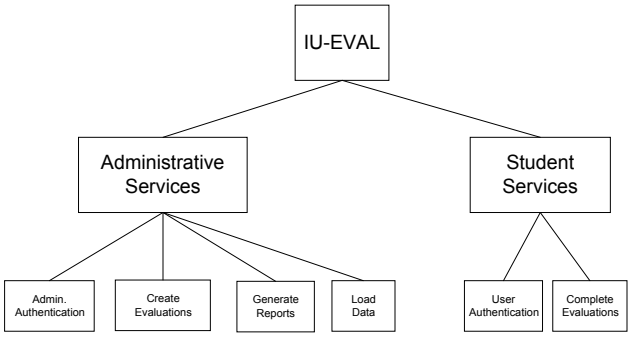
During spring 2003, we embarked upon the initial analysis of a potential electronic evaluation system. Later during the spring 2004 semester, we began to further analyze and design a prototype system in our Systems Analysis and Design course. Following that semester, we developed a design team composed of students and faculty and embarked upon developing a more robust and production quality system. Following its implementation, IU-EVAL was beta tested during the fall 2004 and spring 2005 semesters.

The IU-EVAL system is currently being used by 13 departments in the college of Liberal Arts and Sciences and two Schools on our campus. This level of usage has provided us with significant opportunity for feedback and reflection.

From the beginning, our goal was to develop a highly customizable and scalable electronic course evaluation system. We tried to be fully cognizant of the university's organizational model and its unique needs and requirements for conducting course evaluations. We also tried to be sensitive to both student and faculty needs for anonymity and privacy. Our team of students and faculty spent approximately three months interviewing various stakeholders, analyzing the requirements, and refining the design of the system prior to implementing a single line of code. As the result, our data and process models have proven to be quite robust and have been able to easily accommodate new and unanticipated requests for new features. In addition, our decision to use open-source development tools has contributed to the system's flexibility and portability.

As shown in figure 1, IU-EVAL has two major sub-systems. These are Student Services and Administrative Services.

Fig 1. IU-EVAL Sub-Systems



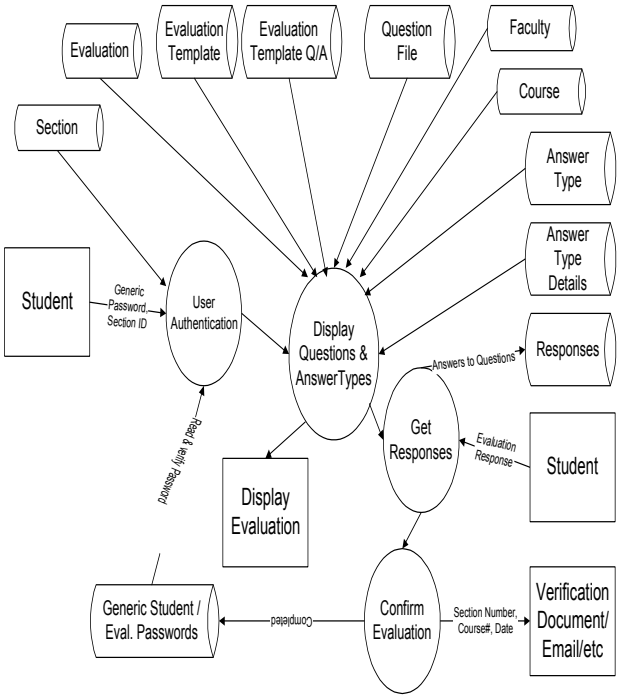
Conceptually, the STUDENT SERVICES sub-system is quite simple and intuitive. Each student is provided with an anonymous password (randomly generated) for each course registration. The IU-EVAL system is able to identify the course, section, instructor, semester, and other pertinent information from this single password. It is important to note that passwords are completely anonymous. The IU-EVAL system does not maintain any identifying information about the students.

Once the password is entered, IU-EVAL will display the corresponding evaluation form for the course. It should be noted that at IU South Bend, academic units are free to use their own evaluation instruments. Therefore, students taking multiple courses are likely to complete different evaluation forms for each of their courses. (Currently,

there are over 40 distinct evaluation instruments used at IU South Bend.) Once the evaluation is completed, the student's responses are recorded in the IU-EVAL database, and the password is invalidated and may not be reused.

