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Learning for the future: Online student evaluation of generic and context-specific library skills tutorials

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This paper reports on a project stimulated by two major challenges facing higher education in the twenty-first century; massification and the citizenisation of academies. This empirical study reports on the use of emergent technologies, in the acquisition of information, for diverse cohorts of students enrolled in two scientific subjects (n=47). A generic online library skills tutorial (LST) in one subject is compared to an embedded virtual, context-specific LST in another. Student attitudinal evaluation, both affective and cognitive, was measured by an 18-item online survey. The rich qualia showed a ten-fold difference which adds to a body of knowledge which was reinforced by an objective measure, a graded assignment. As consumers, the students have been valued and voiced their demands. Lecturers and librarians need to lead in this climate of change to develop a creative and emergent, reciprocal non-linear mechanism to build on this trajectory and plan a future for learning.

Keywords: acquisition of information, library skills tutorial, online student evaluation

Background

Two international drivers for future transformational change within contemporary discourse in global higher education are massification and the citizenisation of academies, each of which have national advocates. In parallel, government social and economic objectives drive investment and construction of network infrastructures to offer all citizens high speed connectivity.

Future orientated academics must be cognisant of this phenomenon as tertiary education is no longer perceived as an endeavour of the elite but is being transformed into a universal system designed for the masses (Fisher, 2006). This trend towards education of the masses requires innovative future-orientated solutions. Consistent with Gallagher (2001) who suggests the growth of online learning is inextricably linked to the commodification of knowledge, Holt and Challis (2007) consider decision makers at Universities should respond to contemporary societal demands and become more industry and customer focused. Leading in a climate of change, the hierarchy of this small regional University in Australia made a decision to offer online learning in response to increased economic pressure, to reduce costs. In turn the lecturers, who adhere to social constructivist epistemologies had to develop new pedagogies through projects of digital inclusion.

Australian Universities have also followed the lead of Anglo-American tertiary institutions, which privilege the notion of training future work-ready citizens by embedding generic skills relevant for the new knowledge economy. Generic skills equip a person to achieve their full potential in employment, life and community. They are highly-valued by employers for their role in enhancing the capacity of employees to respond, learn and adapt when workplace demands change. These skills, including information literacy, are developed throughout a person's life and in multiple settings, including work and life settings and educational contexts. According to Blewitt (2010) sustainable and lifelong learning and the attributes graduates should be embedded in undergraduate learning activities (Kennedy & Innes, 2005) which can be facilitated by new technologies.

Thus, academics, in higher education, find themselves located in this complex social reality of a nascent digital culture. They need to conceive of imaginative and innovative responses to future orientated challenges to ensure large, diverse student cohorts are fully prepared to meet the demands of a new knowledge society with respect to information literacy. Lecturers and librarians, in higher education, strive to design 'learning for the future'

curricula, and act as facilitators enabling students to become self-regulated learners, with respect to information literacy. According to Cochrane (2006) optimum development and implementation of innovation in teaching and learning are informed by a pedagogical framework which should be based on alignment of interactive learning experiences and authentic assessment tasks that enable student achievement of learning outcomes.

In this study, for the students enrolled in two first year science subjects, the authentic assessment task culminated in a piece of summative academic writing, a research report. To be able to write a research report is considered a generic and transferable skill for a science graduate, as they are learning for the future, and one step to success is for the student to acquire knowledge by developing their information literacy skills. Interactive learning experiences for information literacy are increasingly developed and delivered by expert librarians in generic online packages available on-demand (Wesch, 2009). The benefits of skills specific training delivered by library experts versus general training may impact upon the developing skills of future work ready graduates. This study reports the outcomes of a quasi-experimental study to compare a traditional generic package with a collaborative project between a discipline-specific academic and an expert from the library to deliver information literacy learning experiences to diverse cohorts of students.

