MyCompetencies: Competency tracking mobile application for IS students

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MyCompetencies: Competency Tracking Mobile Application for IS Students

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Abstract— The overall aim of learning outcomes and competency based education is to improve the efficiency and effectiveness of higher education. It’s important to track regularly student’s competency acquisition so that the faculty can improve the teaching delivery and adapt the content accordingly. Student based self-assessment of competency tracking on a weekly basis aids faculty to intervene in course delivery process for effective teaching and learning experience. It also helps students to have a better understanding of their competency levels and accordingly prepare for weekly sessions. To enable students to self-assess the competencies in more structured format, there is a need for a systematic tracking tool. Additionally, it is also important for this tool to leverage on the latest technology for enhancing user friendliness and provide pervasive access through mobile technology. In this paper, we present a mobile web application, MyCompetencies, which enables faculty and students to track competencies on a weekly basis. We evaluated the tool in an undergraduate course over one semester comprising 110 students. We experiments showed that the tool helped the faculty to intervene and adapt the content to the students’ learning pace.

Keywords—Competencies, tracking, mobile web application, weekly, tool

I. INTRODUCTION

Learning outcomes and competencies describe and define a learning and assessment process that leads to improved pedagogical practice in higher education and improved student learning practice [15]. Learning outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate at the end of period of learning [16]. “Competencies are defined as the knowledge, skills and abilities in the context of a specific domain (e.g. data management, business process modelling) that enable a student to take an effective action or make sound decisions” [1]. Competency management plays a key role in content development and assessment preparations. In addition, competency tracking enables to improve teaching and learning experiences of both faculty and students.

Competencies are not only beneficial to the faculty for designing the course, but also for students to track their skills development. At faculty level, the focus on competencies enables faculty for improve teaching pedagogy, course design and course delivery. At the student level, the focus on competencies enables students to take a proactive role in their own development by analysing information on competency gaps and take appropriate actions [15][17].

In most cases, the instructor introduces the session agenda in the very beginning and then continues with the session delivery. Mostly, the agenda is about two to three bullet points to mention the high level topics and/or learning objectives for that session. Very rarely the agenda gives a clear mapping of the topics to competencies targeted for a given session. Therefore, at end of the session, the students are unable to track their competencies. Over the weeks the tracking of competencies is completely lost. Thus the objective of using course competencies for supporting student learning and tracking is not met. This triggers a need for a process that enables the students to track the competencies weekly and then automatically aggregate it over the term. The process should be simple and automated with little human effort.

Competency management systems are popular and widely used in large organization to aid systematic development of employees’ competencies [2]. The competency management tools used in the industries are more complex as they cover various dimensions such as, organization goals, cost/budget, employees, jobs, roles, tasks, career progression, talents, skills, training courses, time and so on [2]. However, an educational institute deals with much fewer dimensions, namely students, courses, program level learning outcomes and course level competencies. Higher educational institutions are usually well equipped for management of classroom instruction using tools such as learning management system (LMS), learning content management systems (LCMS) and Course Management Systems (CMS) [3] [7] [9]. These tools usually provide features for course authoring and content management. Sometimes, the LMSs also emphasize communication and collaboration features. They are generally built on the assumption that an instructor is always available to build course content and to communicate with students. These tools can be developed in house or purchased from vendors.

Most of LMS tools provide competency management feature, but not comprehensive competency tracking feature [4]. At the same time these tools are majorly faculty or management focused and not student focused. Lack of competency tracking feature restricts the faculty in reviewing student progression with regard to competency acquisition and thus limits his/her intervention in the teaching activities to accommodate the students’ needs during the on-going course delivery. It is important to track regularly how students are
acquiring the competencies so that the faculty can improve the teaching delivery and adapt the content during the teaching period itself.

Assessments are one of the best options to track the students’ progress. Nevertheless, weekly assessment preparations and execution can be a tedious process and involves painstaking manual effort to track individual student skills development and gaps. A more practical approach is the student’s self-assessment of competence which also enhances critical reflection and promotes self-directed, life-long learning [5]. Student based self-assessment can also aid the faculty in tracking the competencies and intervene in teaching process for improving teaching and learning experience. To enable students to self-assess the competencies in more structured format, there is a need for a systematic tracking tool. Additionally, it is also important to leverage on the latest technology for enhancing user friendliness and providing pervasive access through mobile technology [6].

In this paper, we propose a mobile web application, MyCompetencies, for faculty and students to manage and track course competencies. This tool aids the three main stakeholders of learning process, namely administrators, faculty and students with competency tracking and reporting. MyCompetencies is developed in house using Java technology.