Figure 2 below represents the process diagram used by the students to complete a course evaluation.

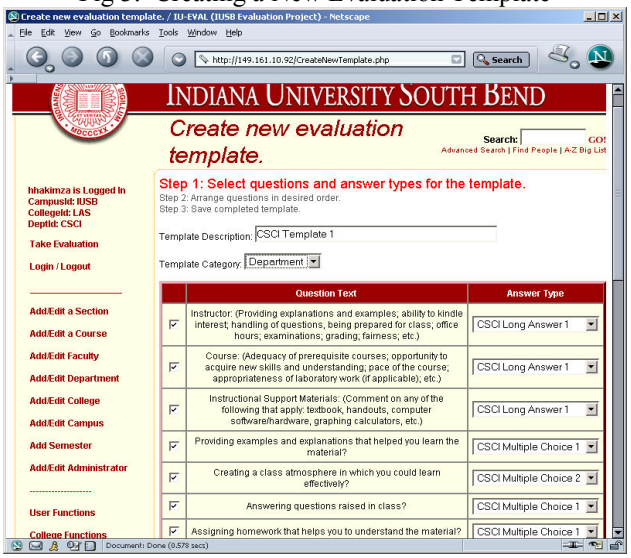
Fig 2. Student Sub-system



The ADMINISTRATIVE SERVICES sub-system is slightly more complex. There are primarily two types of administrators. The first type is the departmental administrative staff member (typically the department secretary) who is responsible for creating the evaluation instrument, ensuring that faculty, course, and section information are correct, generating random passwords, and distributing those passwords to students in corresponding courses. The department administrators are also in charge of printing the final evaluation reports and distributing them to faculty.

The first task that a department administrator must perform is to create one or more evaluation templates for their department. Figure 3 display the interface by which a new evaluation form (template) is created. Typically, the process of creating a template requires the creation of one or more questions and answer-types. An evaluation template is simply the mapping of questions and their corresponding answer-types.

Fig 3. Creating a New Evaluation Template



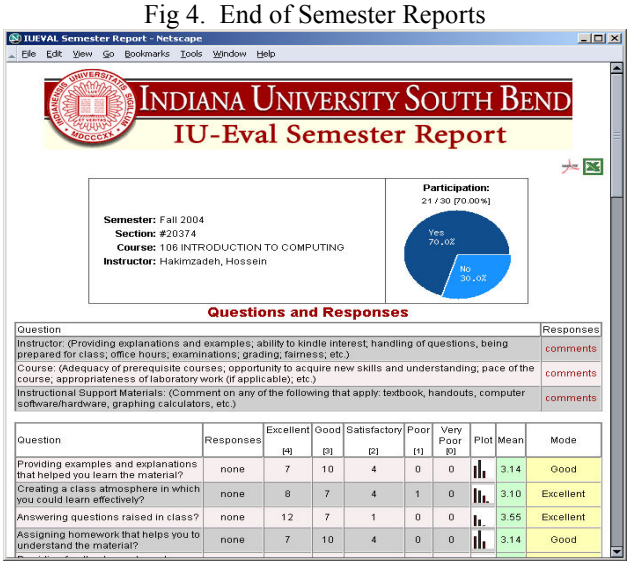
Once the evaluation template is created, the department administrator will simply assign the template to the relevant sections that are currently being offered. The system will automatically generate random passwords for each assigned section.

IU-EVAL allows academic units to create as many evaluation templates as are needed. For example, a department can create one evaluation template for use in lecture classes and another for laboratory classes. Furthermore, if a course has both lecture and lab, one can seamlessly combine the two forms.

Finally, after the semester is over, the department administrator will print the course evaluation results for each professor.

Figure 4 below shows a sample end-of-semester evaluation report.

