GSJ: Volume 12, Issue 1, January 2024, Online: ISSN 2320-9186

www.globalscientificjournal.com

Optimising feedback in online courses – initiative from HBMSU

AwoNiyi Awofeso[1]

[1]School of Health and Environmental Studies

Hamdan Bin Mohammed Smart University

Dubai Academic City, P. O. Bo 71400, UAE

Email: a.awofeso@hbmsu.ac.ae

Phone: +97144241018

Abstract

Instructor feedback is constructive and specific information provided by an instructor to a learner on his or her course work and/or class contributions in relation to the course objectives and expectations. Effective instructor feedback is particularly important in online learning as learners are more likely to withdraw from online learning environments due to delayed, or inadequate feedback, compared with students enrolled in physical classes. Not all learners are equally active, and there are indeed learners who hardly take an active part in online course activities -the so-called lurkers. Courteous instructor feedback to such learners on their limited participation has been shown to improve learners' participation in online courses. Diligent learners engaged in online learning programs expect feedback to be contextual, supportive, constructive, timely, substantive, summative and formative. This study examined the perceptions of 66 undergraduate and postgraduate learners on feedback provided in eight online courses facilitated by the same instructor at the School of Health and Environmental Studies, Hamdan Bin Mohammed Smart University, Dubai, UAE. Data collection from learners was anonymized and participation was voluntary.

The survey sought to elicit learners' perceptions on the extent to which feedback provided in specified courses were motivational, timely, frequent, supportive, and individualized. Unlike single questions related to learner feedback in most Student Perception of Teaching Surveys, this survey instrument comprehensively explores the dimensions of instructor feedback, aspects of which may not be previously known to learners or instructors. Our results indicate that systematic collection and analysis of learners' feedback comments have a strong potential to enhance feedback competencies of course facilitators, as well as provide a common platform for both learners and course facilitators vis-à-vis the diverse objectives of instructor feedback.

Keywords: Instructor feedback survey, learner-centricity public health courses, technology-mediated learning, United Arab Emirates,

Introduction and Conceptual Framework

The importance constructive feedback in enhancing learning has its theoretical origins in the communication theories described in the book titled; "The mathematical theory of communication" (Shannon and Weaver 1964). The authors analysed diverse communication problems at three levels: How accurately can the symbols of communication be transmitted? (The technical problem); How precisely do the transmitted symbols convey the desired meaning? (The semantic problem); How effectively does the received meaning affect conduct in the desired way? (The effectiveness problem). In the learning context, feedback may be defined as any communication given to inform a learner of the accuracy of a response, usually to some form of instructional question (Sales, 1993). The definition of online feedback is information from an educator, peer, or other in an online format, such as the written word, audio file, video, pre-programmed automatic reply, or live web-based conferencing.

In online learning contexts, both web-based technology factors and basic instructional factors play significant roles in the efficiency of the feedback process. Efficient instructor feedback is one that facilitates quality and coverage of feedback processes promptly and with optimal use of available learning technologies. Feedback is one of the seven principles for good teaching practice in undergraduate education described by Chickering and Gamson (1999). The principles of feedback they espoused entailed: addressing learners by name; provide frequent feedback; provide prompt feedback; provide balanced feedback; provide specific feedback; use positive tone; and ask questions to promote thinking. These principles facilitate efficiency of the feedback process. The 2011 survey titled *Going the Distance: Online Education in the United States 2011*, estimated that 6.1 million tertiary education students (i.e. 31%) enrolled in at least one online course during 2010 (Allen and Seaman, 2011). With the expansion of online learning programs globally, peer-feedback is increasingly becoming a common approach to providing feedback, with its generally sub-optimal quality somewhat compensated for by frequency and volume (Suen, 2014).

Instructor feedback takes several forms. Corrective instructor feedback, which is usually focused on specific content of the task performance, may be categorized as; no feedback given, simple verification or knowledge of results, knowledge of correct response, elaborated feedback, and try-again feedback (Dempsey, Driscoll and Swindell, 1993). Given that this is a core rationale for feedback in instructional settings, corrective feedback should be incorporated into most instructor feedback responses. A second category of feedback is motivational, which is learner focused, and provides positive reinforcement for quality performance as well as assist the learner in continuing effort despite challenges and setbacks. Motivation impacts the depth and enthusiasm with which learners perform learning tasks, and high instructor (or peer) motivation is positively correlated with high-perceived learning and superior perceived learning application (Lim & Morris, 2009). A third category is technology feedback. As Mory (2004) posits: "there is ever-increasing need to consider how new technologies…change and impact feedback, its forms, and its dynamic potential for use in instructional settings" (p. 777). The use of Backboard and Moodle platforms have significantly improved technology-mediated feedback. Online feedback using these platforms is

currently presented with grades and learning materials, thus placing them 'in context' and providing a direct connection, making it easier for learners to understand the assessment processes course instructors go through to arrive at a grade. Technology also enables the use of Feedback Wizard, which provides feedback responses from a bank of pre-populated comments, which may then be refined by course instructors with more personalized comments, when applicable (Hepplestone et al, 2010).

