Editorial

Sabine Graf and Charalampos Karagiannidis, Co-Editors

Welcome to the Bulletin of the IEEE Technical Committee on Learning Technology, Volume 16, Number 1, January 2014 issue. This issue includes three articles on diverse topics on learning technologies as well as a Call For Papers for the 7th International Workshop on Personal Computing for Web-Supported Learning Communities.

In the first paper, Petropoulou, Kasimatis, Dimopoulos and Retalis introduce the cloud-based learning analytics tool LAe-R which aims at assessing students' performance using an enhanced version of the existing "classic" rubric method. The tool has been implemented as a plugin for Moodle and has been evaluated with 32 teachers, showing very promising findings.

The second article, written by Gidion, Capretz, Meadows and Grosch, deals with a large-scale investigation about students' frequency of use and satisfaction with media for studying and learning. About 20,000 students were invited to participate in this study and questions were answered by over 1,200 students. As a result, the study showed that students use a mix of traditional and new media.

In the third article, Vallance, Murayama and Sperling introduce iFun, a mobile curriculum mapping app which provides information to determine curriculum strengths, gaps, misalignment, and repetition. The article focuses particularly on the development process of the app in a multidisciplinary team.

We sincerely hope that the issue will help in keeping you abreast of the current research and developments in Learning Technology. We also would like to take the opportunity to invite you to contribute your own work in this Bulletin, if you are involved in research and/or implementation of any aspect of advanced learning technology. For more details, please refer to the author guidelines at http://www.ieeetclt.org/content/authors-guidelines .

Special theme of the next issue: *Sensor-based Learning Support and Technologies*

Guest editor: *Marcus Specht, Open University, The Netherlands*

Deadline for submission of articles: *May 31, 2014*

Articles that are not in the area of the special theme are most welcome as well and will be published in the regular article section.

LAe-R: A new learning analytics tool in Moodle for assessing students' performance

Ourania Petropoulou, Katerina Kasimatis, Ioannis Dimopoulos, and Symeon Retalis, *Member, IEEE*

***Abstract*— A challenging and demanding task for the teachers in e-learning environments is the assessment of students' performance. Several learning management systems (LMS) like Moodle offer several assessment tools such as quizzes, scales, "classic" rubrics, etc. In this paper, we present a new cloud based assessment tool, called Learning Analytics Enriched Rubric (LAe-R) which is seamlessly integrated into Moodle. LAe-R is based on the concept of the "enriched rubrics", which is becoming a popular assessment technique in education. This technique is a blend of marking criteria and grading levels of a "classic/traditional" rubric and performance indicators stemmed from analysis of learners' interaction and learning behavior in a LMS based e-learning environment. Finally, in this paper we present the findings of a case study scenario showed that LAe-R is a very usable tool and is highly appreciated by teachers and students.**

***Index Terms*— LAe-R, Learning Analytics Tools, Students' assessment performance, Enriched Rubrics, cloud-based assessment tool**

I. Introduction

Several systematic efforts have been made to reform school education in order to embed modern pedagogical methods such as inquiry based learning and computer supported collaborative problem solving. The ultimate challenge is to make the learning process more engaging and effective as well as to promote the "21st Century Life Skills", i.e. collaboration, problem solving skills, critical thinking, creativity, etc. These skills are nowadays considered important for individuals to function successfully as global citizens and workers in diverse ethnic and organizational cultures [1].

Along the way to meet this challenge, teachers enrich the traditional teaching paradigm by building a technology enhanced learning environment. Most often, they are using learning management systems (LMSs) as the cornerstone of such environments. So, they design well-orchestrated learning scripts which require from students to engage into sophisticated collaborative learning and problem solving activities such as individual and group tasks, co-acquisiting of knowledge and skills through collaboration and social networking, communication (synchronous or asynchronous), as well as use of various online educational resources, etc. [2]. Despite the proliferation of such teachers design initiatives, a key factor that is still missing relates to the design and application of modern assessment strategies tailored to probe the competencies and skills that these modern learning scripts try to enhance [3].

The assessment of students' performance in such technology enhanced learning scripts is a tiresome and a time-consuming process for the teachers, who should take into consideration a huge amount of performance indicators. The process of assessment involves designing appropriate authentic assessment activities and gathering information from a variety of sources such as discussions log files, project deliverables and co-creation activities in order to come up to a rich and meaningful understanding of student learning and behaviour in the learning environment.

As a result, students assessment needs to be related to participation, support for group activities, quality of contributions to the group deliverables, creativity in product development, helpfulness, etc. New assessment approaches and tools such as learning analytics, which help teachers to have a better understanding of students' online interactions have been proposed lately. Such learning analytics approaches and tools have also started being integrated into Moodle, which is one of the most popular open source systems [4,5,6].

The aim of this paper is to present a new cloud-based assessment tool, called Learning Analytics Enhanced Rubric (LAe-R), which has been developed as a Moodle plug-in (version 2.2+). It helps teachers to assess a number of key students' skills and competencies using an enhanced version of the existing "classic" rubric method. Thus, LAe-R allows a teacher to add types of criteria that are associated to traditional performance metrics (e.g. criteria associated to project deliverables) learning and interaction analysis indicators such as collaboration, grades to assignments or study of learning resources.

The structure of this paper is as follows. The next section gives a brief literature review of existing web-based learning analytics tools that interoperate with Moodle. Then, the Learning Analytics Enriched Rubric (LAe-R) tool is presented, followed by an examplar scenario of its application to which the tool is examined by a group of participating teachers, followed by its evaluation results.

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Concluding remarks will be made about the use of the tool so far, as well as future plans regarding the tool's usage and functionality.

II. STATE OF THE ART OF MOODLE RELATED LEARNING ANALYTICS TOOLS

Long and Siemens (2011) define Learning Analytics (LA) as "the use of intelligent data, learner-produced data, and analysis models to discover information and social connections, and to predict and advise on learning" [7]. LA mainly intends to help teachers and students to involve based on the evaluation of educational data [8].