Library Skills Tutorial (LST)

The nature of the library and information skills is changing rapidly as technologies emerge. Undergraduates struggle to identify, retrieve and evaluate academically acceptable sources of information in challenging science-based writing assignments (Flaspohler, Rux, & Flaspohler, 2007). This is magnified in a diverse student cohort where some can navigate online with ease whereas others are completely mystified (Martin-Kniep, 2000). Cliff and Hanslo (2009) in South Africa, reinforce the challenges facing the educationally diverse backgrounds of the first-year undergraduate students including the academic reading and writing demands. The massification drive for larger student numbers, with no corresponding increase in staff numbers, have reduced opportunities for formative support (Nicol, 2009) for such a pivotal stage in the learning experience. A further risk manifests for students with poorly developed authorial identity who may be at risk of unintentional plagiarism. Elander, Pittam, Lusher, Fox & Payne (2010) report a beneficial intervention which assisted 364 UK first-year undergraduate psychology students avoid unintentional plagiarism. Flaspohler et al. (2007) report the provision of enhanced library-based instruction to biology students improved their library search capabilities and reduced incidents of plagiarism. The literature presented so far makes a case for the inclusion of library skills instruction to first year science undergraduate students. What follows is a discussion about who should deliver the instruction and an evaluation of the optimum methods of delivery.

First year science students need to locate, access, retrieve and utilise information in an effective and ethical manner and master their genre of academic research report writing. Science lecturers may not have the time nor the expertise to support and mentor students through the process (Strauss, Goodfellow, & Puxley, 2009). In her review of Irish higher education practices McGuinness (2009) reports the use of generic library tours and print based guides, one-off lectures, demonstrations, and possibly hands on laboratory sessions delivered by library specialists to small cohorts, in face-to-face 'internal mode'. Recently this support has been extended to 'external mode' students using communication tools, e.g. asynchronous chat, in an online learning management system. However, university librarians often develop and deliver these library skills sessions in a standalone format, using non-integrated methods. Strauss et al. consider this to be problematic as students require specific background information during this pivotal stage of acquisition of information. Thus librarians should collaborate with academic teaching staff to embed context-specific LSTs. In this study, a traditional online generic LST offered to students enrolled in one science subject will be compared to a compulsory, embedded virtual, context-specific LST in another science subject. Subjective student evaluation of the LSTs and the objective impact of the LST on the student learning experience will be measured.

Subjective Student Evaluation

Tensions between financial imperatives and delivering a quality learning experience continue. As a receiver of publicly raised monies, Universities are required to be more productive and more efficient with concurrent accountability for quality. Fisher (2006) proposes the potential consequence may be 'a reduction in the experience of learning' (p. 1) so careful monitoring of the perceived student experience over time will provide data which may refute Fisher's proposition. Student evaluation should not be seen as a cause of anxiety (Donovan, Mader, & Shinsky, 2010) but as a reliable and valid way to learn from the student experience and improve the learning experience for subsequent cohorts of students.

Researchers in education have used various methods to elicit student evaluation of programs. Hendry, Bromberger and Armstrong (2011) combined focus group discussions with self-report questionnaires derived from their qualitative data. This 'triangulation' or a mixed methods approach ensured rigour and trustworthiness of their findings. Hendry et al.'s research was conducted on campus and Anderson, Cain and Bird (2005) note the benefits of online student evaluations over paper based surveys include time efficiency for academia in terms of deployment and analysis. This method of garnering student evaluation also provides the student with a level of control. Students can chose when to participate and for how long. Accordingly, there are more thoughtful and longer remarks for open-ended questions which provide formative, or useful information for the instructor on what was effective and what should be changed (Donovan et al., 2010). Interestingly, Donovan et al. reported no difference between the quantitative ratings between paper based and online evaluations, despite prior perceptions of a higher percentage of negative responses.

