Track: Technology-Enabled Learning

The e-Assessment and e-Feedback System to Enhance Aerospace Engineering Training

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Abstract

The e-Assessment and Feedback System for Enhanced Learning at the Temasek Polytechnic-Lufthansa Technical Training Centre is used for formative and summative assessment of two modules: Materials and Hardware (M06) and Maintenance Practices (M07). Trainees get feedback on their test performance by individual questions and content type viz a viz the whole class while tutors are also able to identify the weak areas of their students. This preliminary study involving 29 trainees showed that they were most appreciative of the availability of the feedback via analytics and they generally found it useful in preparing for their final exam which is closely tied to the Civil Aviation Authority of Singapore (CAAS) examination. Data was collected through three surveys administered at significant times of the programme.

Key words: e-assessment; e-feedback; enhanced learning; Aerospace Engineering

Methodology: Qualitative research study

Objective and Purpose of the Paper

Lufthansa Technical Training GmbH (LTT), a leading provider of training and qualification program for the aviation industry, was founded in 1994. It has since established several training centres in Europe, the Middle East and Asia. As a subsidiary of Lufthansa Technik, it is able to draw on 60 years of experience

accumulated by one of the biggest maintenance organizations and expert knowledge amassed from 50 years of training qualified personnel for the aviation industry.

In 2008, an LTT Centre was established in Singapore at Temasek Polytechnic. It received the SAR-147 Approval Certificate from the Civil Aviation Authority of Singapore in 2009. The Temask Polytechnic-Lufthansa Technical Training Centre (TP-LTTC) is the third aerospace Lufthansa Technical Training Centre to be established in Asia, after Taiwan and the Philippines. The School of Engineering at Temasek Polytechnic (TP) has been audited and certified by the Civil Aviation Authority of Singapore (CAAS) as a SAR-147 Approved Maintenance Training Organisation (AMTO). Students from the Diploma in Aerospace Engineering and Diploma in Aerospace Electronics are offered this intensive prestigious training programme through the TP-LTTC. Below are details of the target groups and intensity of the programme (see table 1).

Table 1. Details of TP-LTTC training programme

	Aerospace Engineering group	**Aerospace Electronics group**
Target group	Year 3, semester 1 students	Year 2 semester 2 students
Curriculum Hours	125 days / 25 weeks / 875 hours (including 511 practical training)	102 days / 20.4 weeks / 714 hours (including 458 practical training)

As a part of Aircraft Maintenance Licensing (AML) training course, the TP-LTT Centre conducts Basic Knowledge Examinations for the SAR Part 66 Modules, M06 (Materials and Hardware) and M07 (Maintenance Practices), for B1 and B2 Category. Each batch of about 150 students undergoes 7 assessments during their training at the Centre. Each assessment consists of a range of 20 to 80 multiple-choice questions for 5 to 20 topics depending on the type and category of the training. In the past, such

assessments have been conducted using hardcopies which were marked manually. Students received only the grade Pass or Fail at the end of the assessments. The assessments did not provide adequate feedback to students. Moreover, it was a challenge for staff to manage. Many factors resulted in the inception of this e-Assessment and Feedback System (eAFS) for Enhanced Learning. These included:

1. Extensive time taken by the setting of the assessments by staff
2. Marking fatigue experienced by tutors resulting in errors
3. Tedious process of recording, verification, consolidation and transfer of marks
4. Limited number of question sets restricting wider knowledge testing ability
5. Lack of prompt and detailed feedback

To enhance the training, the *e-Assessment and Feedback System for Enhanced Learning* (eAFS) was introduced to provide formative and summative assessment of two training modules: Materials and Hardware (M06) and Maintenance Practices (M07). These in turn prepare trainees for their Civil Aviation Authority of Singapore (CAAS) examination. Trainees get feedback on their test performance by individual questions and content type viz a viz the whole class. Trainers have access to the same data and are able to identify the weak areas of their trainees and adjust the pace of their lessons in the classroom and workshop; however, it is not known how trainees are reacting to the eAFS.

The objective of the paper is to examine the usefulness of eAFS to the trainees. Hence, the research question and sub-questions are as follows:
1. How did trainees perceive the use of the analytics provided in the dashboard?
    a. What information were they most interested in?
    b. How did it help them prepare for the final examination?