A number of LA tools (both online and standalone) exist. Some of them, which is the focus of this paper, that interoperate with Moodle have been proposed. These are the following:

1. *GISMO* is a visualization tool for Moodle, which uses log data, process them and finally produces graphical representations that can be used by teachers so as to examine social, cognitive and/or behavioral student interactions. The tool incorporates with Moodle as a supplement block within the graphics environment, visible only by the teacher. It provides analytic statistical representations and shows a general picture of the students as a whole, analyzing the more general learning process of all the students on all subjects [9]. It can also provide analytical statistic representations for specific students, resources and activities.
2. *MOCLog* is a sum of tools that are used for the analysis and presentation of log data within Moodle. The development of the tool was based on GISMO. Thus, some of GISMO's main components for the production of statistical reports for educators and students have been re-used. MOCLog attempts the analysis of interactions occurring in an online course so as to achieve better analysis of both the products and the educational process itself. It distinguishes among users according to their role within the system (cource manager – teacher – student) and presents different statistical reports tailored to these roles. So, the system's users have access to summative reports of interactions related to actions on educational resources and educational tools within specific subjects, such as quizzes, assignments, wikis, etc. [10].
3. *Excel Pivot Tables* is a tool that can be used for the production of learning statistics coming from Moodle. Moodle itself exports its data from the log files in spreadsheet form (Excel), through which the user can feed in data and create Pivot Tables. The graphic result is called 'summative table report'. With the aid of this tool the user can relatively easily and quickly organize in groups a great volume of data, sum up important information emerging from the data and execute immediately complex calculations on these data [11].
4. *Analytics and Recommendations* is installed within Moodle as a supplement block and can be used both by teachers and students. It is a tool for the visualization of students' involvement in each activity of an online course as well as a consultation tool, which can recommend activities to students so that they can improve their attainment. The tool uses tables and graphs, enriched with special colouring, so as to render the provided information easier to comprehend [12].

All the abovementioned tools offer several features that try to support teachers in evaluating aspects of the effectiveness of the online courses design for improving their quality and for identifying opportunities for interventions and improvements. None of them has been used for assessing students' performance. This open research and development topic is addressed by the cloud-based LAe-R tool.

III. LAE-R FUNCTIONALITY

Rubrics are becoming one of the most popular techniques for the assessment of students' performance. They are used to evaluate a wide range of skills, knowledge, abilities in various learning subjects and activities [13, 14]. The Enriched Rubrics (ER) share the same form as the 'classic' rubrics but also allow the inclusion of criteria related to performance indicators stemmed from analysis of learners' interaction and learning behavior in a LMS based online course [15].

As shown in table 1, the horizontal axis of an ER shows the graded levels of performance along with the respective grading scale used for each level.

Table 1. Sample of an assessment rubric

Criteria or Dimensions	Levels of performance (scale): Exceptional Performance 3	Mediocre Performance 2	Low Performance 1	Results
Criterion 1				
Criterion 2		Performance Descriptors		
Criterion 3				
. .				

The vertical axis presents the assessment criteria, which derive from the analysis of students' interaction and their learning paths during an online lesson (e.g. total number of activities-messages per student/team, proportion of writing-reading messages per student/team, social network density, proportion of learning resources read by student/team, etc.). ERs systematize, organize and simplify the process of evaluating students' performance, providing concise and measurable assessment criteria (strongly linked to the learning objectives) for both the learning products and the complex learning process, while at the same time documenting the differential result in students' attainment using levels of grading [15].

The Learning Analytics Enriched Rubric (LAe-R) tool was created as a Moodle plug-in (version 2.2+). It is being integrated as an advanced grading method of Moodle. As shown in figure 1, when creating an ER, a teacher can add

types of criteria that are associated to learning and interaction analysis indicators such as collaboration, grades to assignments, study of learning resources.

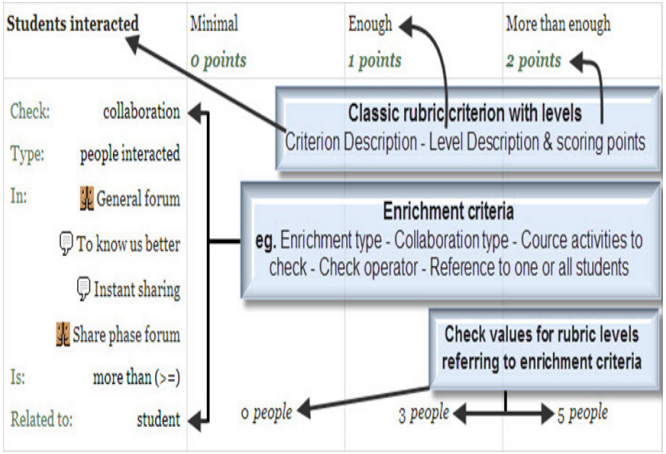

Figure 1. Screenshot of how a teacher can specify an assessment criterion in LAe-R.

For assessing students' performance with regards to "collaboration", the tool analyses and visualizes data such as forum posts (new or reply messages), chat messages and number of files attached to forum post messages. For assessing students' study behaviour, the tool analyses and visualizes the number of students' views upon specified learning recourses. Also, the students' performance in various assignments can be measured or aggregated by the LAe-R tool. By using "collaboration" and "studying of resources" indicators, the teacher can perform a quantitative evaluation on student performance, whereas using the "grades of previous assignments" a qualitative evaluation can be made, upon student assimilation of course material and/or adoption of educational objectives.

The Learning Analytics Enriched Rubric tool computes a benchmark for each criterion by collecting and mining the associated data from the Moodle log files and by exchanging data with other tasks as it is presented in Figure 2 below. Then, the appropriate rubric level gets selected [16].