Pragmatically, this study will use online student evaluation to compare the effectiveness of a generic versus a context-specific LST. In their recent review of library instruction and information literacy, Johnson, Sproles and Detmering (2010) list only three journal articles that report student evaluation. An exception is Figa, Bone and Macpherson's (2009) study on faculty-librarian collaboration which reports the use of a student survey. As there appears a dearth of literature and tools for capturing student evaluation of an LST, a unique measuring instrument has been devised to elicit both quantitative and qualitative data. This innovative metric, an 18-item online survey, has been designed to measure student attitudes, their personal beliefs about way of knowing (cognitive) and feeling (affective) in relation to perceived usefulness of the LST outcomes in their future learning. A feedforward approach will be taken in the analysis to inform future iterations of LSTs and enhance the experience for future learners.

Objective Performance

Student attitudinal evaluation, both affective and cognitive, will not be the sole measure of the relative effectiveness of the two LSTs (generic and specific). An objective measure will add to and potentially reinforce the findings reported in the subjective student experience. The learning objectives for the students in both science units included a requirement to write a scientific research report. Two science subjects, at a regional Australian University, have encouraged scientific writing early in undergraduates' academic career to improve their working knowledge of theories, concepts and techniques that are extensively reported in scientific publications (McClure, 2009).

An academic science report relies on prior preparation and the application of the skills learned and practiced in the LST. Students are expected to identify, retrieve and evaluate academically acceptable sources of information which they cite in the 'Introduction' to construct a coherent argument and develop their research hypotheses. Then after the 'Method' and 'Results' section, they should refer again to some of their citations in the 'Discussion'. Finally, they should consolidate all citations in a terminal 'References' list in the appropriate style for the discipline. For an objective measure, the final grade for the submitted research report is assumed to measure the performance of the student in an authentic assessment which incorporates the skills they acquired and practiced during their LST.

Research Aims

Formal student evaluation of information literacy teaching is not commonly carried out in higher education institutions (Johnson et al., 2010; McGuinness, 2009) and the aim of this study is to gather evidence, to inform a bottom-up change initiative, for the redesign of subsequent virtual, context specific LSTs to improve learning for the future, that is, academic writing in first year science students. There appears to be a dearth of research that documents such a specific skill development in the learning cycle in science undergraduates and this research study will add to literature about transforming education through supporting collaboration, connection, and customisation and individualisation of virtual non-linear, creative and emergent digital environments. Thus the significance is to enhance the future learning experience of large cohorts of science students and to ensure work ready graduates with respect to information literacy.

The main aim of this study is to use student evaluation to compare generic versus context-specific library skills tutorials. The primary research hypothesis is 'students receiving a generic library skills tutorial will rate the tutorial lower than students receiving the context-specific library skills tutorial'. A subsidiary aim is to use an objective measure to determine the efficacy of the library skills tutorial offered in each science subject. The secondary research hypothesis is that 'students receiving a generic library skills tutorial will receive a lower grade in the assessment task than students receiving the context-specific library skills tutorial'.

Method

Participants

The study participants (n=47) included all students enrolled in two, first year, science subjects at a regional Australian University that submitted a research report for grading (N=426). Table 1 shows the demographic data for students from each science subject (psychology and anatomy & physiology).

Table 1: Sample Size and Demographic Variables for the two Science Subjects

Variable		Science Subject	
		Psychology	Anatomy & Physiology
Sample	n	28	19
	%	17.4%	7.17%
Age	mean	35.5 y	26.9 y
	SD	12.5 y	9.5 y
Gender	male	17.9%	26.3%
	female	82.1%	73.7%
Mode of study	internal	21.4 %	55.6%
	external	78.6%	44.4%

Design

This mixed methods study is considered to be an independent quasi-experimental design. Independent group allocation was contingent upon the science subject in which they were enrolled. Due to departmental constraints all psychology students (internal and external) received a generic online tutorial, whereas, the internal anatomy & physiology students were exposed to a face-to-face workshop delivered by the librarian. All anatomy & physiology students had access to the enhanced embedded, virtual, context-specific LST designed for the external student cohort, in collaboration with the lecturer. This was a synchronous Collaborate session using the Learning Management System which was archived for subsequent access by both modes of students.