Perspective(s) or theoretical framework

In general, Lufthansa Technical Training offers three different forms of training, namely classic classroom training, practical training and e-learning methods. In the TP-LTTC

training programme, only e-assessment, supported with e-feedback is used. The future of learning will revolve around learning analytics. In education, real time use of learning analytics by students, instructors could be used to improve success. The selection, capturing and processing of data can be helpful for students and instructors at the course or individual level(Elias, 2011). This adds a new dimension to traditional e-learning where learners interact with the content. Learning analytics can be easily generated using Excel using functions like charts, Pivot Tables, data visualization, and other representation of statistics. Given the plethora of e-data that can be gathered and generated, societies like SOLAR (2016) are promoting dialogue into the role and impact of analytics on teaching, learning, training and development.

Siemens et al (2011) envision Learning Analytics as "a means to provide stakeholders (learners, educators, administrators and funders) with better information and deep insight into the factors within the learning process that contribute to learner success" (p. 5). Some of the potential benefits identified are as follows:
- Extend and enhance learner achievement, motivation and confidence by providing learners with timely information about their performance and that of their peers
- Improve teacher time and effort by providing information on which students need additional help, which students are candidates for mentoring others, and which teaching practices are making the biggest impact.
- Higher quality learning design and improved curriculum development profess through the utilization of data generate during real-time instruction and learning activities
- More rapid achievement of learning goals by giving leaners access to tools that help them to evaluate their progress and determine which activities are producing the best results.

(p. 5)

In education, real time use of learning analytics by students, instructors could be used to improve success. For instance, it improved retention of students and performance outcomes at Purdue University (Arnold & Pistilli, 2012). Verbet et al (2013)'s review of applications highlighted other benefits:

- **CAL Maystem** helped learners reflect ; Was effective in improving self- assessment (Kerly, Ellis, & Bull, 2007)
- **Teacher ADVisor** provided increased satisfaction of course (enjoyment, self-esteem, contact with facilitators, & recommending course to other students)(Kobsa., Dimitrova, & Boyle, 2005)
- With **Course Vis** Teachers could identify more information such as performance of student on a topic of course, concepts that need further investigation. (Mazza & Milani, 2004, November)

Verbert, et al. (2013) propose four stages of viewing personal informatics:

1. Awareness: Data which can be visualised as activity streams, tabular overviews, or other visualisations
2. Reflection: Users ask questions and assess usefulness and relevance of relevant the data
3. Sensemaking: Users answer questions identified in the reflecting process and creation of new insights
4. Impact: Induce new meaning or change behavior if the user deems it useful to do so.

Methods, techniques, or modes of inquiry

The participants in this study were from Diploma in Aerospace Engineering in their Year 3 Semester 1. They were attending a six-month long training on Aviation Maintenance Practices and, Materials and Hardware at the TP-LTT Centre. All the participants attend Higher Aerospace Engineering Training (HAET) either at aviation/aerospace industries or in-house. A small number of students had undergone Private Pilot License training. Out of the five classes that were involved in the eAFS, one class comprising was selected for the study.

This preliminary qualitative study, conducted between September and October 2015, involved 29 third year students from the Diploma in Aerospace Engineering. As part of the enhancements to the TP-LTTC training programme, they were given the following e-assessments. Three formative tests, two familiarization exams and two summative exams were administered using the e-Assessment and Feedback System. Details are in Table 2 below:

Table 2. Online Assessments

Computer based testing	Dates / Duration	Online experience	Type of feedback
Quiz 1	22 May 2015	Open book take home test, completed anytime at home by students; three attempts allowed. 20 MCQ on 5 topics	From computer: Total Score of each attempt
Quiz 2	21 Aug 2015	One practice session (individual work) before the actual test 20 MCQ on 12 topics and 1 essay question	From computer: Dashboard with numerical and graphical data by individuals and class by topics; individual printout handed to students
Quiz 3	18 Sep 2015	Closed book 20 MCQ on 4 topics and one essay question	From computer: Final grade for MCQ
Trial exam	20 Sep 2015 21 Sep 2015	72 MCQ for topics in M06 training manual 80 MCQ for topics in M07	From computer: Final grade

		training manual	
Final exam	1 Oct 2015 90 minute test 2 Oct 2015 100 minute test	72 MCQ for topics on materials and hardware in M06 training manual 80 MCQ for topics on maintenance practice in M07 training manual	From computer: final grade