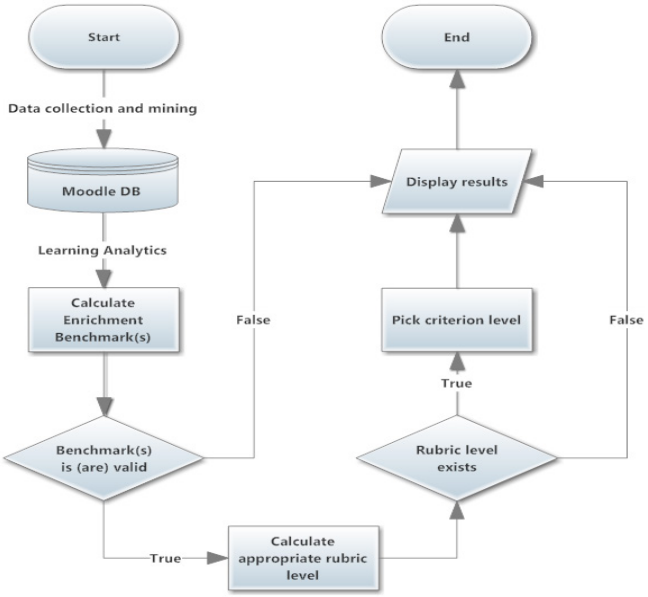

Figure 2. LAe-R automatic evaluation workflow

IV. CASE STUDY SCENARIO

32 MSc students, who were primary and secondary schools teachers, have evaluated LAe-R. All of them had experience in designing complex learning scripts for online courses. The case study was carried out in two phases: At first students were informed about the enriched assessment rubrics during a three hours lecture session. The concept of this new type of rubrics was presented along with examples that gave emphasis on learning interaction indicators. At the second phase, the students formed teams of two or three members. They were asked to:

1. Create complex CSCL scripts on various school subjects, using computer supported learning methods and/or inquiry based science learning methods, as well as instantiate them as Moodle courses
2. Design and submit enriched assessment rubrics for the assessment of students' performance in the Moodle courses which they have designed

The goal of this study was to evaluate the usability and acceptance of LAe-R by teachers-practitioners. As Figure 3 shows, the practitioners rated quite high the several usability aspects of the tool. Concerning LAe-R, teachers indicated that they felt comfortable using this tool. They were very satisfied by its interface. The majority of the participants stated that they found LAe-R very useful, quick and easy to work with. Using LAe-R for assessing students' performance in a pluralistic way seemed rather straightforward and effortless to the practitioners. Very good reviews were also noted for LAe-R's online help that contained detailed videos and files uploaded as Moodle docs.

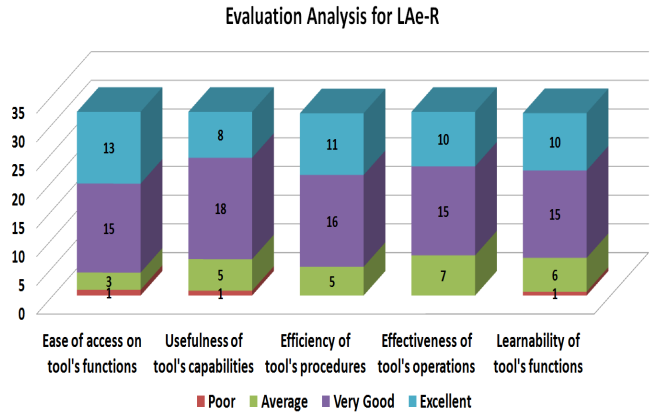

Figure3. Evaluation results about LAe-R tool's usability aspects in creating enriched rubrics with Interaction Analysis indicators

Furthermore, teachers-practitioners gave feedback comments via the open questions of the online questionnaire such as inclusion of:

- more criteria in an enriched rubric thus allowing a teacher to assess even more aspects of learning interaction in a Moodle course such as contribution to wikis.
- more sophisticated social network analysis indicators like the centrality of a social network could be added
- extra ways to visualize learning and interaction analysis indicators in pies or charts.

V. Conclusion and Perspectives

Learning Analytics is an emerging new research field with many tools which offer many valuable services to educators for monitoring and tracking learners' interactions in online learning environments. This paper presented the cloud-based LAe-R tool which seems a very promising assessment tool that could fill-in the gap in holistically assessing students' performance in Moodle, using the wealth of learning analytics with learning and interaction analysis indicators. Currently, LAe-R has been established with the intention to support teachers in their ongoing formative assessment tasks, using a variety of learning and interaction analysis indicators embedded in criteria. Despite its advanced assessment features and specialized customization options, the tool was greatly accepted and adopted by educators.

Future work will include the enhancement of LAe-R, based on the practitioners' feedback, giving emphasis on visualization aspect and more indicators. Also, more field-testing will accompany teachers that will enact Moodle courses based on complex learning scripts from different disciplines. We also plan to enhance LAe-R with a recommendation component for students so that LAe-R could be used for formative evaluation as well.

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Are students satisfied with media: a Canadian case study

Gerd Gidion, Luiz Fernando Capretz, Ken Meadows, and Michael Grosch

***Abstract*—The article presents partial results of a survey about media usage habits for studying and learning conducted in 2013 at Western University, a large Canadian university. The article focuses on students' frequency of use and satisfaction with media for studying and learning. The results of this study support the assumption that student's media usage includes a mixture of traditional and new media. The main traditional media continue to play an important role in the students' academic life, and some new media have emerged as seemingly on equal footing or even more important than the traditional forms of media. The use of some media can be stated as almost compulsory, especially the use of Google search; that is on the highest rank of frequency of use as well as one of the highest satisfaction values with the usage. The use of Facebook and YouTube shows very high values of usage frequency, so this might also be stated as a habit.**

***Index Terms*—e-Learning, Media Usage Survey, Technology-Enhance Learning,**

I. INTRODUCTION

THE intensive use of new media services is a phenomenon caused by new habits that encourage people to work with media on a daily basis. Nowadays, students are equipped with mobile and continuously network connected computers, and they are proficient in using them continuously learning.

The ubiquitous use of IT media and web/online services in higher education has led to substantial changes in the ways in which students utilize them to study and learn [1], [2]. Two of the most comprehensive media surveys was conducted by the EDUCAUSE Center for Applied Research (ECAR) in the Study of Undergraduate Students and Information Technology [3], and the Horizon Report [4] on the current and future use of technology in post-secondary education.

Partial results of our survey involving instructors and students only in the Faculty of Engineering were presented at the Canadian Engineering Education Association Conference [5]. Other more focused survey on mobile learning maturity and specific for m-learning have been carried out [6], [7], [8].

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II. RESEARCH METHODOLOGY

The survey tool was first developed and used at Karlsruhe Institute of Technology (KIT) in Germany [9]. During the application of the 15 follow-up surveys that were administered internationally, the original survey underwent optimization, translation into several languages, and validation.

At Western University, an initial invitation to participate in the research and two reminders were sent by email. The survey was voluntary and anonymous, as indicated in the cover letter. For the student survey, three emails were sent by the Office of the Registrar staff to a stratified random sample of undergraduate and graduate students enrolled on the main campus in the Winter/2013 academic term. The data for this survey was collected online using an established survey provider, Unipark.