Materials

A survey was specifically designed to measure the students' self-reported attitudes (affective and cognitive) of the effectiveness of the library skills tutorial. The 18-item survey consisted of two sections, a demographic and library skills tutorial evaluation section. Eight demographic items elicited data about the student, including age, gender, course, number of semesters studied, their mode of study and student identification number. The latter item was to enable data linkage with the assessment grade (the objective measure).

Of the remaining 10 evaluative items, one required a response about the duration of the LST. The tutorial lasted for one hour and students were asked if this was appropriate, and if not, what length of time they considered would be adequate. The library skills tutorial scale (LSTScale) consisted of 7-items and elicited specific attitudinal responses to a statement. These were measured on a 5-point Likert scale, thus the sum of LSTScale for an individual respondent would range from a minimum of 7 to a maximum of 35. Cronbach's alpha is an index of consistency or reliability across items constructed to measure a construct. For the 7-item LSTScale alpha = .88 which can be considered adequate for exploratory research purposes.

Within this scale were two subscales. The affective subscale of 3-items provided a measure between 3 and 15. It included statements about their feelings, or confidence levels. The 4-item cognitive subscale might produce a value between 4 and 20. This subscale included statements about their knowledge and understanding. Finally, two open-ended items were included to generate a textual response and were designed to elicit information beyond the scope of the researchers' predictions.

Procedure

Early in a 12 week semester the authentic assessment task, a research report, was set and students were advised to take part in an LST to assist in their academic writing. The assignments were due in week seven, and graded and returned to the student by week 10. The activities described so far were part of the normal student learning experience. In week 11, after obtaining ethical approval from the university human research ethics committee, an invitation was posted in the learning management system for students to access an external website that

hosted the confidential survey. This ensured that students had access to link to the site at a time and place of their choosing. This design enhances validity (truthfulness) of responses as they could seek privacy when completing the survey. The ethical issues of informed consent and right to withdraw were taken into account. After reading the information sheet potential participants could choose to continue, skip a question, or withdraw at any time by merely closing their internet browser.

Results

The online survey was available for three weeks at the end of semester and 11% of the target population completed in this time period. The primary research hypothesis relating to subjective student evaluation was tested by examining the outputs from the online survey. The secondary research hypothesis required a comparative analysis of the student grade in the assessment between the science subjects (that is, between the LSTs).

Quantitative Analysis of Subjective Student Evaluation

Regarding student evaluation of the duration of library skills tutorial, 83% *(n = 41)* considered the one-hour library skills tutorial was suitable. The remaining minority requested longer tutorials in future; generic LST *(Mean time = 2.17 hours),* and context-specific LST *(Mean time = 2 hours).* Descriptive analysis is presented in Table 2. For inferential analysis, non-parametric tests for mean difference (*Mann Whiney U*) were conducted as the samples were not normally distributed. There were differences, but these were non-significant differences, for the main LSTScale and both the affective and the cognitive subscales. The generic LST group rated each measure lower than the context-specific LST group.

Table 2: The measure values, mean, standard deviation and range for each LST group

Measures	Range for Value	Generic LST			Context-Specific LST		
		Mean	SD	Range	Mean	SD	Range
LST Scale	7 to 35	24.9	4.7	13-32	27.4	4.1	16-29
Affective subscale	3 to 15	10.8	2.2	5-14	11.7	2.0	7-15
Cognitive subscale	4 to 20	14.1	2.9	7-18	15.6	2.5	8-20

Scrutiny at the item level showed significant differences for two cognitive self-report items between students in the two LST groups. The item ratings for *'I understand what is considered appropriate evidence in my subject'* for the generic LST group (*Mean Rank = 19.82, n =28*) were significantly lower than those from the context-specific LST group (*Mean Rank = 29.22, n =18*). *U = 149.00, z = -2.547, p = .011,* two tailed. This effect (r = .38) can be described as 'medium' (Cohen, 1988). Similarly, the ratings for the item *'I know how to evaluate the quality of a book or journal article or internet source'* for students in the generic LST group (*Mean Rank = 20.27, n =28*) were significantly lower than those in the context-specific LST group (*Mean Rank = 28.53, n =18*). *U = 161.50, z = -2.291, p = .022,* two tailed, also a 'medium' effect (r = .34).