Over the past two decades, online learning has evolved from an instructor-centred to a student-centred paradigm; instructionist and constructivist models underpin these paradigms respectively (Schell and Janicki, 2012). This paradigm shift necessitates greater prominence of instructor feedback in providing guideposts, mentoring and coaching learners, and designing assessments which by themselves provide feedback on learning milestones. Race (2011) discusses the use of feedback in facilitating (online) learning by segmenting feedback categories of conscious competence – where learners know that they have performed well in an assignment and feedback is geared towards taking ownership of their success; conscious incompetence – where feedback is focused on helping learners to become better at things they already know they can't yet do; unconscious incompetence – using timely and constructive feedback to help learners find out much more about what they didn't yet know that they couldn't yet do; unconscious competence – tactful feedback may be utilised to move unconscious competencies towards the conscious level, invariably leading to increased motivation and self-esteem for the learner. He discussed occasional trade-offs between feedback types and learning efficiency. For example, although one-to-one face-to-face feedback provides a high learning pay-off, it is not efficient in terms of instructor's time, especially in courses with large enrolments. Conversely, one-to-many communication and automated feedback using an answer bank for frequently asked questions may be efficient, but does not usually foster high levels of learning.

Richardson and Swan (2003) as well as Ladyshewsky (2013) highlighted the importance of instructor social presence – defined as the degree of salience of the other person in the (mediated) interaction and the consequent salience of the interpersonal relationships – in online learning. They showed that instructors who exhibited effective online presence by creating a sense of online community and providing timely feedback facilitated high learner satisfaction and higher self-reported learning quality. Palmer and Holt (2008) identified instructor feedback for online to be critical to learners' course experience. Yet, participants reported low satisfaction with the instructors' feedback activities, particularly in relation to having a clear understanding of what was required to succeed in the unit and how well they thought they were performing in the unit. Such findings highlight the need for course instructors to be highly skilled in providing comprehensive feedback to learners. A study of determinants of undergraduate student satisfaction in a blended courses at Ajman University of Science and Technology found, among 108 participants, that the instructor's feedback is the most important factor in satisfaction with instruction (Naaj, Nachouki and Ankit, 2012)

A conceptual framework for appraising learnings perceptions and approaches to learning is shown in Figure 1 (Tudor and Penlington, 2009):