In the period between January 16th and February 15th 2013, 19,978 students were invited to respond to the survey. Subsequently, exactly 1,584 visits occurred at the survey website. Among the invited students, 1,266 started to answer the questions, 985 completed the survey, and 803 recorded a completion rate of more than 90%.

The survey uses a fully standardized anonymous questionnaire containing a total of 150 items. Specifically, the tool measures usage frequency and user satisfaction with 53 media services, including: information services such as Google search, Google Books, library catalogues, printed books, e-books, printed journals, e-journals, Wikipedia, open educational resources, and bibliographic software; communication services such as internal and external e-mail, Twitter, and Facebook; e-learning services such as learning platforms and wikis; and media hardware such as Wi-Fi, notebooks, tablet computers, desktop computers, and smartphones.

These variables, as well as the aforementioned methodology, were used to create an acceptance value. Additional variables also underwent evaluation, such as learning behavior, media usage in leisure time, educational biography, and socio-demographic factors.

III. FINDINGS

Usage frequency has been connected in the survey with satisfaction related to the specific use of media. The students, who stated they use a media in any frequency, were asked how satisfied they are with this usage. The question was rated on a

five-point Likert scale with the choices: “never” (0), “rarely” (1), “sometimes” (2), “often” (3), and “very often” (4) resp. “very unsatisfied” (0) to “very satisfied” (4).

A. Frequency of and Satisfaction with the Usage of Several IT-Devices

The comparison between the means of frequency and the means of satisfaction with the IT-devices shows high values for the usage of one's own notebook / laptop both on and off the campus, a low (and group-specific sometimes high) usage of computer labs on campus with high satisfaction, where they have been in use, a rare use of Gesture Computing devices, but in case of use with high satisfaction. The satisfaction value of mobile phones, that are relatively often utilized, is on a lower middle level, the means of satisfaction for the usage of tablet computers and e-book readers tend to dissatisfaction.

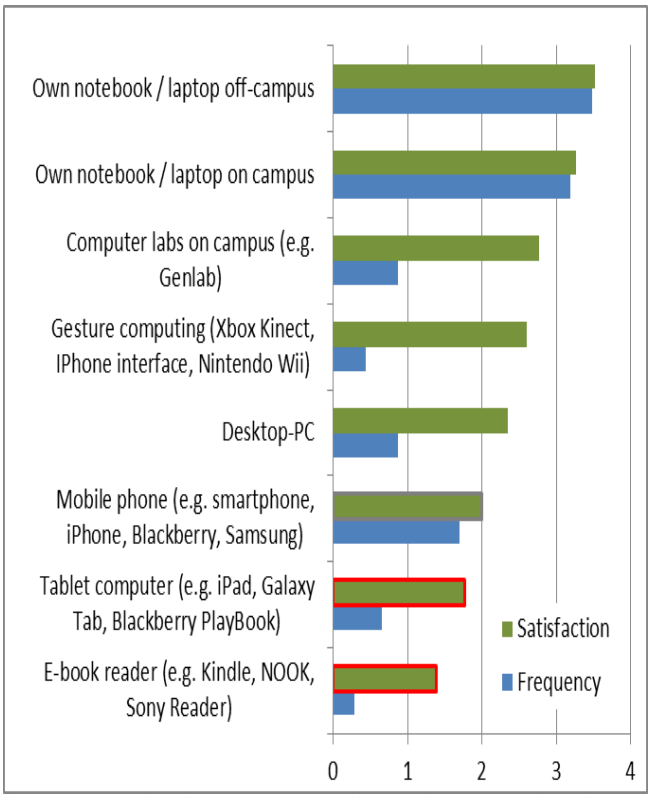

Fig. 1: Means of students’ responses to the questions: How often do you use the following for learning/studying? And if you use it: How satisfied are you with the use / functionality of the following for learning/studying? (red outline: in direction to dissatisfaction).

C. Frequency of and Satisfaction with the Usage of Various Softwares

In the case of the 5 software items the satisfaction value is throughout more positive than the frequency value. The dictionary software installed on the students’ computer shows good satisfaction for the smaller group that uses this application – those, who answered not to use the media, were (obviously) not asked about their level satisfaction.

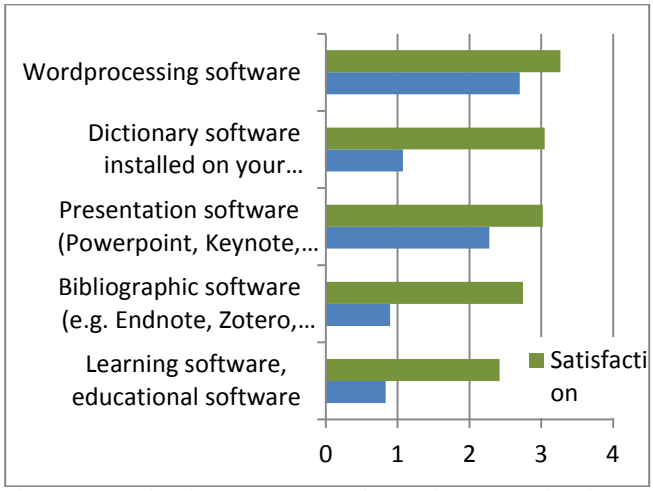

Fig. 3: Means of students’ responses to the questions: How often do you use the following for learning/studying? And if you use it: How satisfied are you with the use / functionality of the following for learning/studying?