A *post-hoc* analysis reveals an interesting mode of study effect. A Mann-Whitney *U* test indicated that the library tutorial ratings by 'internal' students (*Mean Rank = 31.25, n =16*) were significantly higher than those of the 'external' students (*Mean Rank = 18.45, n =29*). *U = 100.00, z = -3.147, p = .002,* two tailed, with a medium effect size (r = .47).

Qualitative Analysis of Subjective Student Evaluation

Sixty percent of respondents chose to add a textual statement into one or both of the open-field items to provide a rich evaluation about the library skills tutorial. The length of these statements ranged from four to 136 words *(Mean = 44.6; SD = 43.5 words).* Phrases were read and reread and classified into four mutually exclusive categories, the mean values and an exemplar for each category are shown in Table 3. There was some variability within respondents, but not between the different LST groups, except for negative statements.

Table 3: Category Mean Phrase Value for each LST group and Qualitative Exemplars

Category	Exemplar	Mean Phrase Value	
		Generic LST	Context-Specific LST
positive	*try out skills ... in the process of learning them*	1.9	2.1
negative	*I just found I was getting confused*	**0.9**	**0.1**
formative	*... make relevant to particular study*	0.9	0.8
summative	*I think it is quite comprehensive*	0.4	0.3

Content analysis at the phrase level for the LST groups, enabled the determination of two ratios. Firstly, the ratio of positive to negative comments, which revealed a large ten-fold difference between the two LST groups; generic ($ratio_{pos:neg} = 2.11$), and context-specific ($ratio_{pos:neg} = 21$). Secondly, the ratio of formative to summative comments did not show such a difference; generic ($ratio_{form:sum} = 2.25$); context-specific ($ratio_{form:sum} = 2.67$).

A thematic analysis of the two most useful feedforward categories (positive and formative) follows. Three emergent themes from the positive category include statements related to the delivery style, content and how the student felt supported in their present and potential future skills related to information literacy. Phrase exemplars below derive mainly from the context-specific group. The style of delivery theme is represented by: *concise; step-by-step; use of simple English; easy to use; easy to understand; and, collaboration sessions were good to be able to hear what problems other students may have*. Content phrases are exemplified by: *summon search database very useful; information on detecting bias; examples of referencing styles; and, kept relevant to anatomy & physiology*. Perceived support statements included: *helps learn how to find quality references in an efficient way; gave me an ability to research and collate material properly; online delivery which enabled you to try out skills as you were in the process of learning them; during the tutorial, I managed to get 2-3 sources already - which I had used in my final report; allowed student contributions; own pace; and, [future] help was available if needed.*

Thematic analysis of the formative category reveals two themes; delivery style and content, relevant to feedforward. The representative phrases show little difference between the two LST groups and derive from both. Style of delivery phrases include: '*make clear what is required; recognise the need for students to revisit the tutorial more than once; I prefer hearing someone talking to me ... I learn better this way; [need to] experience the library research skills themselves; and, by giving an activity after tutorial so that they can learn by doing as well'*. Regarding content a student would like: '*more detailed information on using keywords; more examples on how to reference; and make relevant to particular assignment'*. The final phrase offered below did not fit either theme but is worthy of inclusion. A student from the generic LST group suggested *'make it compulsory'*.

Analysis of Objective Measure

The overall grade (as a percent) for the students in each science subject who participated in the online survey comprises the data for analysis in this section. It is assumed that this is an indirect measure of their LST efficacy. Table 4 shows the mean and standard deviation (the descriptive statistics) for each science subject, gender, whether this was the students first semester of study, and the mode of study (internal versus external).

