# A General Software Framework based on Reform in Formative Assessment

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*Abstract*—**Formative assessment reform is an important tool that can bring about a fundamental change in the traditional education system. It is beyond question that this measure will set new scientific objectives in education. Given this probable advantage, formative assessment is a necessary step that will align our methods with international practice. It is all the more crucial in light of the international character of computer science as a discipline; hence, it has substantial practical applications. Consequently, in order to meet international standards, we should remedy the existing serious limitation in the traditional means of assessment. With the current practice of computer technology education, this paper will introduce a reform in formative assessment and propose a software framework of the web-based practice teaching administration platform for formative assessment. With a certain degree of versatility, scalability, flexibility and value of promotion, this system has been partially adopted in department of computer science.**

*Index Terms*—**Formative Assessment, Software Framework, Reform, Computer Science, Education**

## I. INTRODUCTION

The advent of economic globalization has transformed the manner by which people normally go about their daily lives, from the simple mundane tasks to the more thought-provoking. In fact, so pervasive have these changes been that they have even altered the way we acquire knowledge as well as the pedagogical methods that we employ in sharing what we know. It is no wonder, therefore, that even our universities have realized that there is no avoiding this current trend. In order to meet the stringent requirements of the new educational landscape, universities now seriously reevaluate how they cultivate their academic resources [1][2]. Hence, learning institutions are shifting their focus from more traditional methods to more information-based systems that may suit an international student clientele.

Formative assessment is a non-concentrative assessment [3]. The concentrative assessment refers to the assessment that is completed at designated locations and time, while formative assessment breaks through these two restrictions. Formative assessment can be carried out in a flexible way: it can be distributed throughout the whole process of learning, or concentrated in a certain period of time; it can be carried out in the designated examination rooms of a school or some other places outside the school; it may be a test paper, investigation report, design, application, or production[4], etc.

Formative assessment reform is an important measure that can bring about a fundamental change in the traditional education system. It is beyond question that this measure will set new scientific objectives in education. Given this probable advantage, formative assessment is a necessary step that will align our methods with international practice[5]. It is all the more crucial in light of the international character of computer science as a discipline; hence, it has substantial practical applications.

At present, there are few works which make all-trip management researches on formative assessment using the internet and informational technology. There are only few teaching steps including discussion on the internet used to manage it. These steps only form partial researches on formative assessment, and there is a lack of a whole method to be used. Therefore, it is necessary to make researches the application processes in the formative assessment of the computer majors of the development techniques of the information management software based on the B/S structure. Straightening out the practice contents, specify the cases, improving the teaching methods and means so that the content of the teaching practice can keep up with the development of the technology. Meanwhile, it makes full use of the convenient condition of the software and internet base of the computer department and provide enough practices for the students to understand and master the development technique of the information management software, so that to achieve the expected effect in the formative assessment.

Based on the reform of formative assessment methods, it comprehensively analyzes the service needs in many aspects and gives a design proposal of formative assessment management platform based on web and introduces and analyzes the main function and implementation technology of the system.

## II .NECESSITY OF FORMATIVE ASSESSMENT

Formative assessment, a kind of phased assessment on the learning results of students [6][7], is an important part of teaching management. It is imperative that it be conducted to strengthen the guidance and management in the learning process. Moreover, it is a crucial element in feeding back relevant learning information. Hence, it guides the teaching methods that academics employ, which consequently improve the students' overall quality and capacity.

The traditional concentrative assessment [8] measures the academic performance of a student only through the results of the final examinations. This is widely used in the examination systems of primary schools, middle schools and universities. It goes without saying that it has its own advantages. However, the efficacy of this assessment method is seriously questioned in light of emerging problems in its method as a result of the changing times.

1.  Generally, final examination is carried out at the end of a semester, so many students may keep being relaxed until when the final exam is coming, and then they will have to prepare for the exam in a hurry. Of course, learning in this way won't enable the students to grasp the knowledge well [9].