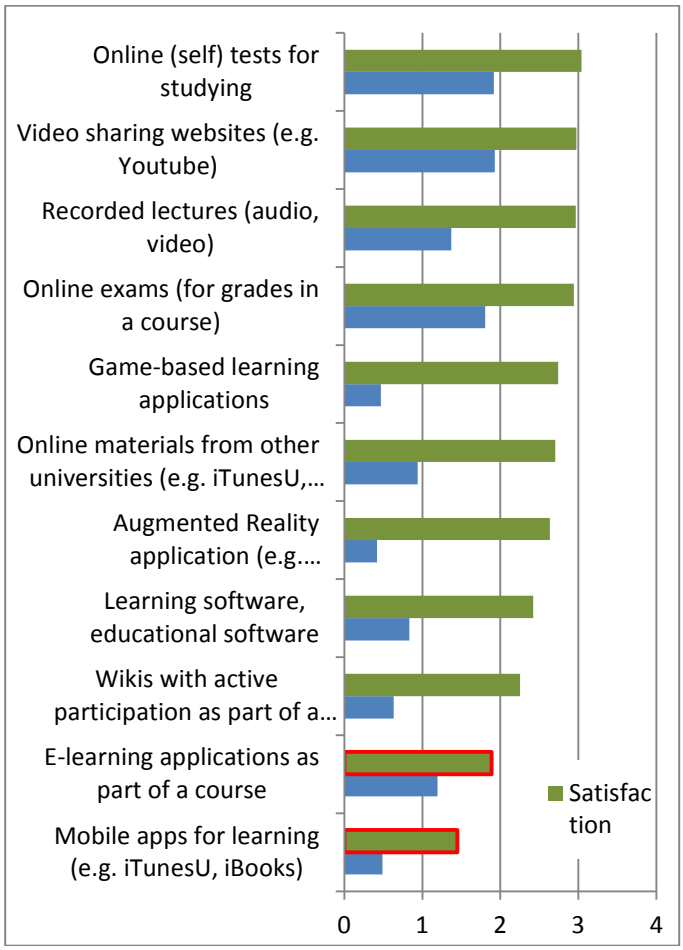

Fig. 4: Means of students’ responses to the questions: How often do you use the following for learning/studying? And if you use it: How satisfied are you with the use / functionality of the following for learning/studying? (red outline: in direction to dissatisfaction).

D. Frequency of and Satisfaction with the Usage of e-Learning Applications

The results show high values of satisfaction in the even very frequently used items of online (self) tests for studying, online exams (for grades in a course), video sharing websites and

recorded lectures. In the middle field of this group of items are rarely utilized game-based learning applications and augmented reality applications as well as the slightly more frequently used online materials from other universities and learning software.

Wikipedia (an item in another group of questions in the survey) is quite often used, but the work with wikis as a method with active participation as a part of a course seems not only to be rarely utilized, but also not very satisfying at the moment from the perspective of the students. A mean with a tendency to dissatisfaction (in a state of not so low value of usage frequency) was the result concerning e-Learning applications as part of a course and mobile apps for learning – they might as well not be really developed and established at the moment.

E. Frequency of and Satisfaction with the Usage of Social Network Related Applications

The dominance of Google search can not only be stated looking at the values for the usage frequency, but also in the satisfaction results – it is a little bit lower than the frequency, but even higher than all other social media variations. Twitter, social bookmarking and other social networks have high satisfaction values despite low usage frequency, Facebook seems to be more frequently used, but not as satisfying as other social network related applications at the moment of the survey.

Video sharing websites, such as YouTube, are only moderately used for learning purposes. Recorded lectures, audio and video, and online self-tests for studying are both used rarely to moderately. Course-based e-learning applications and course-based wikis are rarely utilized, and mobile apps for learning, such as iTunesU and iBooks, and game-based learning applications rarely to never used for learning at the moment.

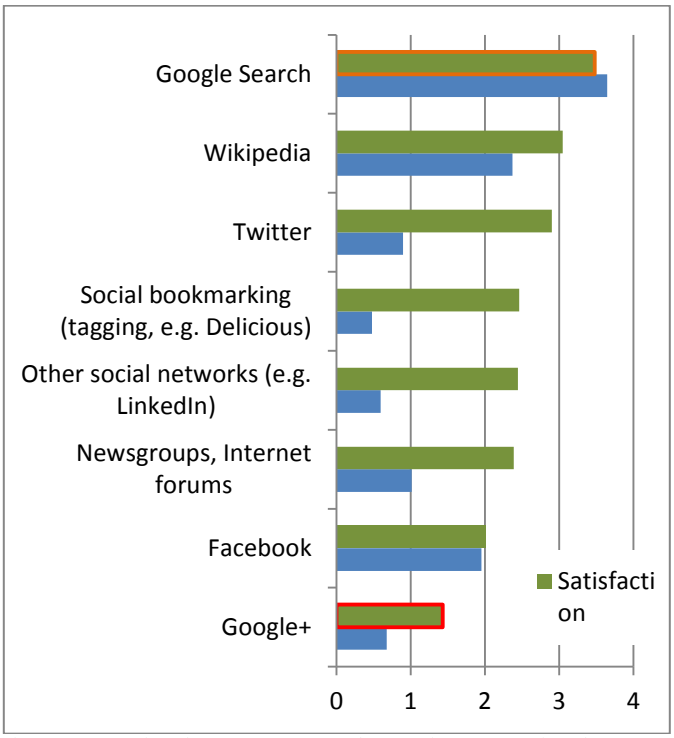

Fig. 5: Means of students' responses to the questions: How often do you use the following for learning/studying? And if you use it: How satisfied are you with the use / functionality of the following for learning/studying? (red outline: in direction to dissatisfaction).

F. Frequency of and Satisfactions with Usage of Printed vs Electronic Media

Several items in the survey belong to either the printed or the electronic version of a similar product. The comparison between those seemed to be interesting to get an impression about the relation and the changes of relevance. In the ranking the online slides and materials directly from instructors are on the first places, but followed by their printed handouts and, a little behind, printed books, that seem to be in good use and have good satisfaction results, too.

The e-books and Google books are less often used, albeit with likewise quite good satisfaction. Wikipedia – that has been expected as an obligatory media – is used frequently by more than 50% and has a similar satisfaction value. The relatively new Google+ applications show the lowest frequency and satisfaction values, but (an application like that) might come up in the next months.