Table 4: Research Report Grade for Science Subject, Gender, Semester and Mode of Study (N=47)

Variable	Research Report Grade (%)		Science Subject (n)	
	Mean	SD	Psychology	Anatomy & Physiology
Science Subject				
Psychology (n=28)	49.04	16.69	28	-
Anatomy & Physiology (n=19)	83.24	13.38	-	19
Gender				
Male (n=10)	59.20	24.58	5	5
Female (n=37)	59.59	22.60	23	14
Semester				
First (n=26)	67.08	23.17	12	14
Subsequent (n=21)	57.64	21.83	16	5
***Mode of Study**				
Internal (n=16)	70.94	20.00	6	10
External (n=30)	58.69	23.38	22	8

**one A&P student chose not to respond*

For inferential analysis, a parametric test for mean difference (unequal variance, independent *t* test) was conducted. There was a significant science subject difference in mean grade for research report, $t(45) = 7.45$, $p < .001$ (one tailed). No significant difference gender difference was found, $t(45) = -.95$, $p = .347$ (two tailed). Overall the semester of study was not significant, $t(45) = 1.31$, $p = .197$ (two tailed) although a mean difference of nearly 10% favouring first semester, novice students was reported. Further analysis of these novice undergraduates showed a statistically different mean report grade between the science subjects, $t(24) = 5.39$, $p < .001$. The mode of study did not show a significant mean difference, $t(44) = 1.41$, $p = 0.83$ (one tailed) despite a mean difference of 12% benefitting the internal mode. However, if the external mode data is analysed separately, there was a significant difference between the mean science subject grades, $t(28) = 6.29$, $p < .001$. An interpretation of the results follows in the discussion.

Discussion

This empirical study has examined the use of emergent technologies, in the acquisition of information, for diverse cohorts of students enrolled in two scientific subjects. Departmental issues constrained a generic online LST in psychology, whereas, the anatomy & physiology lecturer collaborated with an expert librarian to devise and embed a virtual, context-specific LST. In relation to the first a priori hypothesis, the quantitative data for the LST scale does not fully support the primary research hypothesis. Thus there is no significance difference in the quantitative student evaluation of the LST between those receiving the generic version compared to those who received the context-specific version. However, the direction of the difference in the mean values as a percent of the maximum sum of the scale does provide evidence of some support for the hypothesis; generic (71.1%) compared to context-specific (78%). Interestingly, there was also a slight difference between the two subscales, with the affective rating being above the cognitive rating for both generic and context-specific LST groups. This was an innovative measurement tool and the study was exploratory, so the importance of, and the differential between, the two subscales remains to be verified.

There were some statistically significant differences between the two groups. Cognitively loaded items did produce significantly higher ratings from the context specific LST group compared to the generic LST group. These items measured student knowledge of 'appropriate evidence' and 'how to evaluate quality of source'. Also, a post-hoc analysis showed a medium effect difference between the rating for the LST between internal and external mode students, the latter rating the LST as higher. This may provide an insight into a different 'lived' experience for students between the two modes of study and is worthy of further investigation. Only 17% of the sample suggested a doubling the duration for LST from one to two hours, which reinforced the present designed time. These results based on a reliable survey instrument add to the knowledge about student evaluation of LST which, according to Johnson et al., (2010) and McGuiness (2009), was lacking in the literature.

The most compelling results derive from the rich source of information from an emic perspective, that is, the qualia, the subjective or qualitative textual statements from the students. The large (x10) positive: negative ratio difference between the generic (2.11) and context-specific LST groups (21) reveal the lived experience for the latter group far exceeded the former in terms of positivity. This refutes Fisher's (2006) proposition that

massification might cause a reduction in the student experience. Without providing a limitation, to restrict student responses, it was interesting that thematic analysis provided a framework (style of delivery, content and support) to inform feedforward planning to redesign LST for learning for the future. Like Donovan et al. (2010) the authors of this paper do not perceive student evaluation as a threat, but wish to learn from the students to improve the learning experience for subsequent cohorts.