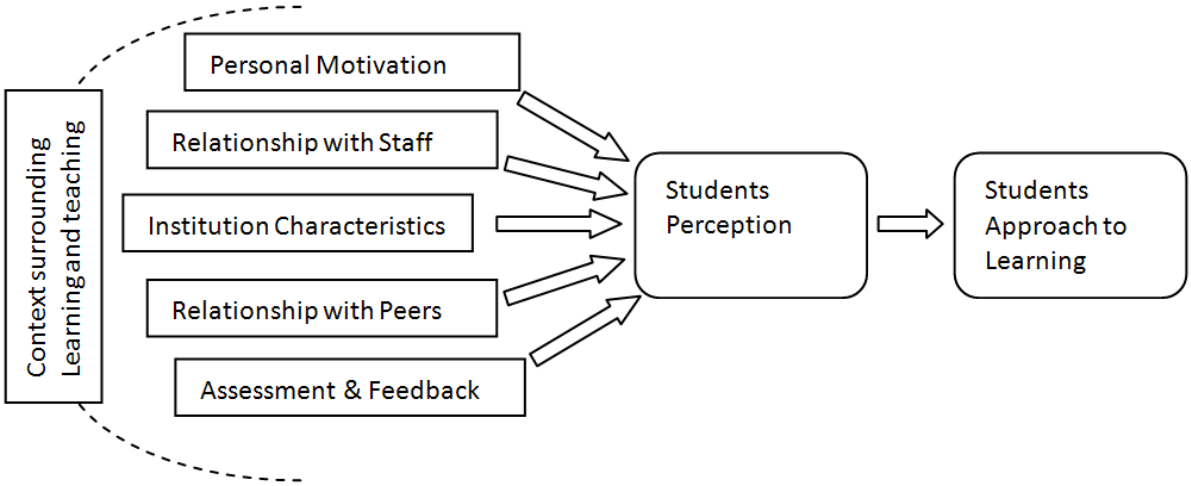

Figure 1: Learning context, student perceptions and approaches to learning

The framework shows that feedback is one of the important influences on learner perception and ultimately on their approach to learning. Understanding how learners perceive their learning contexts at university is as vital as understanding how these perceptions influence students' approaches to their studies. Entwistle (2008, p4) emphasized that "high quality learning depends not just on pass or completion rates, but on the nature of the knowledge, skills and conceptual understanding that students have acquired during their degree course".

In this study, we explore the perceptions of 66 online undergraduate and postgraduate public health learners at Hamdan Bin Mohammed Smart University to feedback provided by an Instructor over two semesters, as well as the process of efficient learner feedback. Our two research questions were:

(1) Is efficient instructor feedback positively associated with learners' perceived learning in, and satisfaction with, technology-mediated learning programs at university level?
(2) How can the evaluations of learners' perceptions of instructor feedback processes be utilized in improving the quality and other attributes of instructor feedback as well as learners' approaches to learning?

2. Materials and Methods

Hamdan Bin Mohammed Smart University is the first online university in the Middle East and North African region. The university is equipped with the latest Moodle online learning platform, and was recently an 'Extraordinary Contribution Award' by Ellucian, a global leader in providing innovative technology solutions for higher education institutions. The study participants comprised 66 (89%) out of 74 participants who were invited to participate in any anonymous and voluntary/optional instructor feedback survey of eight courses taught by the same instructor between August 2014 and September 2015. The survey was conducted online using Moodle's Virtual Learning Environment. The survey instrument used was the Likert Scale feedback assessment template developed by Getzlaf et al (2009). It comprised 20 questions, which seek to ascertain learners' perspectives of the content and process of efficient instructor feedback.

Correlation analysis and one-parameter Item Response Theory model was utilized, commonly known as the Rasch Model, using Winsteps software (Linacre and Wright, 2000). Winsteps implements the Andrich "rating scale" model with the Joint Maximum Likelihood Estimation method, also known as UCON, which does not assume a person distribution and is flexible with missing data (Wright & Masters, 1982). The Rasch model used in Winsteps for this analysis is the polytomous "Rating Scale" model with the equation: $\text{Log}\, {P_{nij}}/{P_{ni(j-1)}} = B_n - D_i - F_j$, where P_{nij}probability that person n encountering item i is observed in category j, B_n is the "ability" or rater-severity measure of person n, D_i is the difficulty-to-endorse measure of item i, and F_j is the "calibration" measure of category j relative to category $P_{nij}\ B_n\ D_i\ F_j$ (j-1) (Linacre, 2004).

Throughout the analysis, several results were produced. A statistical summary table is generated to show the fit indices of student and item. There are two types of fit indices i.e. the mean square (MNSQ) and standardized fit statistics (ZSTD). The acceptable range of weighted MNSQ for a Likert scale item is from 0.6 to 1.4 (Smith, E., Jr. 2000). The acceptable range also holds true by following the general rule of mean ± standard deviation. The acceptable range weighted ZSTD values is between -2 and 2, whereas the optimum unweighted ZSTD for student is below 5. Fit statistics of items and students were checked at first and misfit items or students should be excluded from further analyses due to the violation of model assumption or redundancy (Linacre, 2000).

Results

Findings show that on average, about 73% of the undergraduate and postgraduate of students responded Mostly Agree or Completely Agree to the evaluation questions, indicating that the majority of respondents were satisfied with the process and content of feedback provided by the instructor. The category measures the evaluations increased as the categories increased (see appendix I).