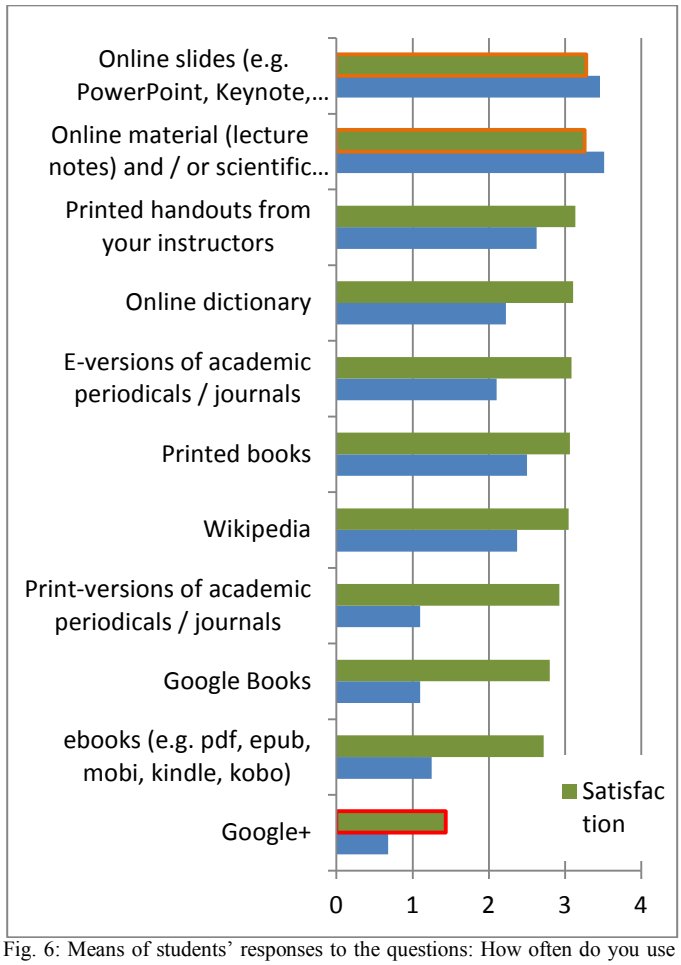

Fig. 6: Means of students' responses to the questions: How often do you use the following for learning/studying? And if you use it: How satisfied are you with the use / functionality of the following for learning/studying? (red outline: in direction to dissatisfaction).

IV. IMPACT ON TEACHING AND LEARNING

Certain innovative usage variations of new media for teaching and learning/studying are distinct – such as wikis as a part of a course, recorded lectures, or online tests – but more often for certain courses. They have been developed, launched, and proved; however, just a few arrangements seem to apply to these options. It can be assumed, that in those cases where a serious effort has been made, these new variations of working with new media have a distinct relevance, such as recorded lectures in science.

Media usage expands the interdependence with the market of academic education. So the competition with other universities and service providers has intensified. Although the frequency of use of online materials from other universities (e.g., iTunesU, Coursera, MIT open-courseware) or mobile apps for learning has not reached a similar level as Western's own materials, the use of media with a non-direct competitive influence seems to be especially remarkable, such as video sharing websites, Wikipedia or Google books. It can be assumed that the competition will be much more intense in the future, because the main players on the market collect (and utilize) much more specific data about students and instructors than every single university can (or would be allowed to) do.

Overall, the media usage by students and instructors is in some aspects different, but explainable, too, as in the case of Desktop PCs, Facebook, and YouTube. Instructors – as a heterogeneous group – generally have a more traditionally oriented usage of media, but some show ingenuousness in using new options. So the frequency of using Google+ is higher for the instructors as compared to the students. Many new media are extensively used by both instructors and students and can be considered as "new habits" (in a world of academia, where some habits seem to be unchangeable, although that has been intended over the years).

The survey at Western University followed the same concept as surveys in Europe and Asia. An international comparison is problematic; the development could just be interpreted if repeated surveys have been conducted. So it is speculative to answer questions about international similarities and differences. Nevertheless, it seems that the usage of IT-devices might differ (like more smartphone usage in Thailand/Asia and even Germany/Europe compared to Canada) and the use of social media in academic education seems to be more common in Thailand/Asia compared to Canada and Germany. The competitiveness of the Internet-based market of academic education might be more intensive in Canada because of the proximity of the U.S. market.

V. CONCLUSIONS

This survey purports to measure the students' satisfaction with current media that are used for studying and learning. Google search is the most commonly used web service by all students for learning and study purposes, with Wikipedia as a moderately close second. Facebook is only in moderate use for learning and Twitter and Google+ are quite infrequently used for this studying and learning.

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A multi-disciplinary approach developing a mobile Curriculum Mapping App called iFUN

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Abstract — **Curriculum content and delivery during rapid technological advancements and socio-economic changes present complex challenges for universities worldwide. The paper summarizes a multi-disciplinary process developing an iOS App called iFUN which maps a university's curricula, thereby allowing course designers to determine curricula strengths, gaps, misalignment, and repetition. iFUN is being adopted to envision current and future curricula, and contributes to the pursuit of a more multi-disciplinary student education.**

Index Terms — **curriculum, design, programming, education**

I. INTRODUCTION

The impact of socio-economic changes and technological advancements is prompting many educational institutions to re-think the processes of planning, designing and delivering courses in Higher Education. The effect is a re-emergence of the importance of curriculum design [1].

Curriculum delivery presents many complex challenges: e.g. responding to learner needs; delivery of engaging and flexible learning experiences, and varying assessments. Like any act of design, curriculum design is usually based on some initial ideas. Yet because ideas about education are important politically and socially, the ideas that go into curriculum design are also usually politically and socially significant, or ideological. Policymakers, educators, businesses, researchers, parents, pressure groups and other stakeholders interested in a curriculum all attempt to generate support for their own particular ideas. For example, some academics do not share the enthusiasm for curricula designed to promote post-industrial work; some parents don't possess the same passion for children's participatory cultures; some policymakers disregard educational research that cite benefits of experiential learning over rote-learning and standardized testing. In other words, developing an education curriculum is a complex act of creative design.

To exacerbate the dilemma, the implementation of 1:1 technologies such as the iPad, iPhone, Android devices and laptops impacts upon academics, students and education managers. Despite resistance from some academic staff, it is imperative that a 21st century curriculum represents the development skills necessary for knowledge and information –based economies. This can only be achieved by adapting the way of teaching with the linking of syllabus content and new forms of assessment: i.e. a multi-disciplinary curricula. What kind of approaches to curriculum design should we then be developing?

One approach is known as 'curriculum mapping' where stakeholders such as academic staff, students and community partners are engaged in a participatory development of a university's curricula. To facilitate access to a curricula and subsequently display links across courses in various disciplines, a mobile App was developed providing university course information and dynamically mapping curricula data based on end-users' search terms. This paper summarizes the development process.