The secondary hypothesis has been supported by the results. Students receiving a generic library skills tutorial did achieve a lower grade (psychology: 49.04%) in the academic writing task than students receiving the context-specific library skills tutorial (anatomy & physiology: 83.24%). The value and validity of this metric will be examined in the section on limitations. Subsidiary analysis reveals interesting insights into the patterns of the mean grade achieved by subsets of the sample. Novice students gained significantly higher grades for their research report than students who had studied before. This seems counter intuitive and perhaps might be explained by the ideas that 'experienced' and 'external' students feel they do not need to be shown again how to use databases, etc. Certainly one qualitative comment from a student (external; generic LST) in the online evaluative survey testifies to this effect *'I did do this tutorial for [named subject] and it was informative but took me hours'* and is dismissive. Also, these students might be repeating the same subject and bring their associated issues of progress.

The non-significance difference for mode of study was interesting as it might be interpreted that face-to-face (internal) LST had not impacted favourably upon the student's academic writing when compared to an online (external) LST. However, the significant difference between the two science subjects, for students studying only in external mode, privileged the context-specific LST over the generic LST. A cogent comment from a student (external; generic LST) stated that we should be cognisant of the advantage of the archived online tutorial as the student may *'revisit the tutorial more than once'*. This reinforced Wesch's (2009) concept of developing generic online packages available on-demand.

This comparative study has shown differences in student ratings (and performance) of generic online non-integrated instructional LST with an enhanced fully integrated context-specific (course embedded) LST which was student-centred and applied social constructivist learning principles. The generic tutorial has provided a clear algorithm, a step-by-step instructive process, to search library databases using generic keywords and phrases. However, the context specific tutorial transforms the process through supportive collaboration, connection and customisation (Gilliver-Brown, & Johnson, 2009). It provided meaningful activities in an almost individual learning environment that were fundamental in supporting students to bridge learning gaps (Brew & Ginns, 2008) and complete their assigned tasks.

The complex problem of redesigning generic LSTs for all subjects is now manifest. Blewitt (2010) and McWilliam and Dawson (2008) consider creativity as central to teaching in higher education. That the complex questions of the future will demand creative and forward-looking individuals who are not constrained by the functional fixedness of their role and can perceive of non-linear and emergent solutions. As lecturers and librarians we are challenged by the consumers to consider new approaches to teaching information literacy by examining methods of online instruction that can transform the future learning experience, promote self-directed learning (Ellis, 2004), be sustainable, and be relevant for the context (subject), even the assignment. This will provide an opportunity to use the emerging space of digital infrastructure, to underpin the development of digital literacy skills, and provide affective and cognitive support to first year students.

Important perspectives into the emic perspective of cognitive access and digital literacy have been discussed. While understanding the process of their engagement in their learning the higher affective responses and qualia from the students reveal that the relationship with a supportive and inclusive learning tutor is fundamental. It sets a base for lifelong learning (sustainability), being able to, with confidence, identify, retrieve, and evaluate sources of information, write with authority by citing/referencing appropriately and be able to use, synthesise and construct knowledge.

Limitations

All research design is compromised and in this study the major threats to internal and external validity are evaluated. External validity is threatened by sampling errors. A reason for the small response rate (11%) may be explained by the timing of the survey deployment. The invitation was issued in the last weeks of semester when the student priority is their preparation for final examinations. Regarding the objective measure, a critique of the sample, the nature of respondents, may have potentially biased this result. The sample who responded may not be representative of larger target population, for each science subject, with respect to their assessment grade.

The psychology respondents recorded a lower mean research report grade than all the psychology students. The anatomy & physiology respondents recorded a significantly higher (nearly 14%) mean than all anatomy & physiology students. These bias samples from each science subject are interesting and is worthy of further investigation. Further questions might enable an understanding into the possible motive for students in completing an online evaluation survey. On face value the differential calibre of the students who respond might enrich our data set and inform appropriate action to design more targeted interventions for the future of learning.