2.  As the final examination can only be conducted once, the situation that the failure rate is too high may appear. The main reasons are that final examination excessively stresses concentricity which may lead to temporal & spatial separation between the teaching process and evaluation, so teachers can't understand the students well, resulting in high possibility of abnormal situation in assessment[10][11].

Therefore, we should keep conducting our study and research in the process of teaching, and try to push forward the reform and improvement of formative assessment continuously [12].

Since 2004 when School of Information and Electronic Engineering of Zhejiang University of Science and Technology (ZUST) began to cooperate with University of Southern Queensland (Australia) to develop the specialty of Computer Science and Technology (double degree), School of Information of ZUST has launched many courses that are undertaken by the Australia side, while most of the teaching mission is undertaken by the Chinese teachers. During the teaching of these courses, we keep communicating with the Australian teachers and have learnt quite a lot. The Australian teachers attach great importance to formative assessment in the process of teaching. They will give the students at least one assignment in each main course, while it's possible that more than three assignments are set for the students in some special courses, and the results of these assignments of a student account for 30%-50% of his final results.

In the actual process of teaching, we find that these assignments can lay a great impact on the whole teaching process. The assignments, which are given to students at the beginning of a semester, makes the students understand the importance of learning deeply, and even some students begin to consult the teachers about the relevant courses and problems related to the assignments in the second week of a semester. At this period when the students in common classes are feeling "relaxed", the students in China-Australia Class have already begun to study hard. In the next course of teaching, more and more students begin to ask questions that are related to the assignments. As the themes of these assignments are perfectively in line with the actual situation of the courses, the students have to combine these problems with textbooks and teachers' lectures together, thus achieving a better learning result. As the deadlines of the assignments are coming, the class atmosphere becomes more and more active, and the students can give quick responses to almost all the points of knowledge and then use them into the exams. Quite the contrary, the students are not as tense as expected, and thanks to the practice of the assignments, the students are confident enough in the face of the final exam.

It is precisely because of the introduction of formative assessment that the whole teaching process is full of vitality, and the purpose of enabling students to learn solid knowledge is also achieved.

## III. REFORM OF FORMATIVE ASSESSMENT AND ITS IMPLEMENTATION

By cooperating with foreign universities and learning their mature experience, we have made a decision to carry out a reform of formative assessment in the courses of computer specialty.

First, formative assessment is carried out in the teaching process of each course. Generally speaking, formative assessment of courses includes scored schoolwork assessment, specially designed assignments, experiments, and assessment in the whole teaching process of the courses, etc. The specific requirements of assessment for each course can be found in the syllabus of this course.

Second, the assessment of after-school work is also carried out in the way of scoring, and the result of formative assessment of a student is determined by the quality of his scored after-school work. Generally, 3-5 scored assignments are set for each course.

Third, the assessment of specially designed assignments, which are the comprehensive assignments designed in accordance with the requirements of the course, is the most important part in the whole formative assessment. The result of formative assessment of a student is assessed according to the quality of his assignments. The specially designed assignments emphasize particularly on the test of students' abilities in application, analysis, comprehension, and practice, and they are studied out by the assigned teacher himself. Generally, 2-3 assignments are set for each course. Assignments can enable the teachers to test the learning results of students in the teaching process of a course, thereby monitoring the progress of the course more effectively. Also, flexibly setting the themes of assignments can arouse students' interest in learning this course.

Fourth, assessment monitoring on the whole teaching process of a course is actually the assessment of students' actual situation in learning the course, and it mainly includes the assessment on students' performance in the learning process (including class note-taking and discussions), aiming to assess the active thinking of students. In this way, by integrating the assessment on in- and after-class work, assignments, and assessment monitoring on the whole teaching process, we can get a multifunctional, instant, and effective assessing system, which can enable us to duly understand the learning results of each students in the whole teaching process, thereby laying a foundation for the final assessment. Thanks to this assessing system, we can not only avoid the situation that the academic performance of a student is determined only by his results in final exam, but also duly adjust the teaching content and further promote the teaching management.