While participants were given the results of their performance immediately after each quiz and familiarization exam, they would also have access of their detailed test performance by individual questions and content type viz a viz the whole class. Their tutors were also able to see their performance and identify the weak areas of their trainees. Data was presented in the form of a dashboard (see Figure 1 for sample).
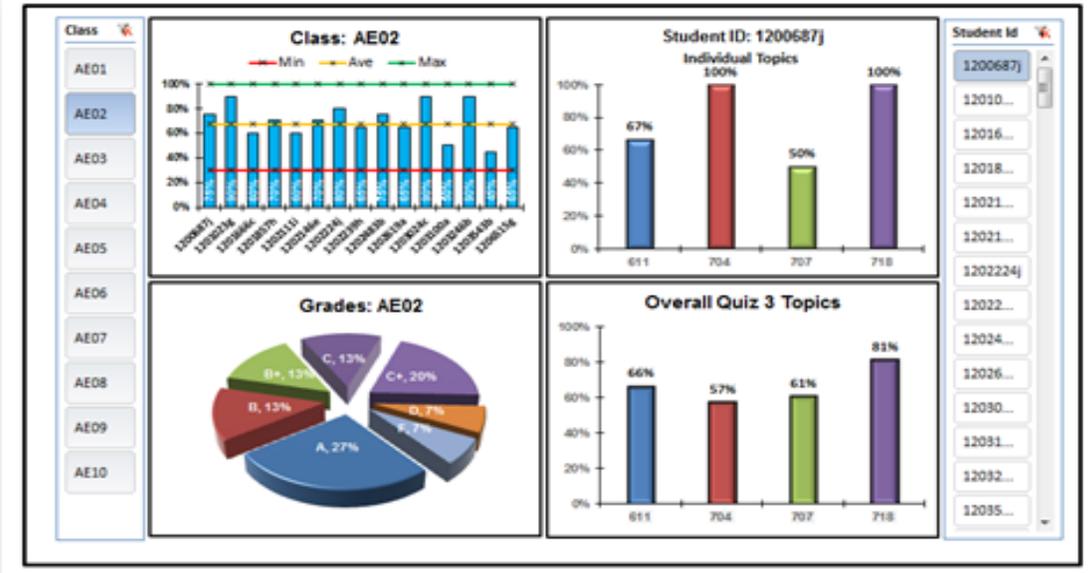

Figure 1. Dashboard of Quiz 3 for individual performance viz a viz the class.

Data sources

This qualitative study involved the use of three surveys administered during the use of the eAFS. The first survey was administered on 18 September 2015 after participants completed their quiz 3. Participants were asked to provide feedback on the usefulness of their dashboards. A copy of their individual dashboards for Quiz 2 was printed out for reference. The second and third surveys were administered after their completed their final exams for M6 and M7 modules on 1 and 2 Oct 2015 respectively. These focused on the actual usefulness in preparing for the examinations, in terms of familiarizing them with the topics of the module, the theoretical knowledge, understanding the theoretical knowledge and applying theoretical knowledge as well as familiarizing them with practical knowledge, understanding the practical knowledge and applying the practical knowledge.

Findings

With regard to the research question "How did the trainees perceive the use of the analytics provided in the dashboard", the preliminary findings showed that the participants had a deep appreciation of the provision the analytics, and recognized the potential uses of it. However, they felt that they were only interested in their own results and not performance of peers. In terms of preparation of the final examination, more participants felt that the eFAS helped familiarizing, understanding and application of the theory than the practical knowledge. However, a few participants did not seem to need it as they had their own strategies.   Further analysis would be required to review responses by their educational background (i.e. ITE or GCE "O" levels).

Scientific or scholarly significance of the study or work

This e-approach has taken the tedium of running pen and paper tests and facilitated the provision of immediate feedback (Siemens, et al., 2011)that is analytical by

questions, providing each trainee individual and comparative performance. The visual representation of a dashboard allows for quick reading of the feedback. The item bank provides a constant supply of questions, so that the scope of learning is wide.

While the 4 stage process of looking at personal learning analytics (Verbert, et al., 2013) might work for trainers, for the trainees, it seemed more useful for self-awareness. This is possibility because of the difference in the responsibilities:

- It was mandatory for trainers to review the dashboard for the performance of their students, identify who needed help, reflect on the effectiveness of their training approaches, and modify their approach. Hence it has the potential for awareness, reflection and sensemaking.
- It was optional for students. While the use of the dashboards was well received, it had the potential to work well as an awareness tool for students during the quizzes, however, it was not so important for exam preparation or comparison of performance of peers. It was useful for helping them in the familiarizing, understanding and application of theory, but not the practical.

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While this is a preliminary study on the usefulness of the provision of analytics to the learner, the review of the dashboards was optional. Further work needs to be done in terms of investigating the following:

1. Impact of incorporating self- review activity as part of the curriculum and closer analysis of responses by their prior mode of education (i.e. ITE or GCE "O" levels).
2. Correlation between consistently referring to the e-Feedback system and performance in the final exam and CAAS exam.

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