Student evaluation can empower students if they are made aware that as a result of their feedback subsequent changes have been put into practice. This feedforward process enables them to become part of their learning community and to maximise their educational opportunity (Donovan et al., 2010). Johnson (2002, as cited in Donovan et al., 2010) noted an increase in annual response rates from 40%, then 51%, 62% and finally 71%. Although this study is starting at a lower initial rate, it is the first in a planned series of student evaluations. The size of the sample (n=47) may be small but this is not deemed important when considering: the exploratory nature of the study; the sample was representative of the target population demographics; statistically significant difference were reported; and, rich qualia was obtained. The latter comment suggests student evaluations in the future might ask more open-ended questions, perhaps even use focus groups, even virtual focus groups.

Design error threatens internal validity. This was not a pre-test, post-test survey based on an intervention for a single cohort of students who might be their own controls. Rather the quasi-experimental design exploited an existing difference between two scientific subjects creating an independent design. Psychology offered the generic LST, and anatomy & physiology mandated a context-specific LST. Despite the HREC suggesting random allocation to the two LST groups within one science subject, the authors considered this contrary to natural justice. Also, outcomes from the study can now inform a course development cycle in psychology which is currently undergoing reaccreditation. However, the LST was part of a similar piece of academic writing, a research report

Further threats to internal validity include measurement errors. The Likert scoring for the LSTScale used a middle value; in future it may be better to use a tipping point, even-numbered, scale to create a difference. Although consistency between the seven items showed good reliability (alpha = 0.88) it does not imply that this is a valid measuring tool. Also, a self report survey, of an event that happened weeks ago, can be contaminated by retrospective memory. Students may also be reporting in a perceived socially desirable manner to please their lecturer. Regarding quantitative analyses, the non-parametric tests are not as sensitive at detecting an effect of independent variable (type of LST) on the dependent variable (score on the LSTScale), however, as the effect sizes reported are medium this can be considered acceptable. Bias may have occurred in thematic analysis of the qualia by the primary author; however, this effect was reduced by independent checking by the co-authors and others.

Another measurement error exists and will need to be addressed if the study is repeated. The objective measure of the final grade for the student research report is considered an indirect but assumed measure of the efficacy of the LST. This is a crude overall measure and is not sensitive to show only the skills gained from the LSTs. It reflects more than the student's ability to use databases to identify, retrieve, evaluate and cite academically acceptable sources of information. It shows their ability to develop a coherent and holistic approach to academic writing; including developing hypotheses, planning a method, analysing and interpreting results. A more sensitive assessment rubric for the research report might reveal a submark for these particular skills. Or a new task, such as, developing an EndNote library to use for a specific topic might be developed and graded separately as a milestone to report writing. However, that may seem removed from such an authentic task as a scientific research report.

Learning for the Future

This experimental development research evaluating LST has been innovative and findings of this study are currently being put into practice for semester two. The online evaluation provided an administrative convenience for timely student feedback. Institutions are concerned with the macro-level delivery (massification and the citizenship of the academies). However, it is the authors, as lecturers and librarians, working at the micro-level, that the details of the skills and competences are delivered. Innovative practices and procedures need to be developed to maximise the efficiency of lecturers and librarians in delivering to a large, external student cohort. Furthermore, librarians may have little or no instructional design training, and institutional support needs to be made for their professional development, as embedding an LST may create workload efficiency gains for the future.

The authors are collaborating to develop creative, reciprocal and non-linear LSTs through formative feedback. We are building on this trajectory and planning a future for learning, particularly knowledge acquisition in undergraduate science students. An emerging issue from the student perspective was support, which can be achieved by the use of multiple resources and social software tools. A final quote reveals the need for vicarious social learning in a collaborative situation and reinforces concepts of social constructionism and digital inclusion. The last words are reserved for an external, context-specific LST student.

> It gave me an ability to research and collate material properly; otherwise I think I would still be all at sea. The collaboration sessions were good to be able to hear what problems other students may have. However, this never beats face to face situations and it is something all external students especially those in an isolated area must come across.

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