## A  Combination of formative assessment with concentrative assessment

Both formative assessment and concentrative assessment are important parts of the system of teaching, and they themselves have both advantages and disadvantages, so the ultimate objectives of assessment can be achieved better by combining their advantages.

In the stage of bilingual examination, the teachers may extract the key terms and translated them in accordance with China's actual conditions. Also, the terms can be defined in Chinese to help students deepen understanding of them. In this way, the trend of over-reliance on Chinese can be prevented. Introducing cases that are in line with our national conditions
In the stage of combination, teachers should add more examples of China to their lectures to speed up the assessment integration. Taking the concept of "Web portal" as an example, we can try to explain it by citing some large websites on the internet, such as Taobao, eBay, and 360buy, etc. These portals are very close to the daily life of students in the department of computer, so introducing "Web portal" in this way may enable the students to have a full understanding of the definition, portals. features, uses, and development trend of portals. When these examples were mentioned in class, the students became significantly interested in them: first of all, they exchanged experience in consumption on these portals with each other, and then they actively made suggestions to promote the operation of e-commerce by the means of electronic marketing.

After the stages of infiltration and integration, the students may have certain ability to understand the teaching content by their thinking, so we should further enhance the teaching requirements and help students realize the importance of the teaching content by organizing class discussion or asking them to refer to the relevant information. By use of Internet, which is the most powerful tool in the information age, the students can easily search out quite a lot of information that is related to the teaching content, and the real purpose of

bilingual teaching can be achieved by encouraging them to narrate the information they get in class.

## B  Bilingual formative assessment

As we know, bilingual formative teaching is a new teaching model [13][14], so how to examine the learning results of students is also a key and difficult problem. Until now, there hasn't been a uniform standard for the bilingual examination. In accordance with the characteristics of bilingual teaching, the examination for students may be conducted in the form of integrating several academic achievements instead of the traditional examination papers. At the same time, the students can improve their English writing skills by doing homework in English. According to the number of points of knowledge, the teachers may set three or four times of homework for each course, and the final results of the students will be calculated by integrating their results of all the homework[15][16].

Additional, the measures we take the following steps :

First, by integrating the final examinations, formative assessment and usual results of each course together, we can effectively supervise the teaching process, overcome the spatial-temporal separation of teaching, reform the teaching management, and thereby improve the teaching quality [17].

Second, the results of final exam of each course are statistically analyzed at the end of each term. If exams are in the following abnormal states, we will ask the assigned teachers to analyze the reasons and increase the intensity of formative assessment to makeup the weakness of concentrative assessment in the next semester[18].

1. The courses in whose examinations the failure rate is more than 35%.

2. The courses in whose examinations more than 35% of the students get 90 scores or more.

3. The courses in whose examinations the difference in failure rates between test results and comprehensive assessment is more than 30%.

## C The second classroom assessment

The second classroom assessment is the important component of formative assessment.

The so-called second classroom refers to the educational activities (except for those of the first classroom), whose purpose is to improve students' abilities in innovation and practice and further promote their comprehensive quality. It is mainly includes professional training, social practice, scientific research, academic competitions, practice in various training bases, accession in relevant student clubs, military training for college students, and other practical activities recognized by the college or its branches.

The teaching content of second classroom is also divided into required courses and elective courses. A college student has to obtain the credits in both the first classroom and the second classroom, and he can't

graduate smoothly without obtaining 10 required credits and 2 selective credits.

The selective course modules of the second classroom include discipline contests, research papers and scientific and technological innovations, cultural and sports competitions, social practice, club activities, young volunteers, practice in art troupe and news center of the college, and some other activities recognized by the related departments of the college.

### The guiding principles of the second classroom

Teaching students in accordance of their aptitude:

Short-term practice education in summer vacation should stress the cultivation of students' sense of "innovation, creativity, entrepreneurship", pay much attention to cultivate diversified talents, encourage independent research study, teach students in accordance of their aptitude, and attach importance to the cultivation of students' interdisciplinary capacities.