We evaluated our tool on an undergraduate core curriculum; Bachelor of Science (Information Systems) degree program BSc (IS), offered by the School of Information Systems (SIS), Singapore Management University (SMU). A Year 2 course, Process Modeling and Solution Blueprinting, was chosen to evaluate the tool. We present our results and feedback on the tool. We present the faculty experiences and the student experiences with the tool. To study students’ experience, we conducted a survey to gather students’ feedback on using the tool.

The rest of the paper is organized as follows. In section II, we explore the current literatures on learning management systems and competency tracking tools. Section III provides the background of competency framework that is used for the development of the tool. Section IV will provide the solution approach and Section V goes into details of the MyCompetencies, the features and the interfaces implemented. Section VI presents the evaluation of the tool in terms of a case study on a pilot run of the tool for an undergraduate course. This paper will then conclude in section VII.

II. RELATED WORK

Learning Management Systems (LMS) and Course Management Systems (CMS) are tools that support educators in their teaching, though they have some minor differences in the features they provide. CMS systems are narrower in scope and are used primarily for online or blended learning, supporting the placement of course materials online, associating students with courses, tracking student performance, storing student submissions, and mediating communication between the students as well as their instructor [9]. LMS are applications that empower educators to guide and manage students’ achievements more effectively by contextualizing the learning experience [8]. Most LMS encompasses course management and are web based to facilitate “anytime and anywhere” access to the content and management [3]. In this paper, we adopt the ideas and approaches from LMS.

Watson emphasizes on how technology can be maximized to best meet the needs of the learners [13]. Specifically, there is a need to examine more closely what features LMS products offer as well as identify what additional features are needed. Further, technology should be aiding student, teacher, parent, and other stakeholders within the context of Information Age paradigm of education. The tools should support students directly in their new roles, as active agents of their own learning [12]. Therefore, in this paper we propose an additional feature for LMS that helps students manage their won learning by tracking competencies.

One of the key functionalities of LMS systems is assessing learners’ competency gaps and managing skills acquisition and status [11]. LMS enable to define competencies and track competencies of students. Such competency tracking is based on the assessments [4] or student inputs [14]. Bishop developed an online competency tracking tool for faculty and students which can aid not only in tracking but also for sharing across the schools. Once the students’ skills are assessed, curriculum decisions can be made about the teaching intervention [14]. However, this tool is majorly dependent on assessments which is a tedious process, and not on a weekly based topic and skills tracking approach. Our system is similar to these tools in term of the main objectives of tracking students’ competencies achieved in a course. In these tools, the focus is on tracking the student competencies after taking assessments and completing the course. However, our research work differs in the approach by providing weekly based tracking of competencies that supports the educators in improving the teaching during the on-going delivery of the course and simultaneously aids the students for identifying gaps in their skills on a weekly basis and addressing these while studying the course. MyCompetencies is a mobile friendly application that provides a pervasive access to students and faculty.

III. BACKGROUND

Learning outcomes are statements of achievement of what the learner is expected to know, understand and be able to do on completion of a program [15]. In higher education the learning outcomes are becoming a necessity for accountability and quality assurance frameworks [17].

In Figure 1, we show the Learning Outcomes Framework (LOF) implemented at the School of Information Systems, Singapore Management University. LOF provides the common platform to IS educators to design and deliver IS program. The user requirements for competency tracking tool is based on LOF.

LOF consists of three major components: learning outcomes, course objectives and competencies. While the
learning outcomes are defined at the program level, objectives and competencies are defined at the individual course level.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Competencies</th>
</tr>
</thead>
</table>
| 4    | 1. RCI Models  
2. RCR Model  
3. Dynamic analysis approach  
4. Simulation and analysis | 1. Understand the methodology for performing Static Analysis of a business process  
2. Perform Static Analysis of a given (As-Is) business process and document the appropriate issues and recommendations for developing the To-Be process  
3. Understand a systematic methodology for performing dynamic analysis of the as-is  
4. Apply the methodology using a tool and document the analysis |
| 5    | 1. Analysis techniques  
2. Impact analysis | 1. Collect data for the Dynamic Analysis and identify relevant simulation parameters  
2. Produce and interpret static and dynamic analysis reports in a BPM tool  
3. Make decision on to-be process for implementation |

Table 1: Sample topics and competencies by week for Process Modeling and Solution Blueprinting course

The key objectives of the course are first defined by the teaching professional followed by the detailed competency definition. For each 1st level learning outcome, several 2nd level learning outcomes are defined, and each 2nd level learning outcome has several competencies attached to it. In this framework, the learning outcomes are statements which are rather generic in nature, and those statements do not explicitly refer to any specific course or content covered in any particular course. For example, some learning outcomes at the 1st level are, “Integration of business and technology in a sector context”, “IT architecture, design and development skills”, and “Project management skills”, etc. The corresponding 2nd level outcomes for “IT architecture, design and development skills” are, “Implementation skills”, “Software and IT architecture analysis and design skills”, etc. For the complete list, please refer to [18]. Contrary to the learning outcomes which are defined at the program-level and are common to all courses, the competencies are defined at the individual course level. Competencies are usually expressed based on the course topics using the vocabulary of cognitive taxonomy. Table 1 shows the competencies listed for one of the courses in Information System undergraduate curriculum, Process Modelling and Solution Blueprinting. Table 1 also shows a sample weekly competency list (week 4 and week 5) and main topics in PMSB course.