II. CURRICULUM MAPPING

Curriculum Mapping identifies core skills, content and assessment in all taught subjects and highlights strengths, gaps, misalignment, and repetition [2]. It is recognized as a continuing process for orchestrating the scope and sequence of a curriculum to inspire coherence across grade levels, avoid unnecessary redundancies and provide teachers with timely feedback on curriculum implementation so that positive modifications can be made. The aim of this research project was therefore to design and develop a Curriculum Map mobile application which can digitally inform staff and students of course integration to provide a 'more informed' curricula.

TABLE 1. PLAN – DO – REFLECT

Dates	Technology goals	Education goals
PLAN April – June 2013	Input an updated syllabus to secure server using Java Eclipse.	
DO July – Dec 2013	Design a curriculum map of the syllabus for use in an iOS App. Use Node.js.	Keyword search for gaps and duplication in syllabus.
REFLECT Jan – March 2014		Trial some suggestions for modification to university syllabus, and see how these impact upon curricula. Obtain feedback from academic colleagues.

The research project comprised of 3 stages: PLAN – DO – REFLECT (see Table 1). The project has a technology focus and an education focus. An iOS App was subsequently

programmed so that data from a secure server can be illustrated as a curriculum map. The curriculum map can be updated in real-time by Administrator access to a secure server. Education researchers in the university's Center for Meta-learning (CML) can then analyze the resulting map for syllabus strengths, gaps, misalignment, and repetition.

III. APPROACH

A. *Technology focused*

Programming and development of an iOS application (using javascript) which allow users (after secure login) to amend courses on a dedicated secure server (using Java Eclipse) was implemented. Server-side programming and hosting support was provided by Solana Systems Inc., and iOS programming was undertaken by a Future University graduate student conversant with javascript and Node.js for App development. The usage procedure is as follows:

- User applies for a server-side account.
- User can update course theme, keywords, assessment, rate course relevance, and indicate other, essential linked courses.
- When completed, the curriculum map will refresh in the iOS App.
- The determining variables of the digital map will be primary (immediate course) keywords and secondary (associated courses) keywords, course relevance rating, and essential linked courses. This is programmed using Node.js: Node.js uses an event-driven I/O model for data-intensive real-time applications that run on distributed devices.
- The digital curriculum map is simultaneously updated in real-time taking into account the user's input.

B. *Education focused*

We have designed, programmed and developed an iOS App for Future University's syllabus. The syllabus data initially had to be inputted manually by one person. However, this data is considered to be 'retrospective' data; in other words, it is the current syllabus (i.e. 2012-13) that was designed and confirmed in the previous year (i.e. 2012). Analysis of amended curricula was then undertaken by looking at repetition of course content, primary links between courses, gaps in content delivery, appropriateness of assessment type, opportunities for flexible pedagogy (e.g. the flipped classroom), and opportunities for new courses. This will be continually conducted by researchers and educators in Center for Meta-Learning (CML) at Future University Hakodate.

IV. IMPLEMENTATION

The university's syllabus data was extracted from Excel and Word documents and added to an online Google Document. The data was arranged so that each column in the Google Document table represented possible variables that the App may retrieve. The document was shared with a translator who translated subject names and summaries from Japanese to English. The resulting document contained 184 subjects (the Rows) and 32 variables (the Columns).

The syllabus data was then imported to the Java Eclipse application so that the variables could be called upon when programming the iOS App on a dedicated laptop.

In order to design and develop the App, a program with objects and associated attributes needed to be prepared. The required information had to be specifically determined, and then represented diagrammatically so that the project leader, the programmer and the consultant were very clear about the project's outcomes and iOS App's focus. Figure 1 illustrates 3 of the 9 desired outcomes by the student user.

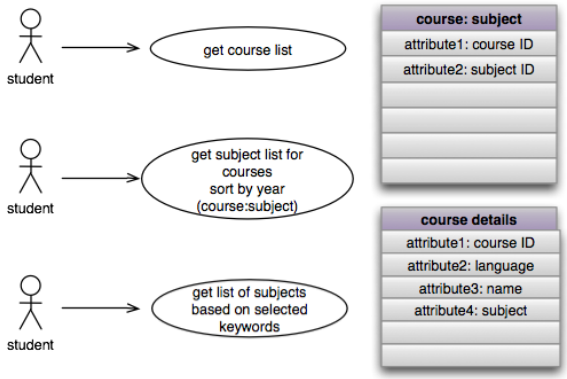

Fig. 1. App usage by end-user

Then the App's objects and variables needed to be determined, and the attributes needed to be specified. Once again, after much discussion, the agreed information was represented diagrammatically for clarity. The objects, variables and attributes were then represented in a model – controller - view (MCV) pattern (see Fig. 2). These three interconnected parts separates data within an application so that the data can be presented in different ways to the end-user. The model is the application data, the view is the output representation in multiple formats, and the controller accepts input and converts it to commands for the model or view.

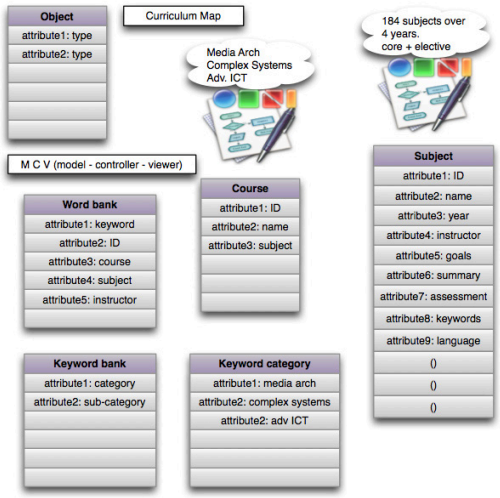

Fig. 2. Objects and Attributes

The syllabus data was then transferred to a dedicated server using the Java Eclipse program software. Eclipse retrieves specific data called a DAO (Data Access Object model). DAO's provide some specific data operations without exposing details of the database.

The App programming was undertaken using Appcelerator's Titanium Studio for Mac OSX software [3]. This has the advantage of developing one-time but being able to export to multiple platforms such as iOS and Android. The panes of the App were agreed to be Twitter, Links, Syllabus, Map and Settings. With the syllabus data now accessible from the server, the programmer could start to develop the App while other team members regularly updated the syllabus content. At the same time any updates to the syllabus could be undertaken by inputting data directly to the server thereby not interfering with the development of the programming of the App.