Independence:

The content of short-term practice in summer vacation can further enhance and perfect the teaching plan system. Thanks to its independence and integrity, it can not only reflect the characteristics of the specialties, but also integrate some social practice and researches.

Modulization:

Modular management should be implemented in short-term practice education in summer vacation, and each module should be well-designed. Every student is allowed to select a practice module in accordance with his own specialty, strong suits, interests and hobbies.

### Division of the practice education module

The short-term practice education in summer vacation, which includes professional research, social practice, educational practice of ideological and political theory, and professional training, is carried out in three phases.

Practice Education Ⅰ is set in the short term of the first school year. In this practice education, the students need to design and plan the research subjects of practice, write research reports, and answer questions of their tutors by integrating professional knowledge with the hot subjects of the political & economic development. Under the guidance of tutors, the student teams should carry out various forms of social practice and training of scientific research. The subjects of Practice Education Ⅰ should be in line with the aptitude of freshmen, and the establishment of mixed team comprising students from different specialties is encouraged.

Practice Education Ⅱ is set in the short term of the second school year. In this stage, the subjects of practice don't rely on the specialties of the students, so they can choose any subjects of practice. Practice Education Ⅱ requires students to conduct the research practice by use of their professional knowledge.

Practice Education Ⅲ is carried out in the short term of the third school year. In this stage, the subjects of professional practice should be in line with the specialties of students, and they can select the practice subjects set for their own specialties.

The selective course modules of Practice Education Ⅱ and Ⅲ include:

1. Training for electronic-design contests. With the purpose of training college students' abilities in innovation and cooperation and their study style of linking theory with practice, the training for electronic-design contests is of great significance in cultivating students' abilities in engineering practice, improving their abilities in electronic design and production in accordance with actual problems, as well as attracting and encouraging young students to participate in extra-curricular activities of science and technology, thereby enabling new excellent talents to come to the fore.

2. Training of vocational quality. Objective: to enable students to learn the basic professional etiquette, develop good behaviors, learn the basic principles and methods of enterprises' pay management, know the basic knowledge of "Labor Law", and roughly understand the methods for labor dispute arbitration. On the one hand, the training content can be regarded as basic management knowledge that is helpful to their self-employment; on the other hand, it can be taken as the preparatory knowledge before entering a company.

3. Innovative product design. Availability is the key to determining whether an electronic product is successful or not. Therefore, integrating availability into the design of electric products is of great significance in cultivating students' abilities in practice & independent thinking as well as sense of innovation.

4. Scientific research of college students. Objective: to further promote the innovative education for college students, enable new excellent talents to come to the fore, encourage college students to take scientific research training as a carrier, and improve their abilities in innovation, practice, self employment, and self study, etc.

5. Production practice. As a very important link in the teaching plans of science & engineering specialties, production practice is set for the purpose of conducting basic professional training for students and cultivating their abilities in operation and linking theory with practice.

6. Professional practice. Objective: to enhance students' abilities in combining professional knowledge with real practice, improve their abilities in analyzing and solving actual problems, stress the practicality, application, design and creativity of professional practice, enable students to apply their professional knowledge flexibly and improve their actual social competitiveness, equip students with necessary basic skills for them to participate in various electronic-design contests, and enhance their sense of teamwork.

### Implementation and process control

Program system, team system and tutorial system are employed in the implementation of practice education, which is jointly managed by Practice Teaching Center, Student Affairs Office, Teaching Office and Second Classroom Executive Committee.

An oral defense committee affiliated to Practice Teaching Center is set to take charge of the moderation, defense and assessment. The main implementation process of short-term practice education in summer vacation is as follows:

First, Practice Teaching Center organizes teachers to design subjects and determines instructors as well as the content of the practice. Then, Practice Teaching Center organizes defense committee of short-term education in summer vacation to review the candidate subjects, and the education program and teaching calendar of each practice module are developed by the principals.