To aid the teaching professionals in course delivery, SIS uses a Learning Management System called “e-learn”. E-learn system provides various tools for educators and students for class management, content delivery, assessments, feedback and interactive learning. One of the e-learn tools that helps the educators to track students’ progress in achieving the goals is “Competencies”. Competencies tool enables to define the competencies and can be associated with course activities. The course activities refer to assessments such as quizzes or exams. Tracking competencies using assessments is referred to as assessment based competency tracking. In this approach, the faculty has to create assessments every week and align the competencies to the assessments which can be a tedious and painstaking effort. Moreover, the current system doesn’t support weekly competency tracking and it is not a pervasive web application, furthermore it has limited reporting features. Therefore, we proposed a mobile web based tool with reporting features that helps both students and faculty to track weekly competency acquisition. We provide the details of our tool in the following sections.

IV. SOLUTION APPROACH

Our solution is based on LOF, content delivery and the learning goals of weekly class sessions. Weekly competency tracking benefits both the faculty and the students. Firstly, it aids the students to prepare and plan for the weekly content. Secondly, since competencies are the major focus of the assessments, it aids the students to prepare for assessments. The students can now focus more on “weak” competencies and apply appropriate methods to improve them. Finally, it aids the faculty to adapt the teaching activities to provide more focus on those competencies that are difficult for the students. The system requirements are gathered based on the course delivery setup in School of Information Systems, Singapore Management University. Each session for an IS undergraduate course is designed along three major dimensions to achieve the competencies defined in the course design document.

Content: The topics of the course that will be learned by the students through lecture slides and additional reading materials.
Activities: The in-class exercises, labs, case study discussions etc., which emphasize the learning by doing pedagogy.
Delivery: The teaching style of delivering the content and managing the activities. This aspect relates to time management and dynamism of the classroom session.
Our solution uses the weekly competencies defined in Table 1. In next section, we describe the details and features of MyCompetencies.

V. SYSTEM DESCRIPTION

MyCompetencies system consists of three major modules; admin module, faculty module and student module. Overview of MyCompetencies system requirements for all the three stakeholders is depicted in Figure 2.

Admin module deals with the administration tasks of the curriculum manager in order to setup courses and assign the respective faculty. This is a onetime setup and data can be extracted from the university’s faculty management system. The module provides a spreadsheet based import feature to setup faculty information such as name, email etc., and course information such as course name, year/term, number of sections etc. A sample screen from the admin module is shown in the Figure 3.

Faculty module deals with students, courses and competencies. It also includes a reporting tool to track the weekly status along various dimensions. The reporting tool enables the faculty to dynamically adapt the course delivery by taking informed decisions gained from the data insights. Many institutions have developed competency management systems. Therefore, the setup for course competencies can be directly imported from the competency management systems.

Faculty module enables a spreadsheet based import feature for the courses and their competencies. Similarly, the data regarding students can be imported into the application via spreadsheet based import feature. A sample screen from the faculty module is shown in the Figure 4.

Student module aids the students to plan, prepare and track the weekly class session competencies. The module also helps the students to generate reports to track their competencies and improve their learning experience. Further, the module allows tracking along three time dimensions, namely year, term and week.

Sample screens from student module mobile interface are shown in Figure 5. The first screen is for login where student provides the credentials to login to the application. The second screen displays the list of courses that the student has attended or attending. The third screen shows the list of competencies for a given course and week. The last screen displays students’ reports by course, week and ratings. The student can self-assess their level of competencies to discover the gaps in his skills acquired for a given course and focus on improving such skills. Students can always revisit and update the competency ratings any time during the semester. Similar reports are generated by the faculty for the entire cohort and can improve the teaching process by providing more content or exercises for the competencies which are rated low by the students. In the next section, we describe the execution of the tool using a case study.
Figure 3: Admin module web interface

VI. CASESTUDY

For evaluating our application we have run a pilot study on an undergraduate course, Process Modelling and Solution Blueprinting (PMSB) at the School of Information Systems, Singapore Management University. Over 110 students participated in the study and we collected student feedback on the tool. The evaluation is done in three phases. In the first phase the tool is evaluated for its portability and usability. In the second phase we evaluate the tool in terms of its capability in supporting the learning process, both from the perspective of faculty and students. In the third phase we evaluate the student feedback in terms of their experience in competency tracking and the tool.