Table 1 provides an overview of the reliability estimates. The real separation reliability is highlighted above and is comparable to a Cronbach's alpha estimate. Here, "real" indicates that the estimated standard errors of measurement have been adjusted for any misfit encountered in the data. The real person reliability of 0.82 suggests that the scale discriminates well between the persons. The real item separation reliability of 0.77 suggests that the questions are reliable in measuring the proper item. INFIT and OUTFIT ZSTD statistics are also reported in Table 2. OUTFIT ZSTDs are the standardized unweighted item and person fit statistics. These estimates are sensitive to unexpected rare extremes. INFIT ZSTDs are standardized information-weighted item and person fit statistics. These estimates are sensitive to irregular inlying patterns. When the data fit the model, these statistics are approximately t-statistics. For this setting, the approximate t-statistics would have a mean of 0 and standard deviation of 1. Here (highlighted), the mean is close to 0 in both cases; however the standard deviation is high suggesting that there are some items that misfit and there is more variability in the fit of the students than expected (Wright and Masters, 1982).

Table 2 presents a summary of the individual item statistics. Values less than –2 are considered to be 'muted', meaning redundancy or error trends exist; values greater than 2 are considered to be 'noisy, an indication of unexpected or inconsistent irregularities (Linacre, 2000). Highlighted items above are 3 and 11.

Research Question One:

Is efficient instructor feedback positively associated with learners' perceived learning in, and satisfaction with, technology-mediated learning programs at university level?

Table 3: Correlations

		Instructor feedback	Learning perspective	Satisfaction
Instructor feedbakc	Pearson Correlation	1	.718**	.810**
	Sig. (2-tailed)		0	0
	N	66	66	66
Learning perspective	Pearson Correlation	.718**	1	0.551
	Sig. (2-tailed)	0		0.032
	N	66	66	66
Satisfaction	Pearson Correlation	.810**	0.551	1
	Sig. (2-tailed)	0	0.032	
	N	66	66	66

**. Correlation is significant at the 0.01 level (2-tailed).

The result in Table 3 above shows a significant positive relationship – effective instructor feedback positively associated with learners' perceived learning in, and satisfaction with, technology-mediated learning programs at university level ($r = 1$, $p<0.001$).

Research Question Two:

How can the evaluations of learners' perceptions of instructor feedback processes be utilized in improving the quality and other attributes of instructor feedback as well as learners' approaches to learning?

Figure 2 documents item difficulties on right side of the mapping. Item difficulty is a measure of the difficulty of endorsement for an item. An item placed above another item is said to be more difficult to endorse then the lower item. Person difficulty, found on the left side of the mapping, is a measure of the individual's level of agreement with the items. A person higher on the chart would find an item easier to endorse, or more likely to agree with the item, than a person who was placed lower on the figure.

In figure 2, each "#" represents one postgraduate and "." represents one undergraduate student and the mean of these students ability, or level of agreeableness for the students is found on the left side of the figures and is denoted with an "M". The mean of the item difficulties, or difficulty to endorse, is also denoted with an "M" and is located on the right side of the figures. For the student efficient instructor feedback evaluation, the mean for the students is much higher than the mean of the items. This agrees with the previous finding that overall, most students agreed or strongly with the items, i.e. that the process and content of instructor feedback was at least adequate to enhance their learning.

Discussion and Conclusion

This study provides answers to the two research questions posed. Our validated survey instruments have been formulated to ascertain the influence of feedback in learners' perceived learning in, and

satisfaction with, technology-mediated-learning. The correlation findings shows a significant positive relationship ($r = 1$, $p<0.001$), which implies that the first research question is achieved - efficient instructor feedback positively associated with learners' perceived learning in, and satisfaction with, technology-mediated learning programs at university level. The second research question states: How can the evaluations of learners' perceptions of instructor feedback processes be utilized in improving the quality and other attributes of instructor feedback as well as learners' approaches to learning? Result from the item mapping analysis shows for the student efficient instructor feedback evaluation; the mean for the students is much higher than the mean of the items. This agrees with the previous finding that overall, most students agreed or strongly with the items, i.e. that the process and content of instructor feedback was at least adequate to enhance their learning. In most universities, gaining (and responding effectively to) student feedback on courses and lecturers is increasingly important for universities to provide clear evidence of the 'value' of studying at their institution. With improvements to feedback processes based on learners' perspectives, lecturers become more aware of the major potential of effective feedback in facilitating learning. Most formal university surveys of learners' perception of teaching include only one or two questions on feedback, which may not adequately elaborate on the role of learners feedback in improving both students' approaches to learning and the quality of feedback provided by surveyed instructors. This study provides a clear example of how results from analysis of a comprehensive survey instrument enhances learners' appreciation of the pathways through which instructor feedback can enhance their learning experience, while concurrently improving the feedback competencies of course instructors.