After Practice Teaching Center publicizes the qualified subjects on the campus network, Student Affairs Office and Second Classroom Executive Committee organizes student groups. The number of members in each group is determined in accordance with the nature of the module, and a team head and deputy tem head are appointed through democratic election in each group.

Practice Teaching Center appoints tutors for each group in accordance with its subjects and situation of the student team.

Each student team carries out their practice under the guidance of their tutors. In accordance with the subjects of practice, the tutors may give guidance to the teams in various ways, such as classroom lectures, practical guidance, instruction or tour guidance, and inspection of oral defense, etc. In addition, the practice attendance is checked by Practice Teaching Center, tutors, Second Classroom Executive Committee or the off-campus training bases.

When the practice is over, Practice Teaching Center will ask defense committee of short-term education in summer vacation to appraise each group by holding oral defense and then recommend the excellent student groups, thus stimulating students' enthusiasm for learning.

*D  Quality guarantee of formative assessment*

Formative assessment is a subjective assessment, so strictly managing it is of great significance in controlling its randomness and chanciness and improving its quality. In order to guarantee the quality of formative assessment effectively, we take the following measures in the teaching process.

1. The schoolwork and assignments for formative assessment should be reviewed carefully with full and accurate remarks, and they should be kept properly for future inspection.

2. The quantitative record of students' performance in the teaching process (such as class note-taking, class discussions, etc.) should also be kept properly for future inspection.

The assessment of results of formative assessment should be objective, fair, and accurate, and the results

can't be changed ad arbitrium once they are determined. Also, they will be effective for a long time after being recorded into the total results of the courses.

IV. THE SOFTWARE FRAMEWORK OF ASSESSMENT SYSTEM

*A．system function module*

On the design of the functional module, the formative assessment management platform takes the present condition of the scientific and technological institutes of Zhejiang, different business demands of different teaching procedures and the construction of document database and talent bank into consideration, and combines the international characters of cooperation schooling. The function of the system is as follows:
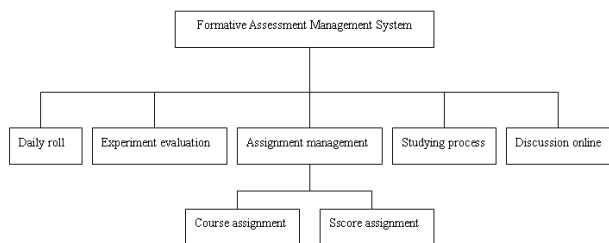


Figure 1 System function for formative assessment system

*B．description of the main functional module*

1. Daily roll call

Document management: roll book

2. Experiment and second classroom evaluation

Document management: work flow，documents of higher authorities, upload, download and view online documents of the specific matters and all kinds of classroom norms.

Topic management: the teachers set questions; upload, correct and delete task books; the students choose topics; the students report their topics; teaching and research office and the department carry out evaluation of the topics; finally confirm the corresponding list of the teachers and students; provide leading in, leading out and printing of the report.

Online guide: students submit test report, system automatic record the working condition.

Defense group management: Fill, modify or delete the defense groups.

Defense management: Record the defense (record only, can not be deleted).

Score management: record, view and print the Students' scores.

Mutual Help Forum: the students discuss and communicate freely, and the teachers are in charge of the forum.

3. Assignment management

Document management: work flow，documents of higher authorities, upload, download and view online documents of the specific matters and all kinds of classroom norms.

Online guide: students submit work or report; teachers check and remark online;, system automatic record the working condition; the students can read and download the remarks.

Database management: instructors choose, classify, upload, correct and delete the newest materials about the assignment. The students can download it and read it.

Mutual Help Forum: the students discuss and communicate freely, and the teachers are in charge of the forum.

4. Studying process monitoring management

Document management: work process, documents of supervising authorities and online documents of the specific matters and all kinds of classroom normsthat could be uploaded, downloaded and viewed.