In time the App began to take shape with course lists per year, course information in English and course details in Japanese. It was decided to summarize the course details to the amount of text viewable in one iPhone screen size (see Fig. 3).

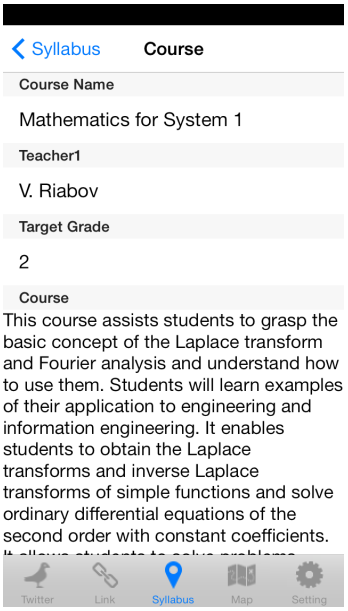

Fig. 3. Course details in English

The most challenging part though was programming the dynamic map. A similar concept was developed for an App called Wikilinks [4]. The project leader contacted the developers and found they were a team of programmers based in Switzerland who programmed their dynamic map using Python. Unfortunately, they were not available for contracting their skills, and we could not find a skilled Python programmer within our university. So we looked at Nodejs [5]. Nodejs is software that primarily builds network applications. It has been developed for data-intensive real-time applications that run across distributed devices. Similar to Titanium Studio, Nodejs ustilzes javascript as its scripting language.

After many hours over a 3-month period the first version was 'live' and could be tested on the iPhone Simulator on the programmer's MacBook. At this stage the Curriculum Map became known as the Syllabus Map (see Fig. 4) due to a translation from English to Japanese where 'curriculum' and 'syllabus' are deemed synonymous. In English, 'curriculum' and 'syllabus' are distinctly different: 'curriculum' refers to course content, the teaching pedagogy and the form of assessment; 'syllabus' refers to the course and subjects' content only (i.e. what is being taught). However, given the relief at the result of a dynamic map we decided to dispense with semantics for the moment.

Fig. 4. Syllabus map

The syllabus data could then be searched by typing keywords in English (see Fig. 5) or Japanese. See Table 2 for an explanation.

TABLE 2. HOW TO SEARCH THE SYLLABUS

step 1: type a search term; e.g. java
step 2: decide course and year
step 3: click Search
step 4: let's look at the resulting map.
red node = keyword
orange node = primary course
black node = secondary course

At this stage the App was ready for beta testing. To distribute to staff and student volunteer beta-testers, the TestFlight [6] service was utilized for AdHoc distribution. In addition, the Titanium project files were uploaded to GitHub [7] for sharing between developers.

The App also needed a logo due to the interface design changes in Apple's iOS 7. A Future University design student

was commissioned and she created a logo consisting of the 3 letters of FUN plus 4 colors representing the 4 disciplines taught at Future University.

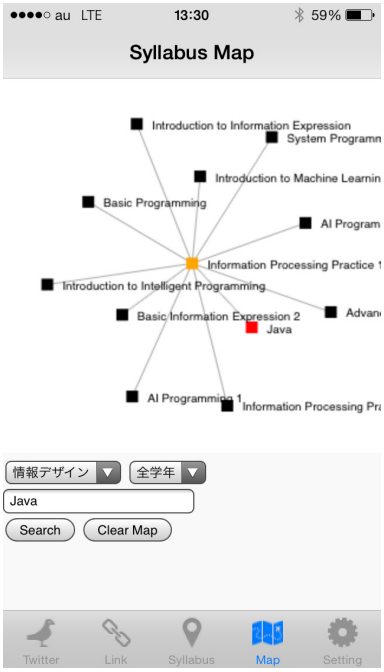

Fig. 5. Searching the syllabus

After feedback from beta-testers, a number of additional Twitter feeds and website links were added. It was also found that some keywords such as 'design' and 'create' occurred in so many subjects that the map became overwhelmed and there was not enough window space to show all the links. The subject keywords had to be curated to be more specific to each particular subject. In addition, the Graduate school courses were added to the server data and iFUN App program. As the initial stages in the determination of the variables were absolutely clear, adding the Graduate school information was seamless and quick.

Once the team had checked that all the variables were in place and accessible, the App was ready for distribution. An iTunes Connect account was created and the App uploaded for approval by Apple. Within less than a week, on Christmas Day 2013, the iFUN App was available for free on iTunes App Stores worldwide. The iFUN App can now be downloaded by typing the URL http://tinyurl.com/n3qa5pg
in a web browser, which will then re-direct to iFUN in the iTunes App Store.

V. CONCLUSION

The multi-disciplinary approach has led to a successful outcome which will prove beneficial to all current and future students and staff of the university. By tapping into the skills of a programmer, working with an external expert in server-side applications, and being guided by an educational technology researcher, the mobile App project has been a success. The regular meetings and subsequent action items provided clarity and transparency. Technological obstacles were overcome as a team; whether they related to code, to server-side variables, to interface design, or to syllabus data.

In addition to the 'search and map' feature, the convenience of the iFUN App enables students to have immediate access to web links such as local information, bus timetables and peer-tutoring schedules, plus twitter feeds of design, technology and science in Japanese and English. Students can quickly access and read about courses and, with personal academic support, student 'learning pathways' can be illustrated thereby empowering students to be motivated to take ownership of their career development.

Moreover, the App has proven cost-effective as it has negated the need to print hundreds of syllabus books (often up to 200 pages each).

Last but not least, due to our 'data-in-the-cloud' approach, syllabus data can now be updated in real-time without the need to specifically update the App itself.

VI. FUTURE RESEARCH

Our future project will adopt a 'wiki' approach where academics and other stakeholders collaborate to continuously update courses and subjects. External stakeholders such as potential employers can also contribute their expectations of university courses (such as particular programming skills, software skills, network diagnostics, effective communication, etc.). By being better informed, course managers and staff can then adjust their style of teaching, the content they teach, and how they assess (in other words, the whole curricula) based upon the evidence displayed. This will help develop new pedagogies within Japanese universities, particularly in science and technology contexts. In addition, an Android version is planned to be available in Chinese and Korean.

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