Fig 4. End of Semester Reports

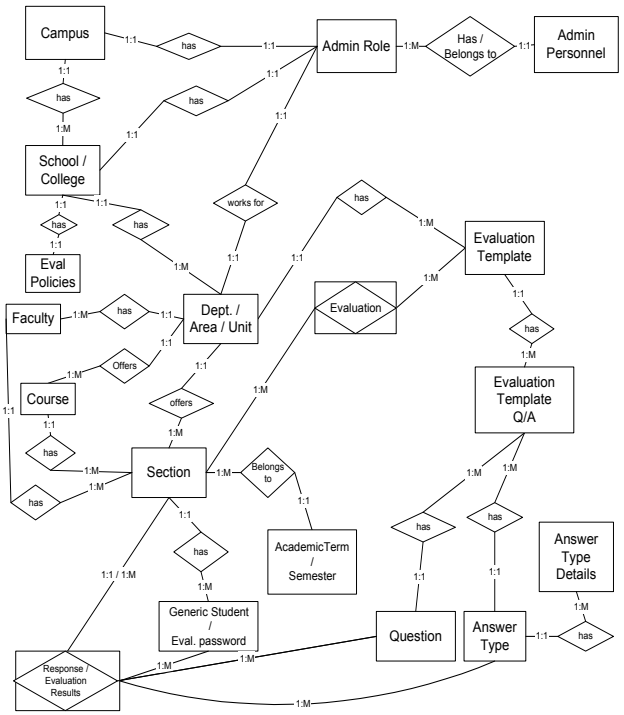


The second type of administrator is the superuser. The superuser serves as the IU-EVAL system administrator as well as the database administrator. The superuser's primary responsibility is to interface with department administrators and with existing university information systems (IU's *OneStart* [6] System which is build on top of PeopleSoft), and to load the initial data for all the sections taught during a given semester.

3.2 IU-EVAL Data Model

At the heart of our system is our data model, captured in an Entity Relation Diagram. Figure 5 below represents the IU-EVAL ERD, which provides the road map for the creation of the database schema. IU-EVAL's data model is designed to accommodate a multi-campus academic institution such as Indiana University. Naturally, it can also be used by smaller organizations.

Fig 5. IU-EVAL ERD

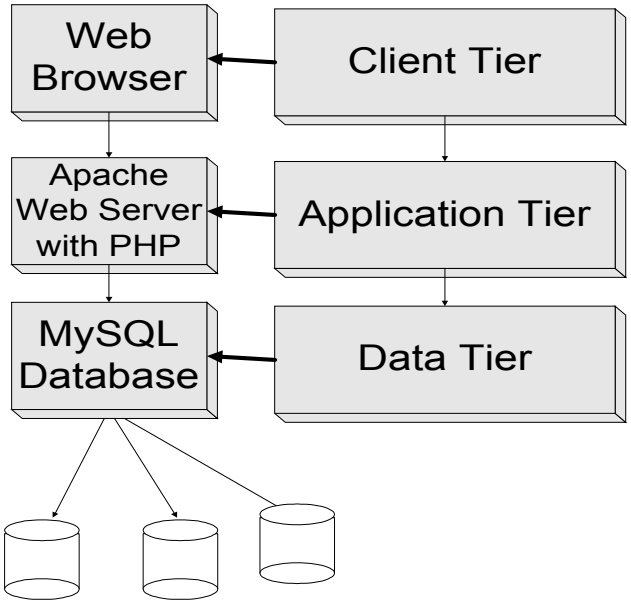


One advantage of IU-EVAL is its flexibility in accommodating almost any evaluation form. This ability is primarily based on the fact that our system is mostly data driven as opposed to being process driven. A data driven system often requires significantly much more time in the development of the data model, however, it pays back in future coding and implementation cost. It is due to the maturity and complexity of the data model that our system has not required any major changes since its release in 2004.

3.3 Implementation Tools

One of our goals has been to make the IU-EVAL system freely available to the larger academic community. In order to easily achieve this goal, we selected a set of mature development tools that already exist in the public domain. After some research, our team chose the combination of MySQL [8], PHP [9], and Apache web server [10], running on a Linux server (see Figure 6). This combination has been successfully utilized by a great number of developers to implement powerful three-tier web based applications. Currently, IU-EVAL runs on a Linux platform. However, due to portability of our development tools, it can be easily ported to the Windows environment as well.