Online management: student registration, name list confirm, providing leading-in, leading out and printing service of the reports.

Online exchange: The students study online and the system automatically records students' studying statuses; The monitoring data of the teachers' input process; The output of evaluating results.

Forum of mutual help: the students discuss and communicate freely, and the teachers are in charge of the forum.

5. Discussion online

The topics are discussed on the internet, and the item pool is formed automatically. According to the students' inquiry conditions of choices or combinations, it can automatically generate discussion questions for the students to discuss.

Online manage: record the content of the discussion, analyze the result of the discussion, and then give the score of the discussion.

*C．implementation technique of the system*

1. Changing Environment of System Development

J2EE is a standard of enterprise's application system development found on Java. This standard defines a standard platform which is based on the multilayer business information system. It's a good choice to develop the graduation design by using J2EE platform. Through J2EE component technology, making the system can establishes practical application system according to

the different needs of clients and has the characteristic of open, commonality and portability.

TABLE I.
SYSTEM DEVELOPMENT PLATFORM

| Operating system | Windows XP Professional SP3 |
|---|---|
| Java develop software | JDK 1.5 |
| Server software | JBoss 4.2.2 |
| Database | MySQL 5.0 |
| Develop language | Java, Javascript, HTML, XML, etc. |
| Develop tools | Eclipse 3.2, Dreamweaver 8, Fireworks 8 , etc. |
| Code version | CVS |

2. The features of System technology

1) Application of MVC in this system

Apache support struts framework which is based on MVC to the development of B/S information system. It use Java Servlet and Jsp to establish application of web and divides it into model, view and director. View is human-computer interface. Model means service logic. Director gets the users' input and transfers the related view and model to meet the needs of users. MVC development mode solves the loosely coupled problems, but it's quite difficult to separate view and model. It mainly reflects in the design practice and configure. Most programmers have to spent time on fussy configure not thinking about the service logic. Because of that, this system doesn't use the traditional MVC framework but the mind of MVC to executable program. This mainly embodies in view and director: View uses XSL to make program, as long as knowing the basic principle of XSL and HTML, it will be finished. There is no use to add Java into HTLM. Director is organized by series of Servlet which is different from the Struts' Servlet. It's just a normal Servelt not the Action servlet. Model realized by template method of Java. It can put code into an important position.

2) Web work

Web work is established according to the MVC over the Command which is called XWork. The features of Webwork2 includes: flexible Validation framework: allowing you definite the content of verification in XML which is totally separated from Action. The new one supports the verification of client. OGNL expression language: allowing the moving object graph traverse and method, using value stack accesses transparently. WW2 also can use JSTL.

IoC vessel: life cycle of management union. The clients don't need to establish register class to get component class. Free Marker Templates: making UI can

be used twice. Allowing developers' custom looks & feel easily.

Interceptors: blocking around handing Action to simplify the code of Action and add the chance to reducing the code. Make it easy to integrate with the third part including Hibernate, spring, Pico, Site mesh and so on. Support sorts of view technologies like JSP, Velocity, Free Marker, Jasper Reports, XML and so on. Support Packages and Namespaces to manage Actions.