A. System Experiments: Phase 1

System experiments are designed to make website mobile-friendly by testing it on multiple smartphone and tablet platforms, and discover issues with the tool. A mobile phone emulator enables to check the responsiveness and functionality of the website across different mobile platforms, such as iPhone, iPad, Android and BlackBerry, without actually having the devices at hand. Mobile emulators can help to pinpoint problems and issues with the website and allows taking corrective measures to make the website visually appealing and functional on mobile devices. We tested MyCompetencies on eight various smartphones and tablet emulators using (http://mobiletest.me/). We skip the details of the system tests as it is not the main focus of our paper.

B. Faculty - Reports and Analysis: Phase 2

First, the admin of the tool created the course, Process Modelling and Solution Blueprinting, for year 2015 and assigned a faculty as course manager. Second, the course manager designed the weekly competencies for the course. The students from four sections taking up the course were assigned to the course. The students were motivated to participate in the competency tracking self-assessment as a part of class participation. Finally, various reports were generated and analysed to study how the students used the competency tracking to support their learning. In this paper, we will focus on the overall analysis of the course and students learning process.

Figure 6a provides average ratings on competencies from all four sections. We observed that some competencies such as “Design model using BPM tool”, “Define a business process and understand its attributes”, “Develop Collaboration models”, “Understand the importance of requirements” etc., are rated higher than 3.6, compared to other competencies. In our analysis, we observed that this was because the students were given in-class activities for learning these competencies. We also observed that some competencies such as “Develop solution Cost model”, “Develop Risk model”, “Understand in
detail how processes can be managed at the Enterprise Level using Process Architecture”, “Develop domain model” etc., are rated lower than 2.6. A deeper investigation led to the conclusion that these competencies were not fully acquired because the topics related to them were either student take home readings or topics covered during the final weeks of the course delivery. Using these reports from the MyCompetencies tool, the teaching team decided intervene and support the students in improving on these competencies, by providing out of class exercises and solutions in subsequent weeks. This clearly showed the capability of the tool in supporting targeted real-time teaching intervention.

Figure 6b shows average ratings by week across all four sections. We noticed that the weeks 9, 10 and 11 are rated very low by students. Some of the observations are that these topics are technically challenging. For example, analytics in business process, IT solution design and process architecture requires to design technical models and therefore are complex. At this juncture, the faculty team had intervened and created additional exercises on analytics for the students.

Figure 7 provides the ratings by various sections on the entire course. We observe that G2 and G3 self-assessed higher than other two sections. We also observed that these two sections performed better in the quizzes and projects compared to other sections.

C. Student – Reports and Survey: Phase 3

Students used the tool to self-assess the competencies acquired in PMSB course. We surveyed the students to gather their experience in competency tracking and the tool. The survey questions are shown in Table 2. The rating scale is 1-5 where 1 represents low and 5 represents high.

<table>
<thead>
<tr>
<th>Competency tracking related questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Rate how useful is the competency tracking in helping you know the skills you will be acquiring in the next class session</td>
</tr>
<tr>
<td>2  Rate how useful is the competency tracking in helping you know what to prepare before coming to class session</td>
</tr>
</tbody>
</table>

Table 2: Survey questions for students

On competency tracking usefulness more than 70% of students have provided positive feedback (ratings are 4 or 5). For system related questions, 61% of students preferred to download as a mobile app where as 85% students preferred as a mobile web application. This shows that students prefer mobility as well as web accessibility. Only 48% rated high for user friendliness. The last open question helped us to link to this lower rating on user friendliness. Suggestions for improvement on the tool from students are mainly focussed on user friendliness of the tool. These suggestions will be considered in the second version of the tool.

“Can provide a short brief/answer for each competency. Since we do not know what it is, we have to go through our own documents/notes to find the answer.”

“Link it to the lesson resources on e-Learn from the web application so that it can open a new tab and we can revise the content to enhance our understanding. Include some mini quizzes for revision, this would help a lot”

“Have a feedback tool, where if a student highlights that he/she is not sure about a particular competency then it can highlight additional reading materials to them, or could there be links to online videos, tutorials etc. Basically after the student realizes that he/she is not confident about a particular topic, he/she should have access to resources to clarify his/her doubts.”

VII. CONCLUSION

MyCompetencies is a mobile web application that enables faculty and students to track the course competencies on a weekly basis. Our case study on an IS undergraduate course shows that such self-assessed tracking not only aided the students in performing skills-gap analysis but also helped the
faculty to intervene and adapt the content and improve the course delivery process. The feedback from students provided evidences for usefulness of the tool as well as areas of improvement. We will consider the suggested improvements for the future versions of the tool.

REFERENCES