Fig 6. Implementation Tool



3.4 Distributed Development Environment

For the most part, the implementation of IU-EVAL has followed a textbook example of system development. By that we mean the following: a great emphasis on analysis and design at the early stages; developing good team dynamics; paying attention to software testing and quality control; setting realistic and achievable goals; keeping the user community involved in all aspect of the analysis, design, and testing; and, finally, proper training of the user community.

Our emphasis on early and deliberate analysis and design, as well as our goal to implement a web based solution, allowed our team of five student developers to work in a truly distributed development environment. The database schema was developed first. Major SQL queries were developed and tested. Data flow diagrams and functional specifications for each module were developed and refined. A bug tracking system [11] was implemented to aid in reporting and resolving bugs (Figure 7 and 8). Finally, each developer was assigned one or more components to develop, and they were also responsible

for responding to and correcting bugs reported within their area. The project manager's role was to work with individual developers to resolve problems, perform individual component tests, perform system integration testing, identify and report bugs, and find and resolve inconsistent or conflicting requirements or specifications.

Fig 7. IU-EVAL Bug Tracking System

Fig 8. Sample Bug Incident

ID	Category	Severity	Reproducibility	Date Submitted	Last Update
0000077	[IUEVAL] backups	minor	always	03-31-05 10:48	03-31-05 10:48
Reporter	hhakimza	**View Status**	public		
Assigned To	jdeboni				
Priority	normal	**Resolution**	open		
Status	assigned			**Product Version**	
Summary	0000077: "College" user Access Privilages				
Description	1) I created an account (hakim_c) and gave myself "College" access level. 2) I logged in as hakim_c and tried the menu items available to a "College" user. 3) I was not allowed to run the "Batch-Load" script. 4) I was not allowed to run the "Add/Edit Department" script. and changed my navigation panel to super-user. 5) Then I changed my navigation panel to "Super-User" and I was able to click on add semester and easily add a new semester record. I checked the other scripts under "User" and "Super-user" navigation panels and everything else seemed to work ok. Nevertheless, I think we should review all the scripts and make sure they are only executable by the appropriate access levels. Perhaps there should be uniform security function that every script calles before it starts to execute.				

These tools, principles and practices have resulted in the creation of an amazingly robust system. During major testing in spring 2005, our main system failure was actually caused by one of our team members accidentally disabling a major subsystem, which caused an approximate 30 minute down time. Since that time, the system has been used by nearly 18,000 more students. Only two students have reported errors, and those have been tracked and determined to be the result of session timeouts (the students in these cases took too long to complete their evaluation). By far the most important issues that we have encountered have been non-technical. A list of such issues is provided below:

1) Administrator training and retraining
2) The logistics of printing and distributing thousands of passwords
3) Increasing student participation
4) Assuring faculty and students about the anonymity and privacy of the evaluation data

As for technical issues, we continue to receive great feedback from the user community as to how the system should be improved. Some of these suggestions are being incorporated in the new version of IU-EVAL. Yet many other suggestions appear to be too specialized to be incorporated. At this point the decisions to accept or reject new features are made by the authors. However, as the system becomes available as open-source, we foresee a more distributed decision making process.

Lessons learned during the implementation of IU-EVAL have been employed in our most recent software engineering projects [12][13][14], as well as the new version of IU-EVAL.

4. Conclusion and Future Work

IU-EVAL is an open-source, web based course evaluation system developed at IU South Bend. The open-source movement has brought a number of extremely useful software products and tools to the user community. For the most part, open source products and tools have stood the test of time. Similarly, our goal has been to develop a generic, customizable, and scalable electronic evaluation system that meets the unique needs and requirements of an academic institution. Furthermore, we sought to make the system available to the larger academic community.

To date we have been able to make significant progress toward our goal. IU-EVAL is currently being used by thirteen departments and two schools at IU South Bend. So far, we have received excellent feedback from the user community. During major testing in spring 2005, we had no significant errors or failures. We are currently developing a new version of the IU-EVA that we hope to be able to put it in production by spring 2008, at which time we will be seeking a number of academic institutions to serve as beta testing sites.

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