3）Spring and Hibernate

Spring, founded by Rod Johnson, is an open source framework ，which is founded to solve the complexity of the application development in the Enterprise. Spring used to complete the things by EJB only before basic JavaBean. However, spring is not limited to the use of server-side development. From the simplicity, and loosely coupled test point of the view, any Java application can benefit from the spring. Hibernate is an open source object-relational mapping framework, which conducted on the subject of a very lightweight package to JDBC. Hibernate can be applied to any use of JDBC occasion, either in the Java client program of practical, as well as in the Servlet / JSP's Web applications. Hibernate has 5 core interfaces, namely: Session, Session Factory, Transaction, Query and Configuration. These five-core interfaces can be used in any development. Through these interfaces, we can not only access persistent object, but also carry out transaction.
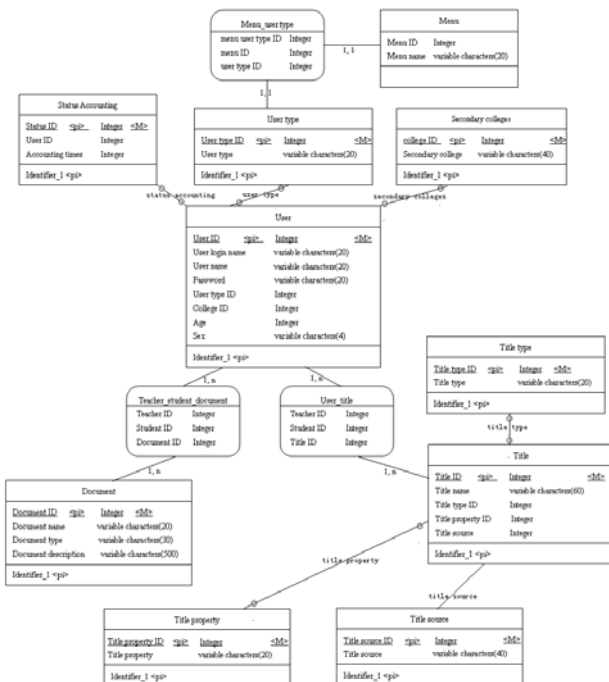
3. The data Model of the system



Figure 2 The concept data model of assignment assessment

Viewing from the functional model, every sub-model of the system has good independency and the code has

good reusability. The following figure is concept data model of assignment assessment.

## V. ANALYSIS AND PROSPECTS

This formative assessment system has passed the preliminary test at present. It has certain commonality, expansibility, flexibility and promotional value. After several years of unremitting effort, through the construction of the formative evaluation platform and the reformation of the practical education system, the computer subject of the college of information has formed strong advantage and obvious feature. At present, through this platform the computer subject can preliminarily achieve the goal of carrying out formative assessment flexibly and quickly. It realizes digital management and relevant resources sharing, and provides effective organizing and managing methods for the reform of the assessment. It is good for enhancing the quality of the teaching management. Meanwhile, it is important for evaluating the teaching effects and readjusting the teaching tactics.

Based on this software framework and the implementation of reform of formative assessment, we keep improving the methods and have made some achievements, and the formative assessment in School of Information has already got into the right track. Thanks to the encouragement of formative assessment, the students become quite active in participating in various class discussions and very interested in the courses; especially, the passing rates of the courses E-commerce and Systems Analysis and Design reached 100% in the last term, and the students were no longer afraid of the final exam. At the same time, in the evaluation of teaching quality, the teachers were highly appraised by the students.

By continuously improving our teaching methods, teaching models and teaching means, we have made some achievements in teaching reform. The China- Australia has encountered many difficulties in the teaching of Australian courses since its establishment in 2004: initially, the passing rates of Australian courses were rather low, and even those of some courses were less than 50%. Thanks to the continuous exploration of the teachers in the teaching and research section in recent years, the teaching in China-Australia Class of School of Information has already been on the right track. In classroom teaching, with strong interest in the courses, the students are active in participating in various class discussions. Especially, in the last semester, the passing rates of the courses E-commerce and Systems Analysis & Design reached 100%. Moreover, in the evaluation of teaching quality, the teachers of the Australian courses were highly appraised by the students in the China-Australian Class.

In the future teaching, we still need to continuously carry out reform in the formative assessment of courses and software framework, thereby making it conform to the requirements of the times and adapt to the talents

cultivation in schools. We still need to enhance the reform in formative assessment, aiming to make it conform to the requirements of the times and adapt to the applied-based talent cultivation in universities. In the future, we want to focus on the reform in the methods of assessment and combine our system with internet, and one feasible method is to search the topics by search engines, which are closely related to the actual production and life and the textbooks, into the formative assessment. In this way, the students can not only acquire solid professional knowledge and use it flexibly, but also improve their comprehensive capacities.

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