Efficient instructor feedback plays a crucial role in enhancing learners' academic achievement, in part though justification of grade derivation, identifying and acknowledging learners' commendable scholarly initiatives, outlining steps for improvement of academic work, and developing in learners the capability to monitor, regulate and evaluate their learning (Nichol, 2010). Effective feedback should be efficient so that learners can benefit individually and collectively in a timely manner, and instructors can manage the feedback activities using smart technology-mediated and writing tools without being over-burdened. The feedback instrument utilised in this study comprehensively addresses the diverse objectives of instructor feedback and therefore addresses common reasons why many learners find instructor feedback unsatisfactory, such as whether and how the feedback is related to their mark, and what they might do to improve. If instructors agree with the objectives of the feedback process contained in our study instrument prior to commencement of a course or discussion forum activity, it might mitigate most of the challenges experienced by instructors, such as the time-consuming nature of individualized feedback. Course instructors benefit from timely feedback by being able to adjust the teaching approach to learners comments and concerns.

Studies which have investigated the determinants of students' perceived learning outcomes and satisfaction in university online education in other regions with advanced e-learning systems have consistently rated timely, comprehensive and motivational instructor feedback highly in the list of self-reported facilitators of in-depth learning (Eom,Wen and Ashill, 2006; Eason, 2003). The quality and coverage of instructor feedback covered by this survey is huge, and it is impractical to assume that course instructors will view the objectives of instructor feedback through this lens. It is therefore important that universities who expect instructor feedback to meet these diverse objectives undertake seminars on instructor feedback and other student-instructor interaction variables during staff orientation, in addition to enhancing the competencies of instructors to craft learning activities that promote interaction with the content, the instructor and the learners in the class (Sher, 2009).

A noteworthy limitation of this study is the small sample size of 66 participants, although this represented 89% of the 74 invited participants enrolled in courses taught by the same instructor during the review period. In addition, there was no open-ended section for learners to describe their perspectives about the content and process of effective instructor feedback. However, we believe that Getzlaf et al's (2009) meticulously constructed 20 Likert-scale questions possessed adequate depth and coverage for our study. Convincing online academic staff to expose themselves to learner's scrutiny in relation to students' perceptions about diverse aspects of their feedback is a difficult task, but an essential one in order to consistently improve the effectiveness of online learning beyond what currently obtains in the traditional classroom learning format (Nguyen, 2015). Our study's noteworthy contributions to the literature on instructor feedback includes the successful use of a comprehensive feedback instrument in a blended learning environment for undergraduate and postgraduate public health degree programs, as well as providing a platform for learners and course instructors to develop a shared understanding of the objectives of efficient instructor feedback. The frustration expressed by some learners that instructor feedback is generally cryptic, and by some instructors that time-consuming feedback is not being used to good effect, if at all, by learners (Bailey 2009) may be addressed by being explicit about the details of feedback processes, ensuring that feedback activities accord with the 20 stated objectives of instructor feedback, letting learners understand why they are getting individualized or group feedback, and how their learning can benefit from their reflecting, and acting, on feedback (Scott, 2008).

References

Allen, I. E. & Seaman, J. (2011). Going the Distance: Online Education in the United States, 2011. Babson Survey Research Group, Boston.

Bailey, R. (2009). Undergraduate students' perceptions of the role and utility of written assessment feedback. Journal of Learning Development in Higher Education. Issue 1, February 2009. Retrieved on 15 January 2016 from http://www.aldinhe.ac.uk/ojs/index.php?journal=jldhe&page=article&op=view&path%5B%5D=29&path%5B%5D=13

Chickering, A. W., & Gamson, Z. F. (1999). Development and adaptations of the seven principles for good practice in undergraduate education. New Directions for Teaching & Learning, 80, 75-81.

Dempsey, J. V., Driscoll, M. P., and Swindell, L. K. (1993). Text-based feedback. In J. V. Dempsey & G. C. Sales (Eds.), Interactive instruction and feedback (pp. 21-54), Educational Technology Publications, Englewood Cliffs, N.J.

Easton, S.S. (2003). Clarifying the instructor's role in online distance learning. Communication Education, 52(2), 87-105.

Eon, S. B., Wen, H. J., and Ashill, N. (2006). The determinants of students' perceived learning outcomes and satisfaction in university online education: an empirical investigation. Decision Sciences Journal of Innovative Education, 4, 215-235.

Entwistle N. Taking stock: teaching and learning research in higher education. Paper presented at the Ontario international symposium on teaching and learning in higher education, May 2008.

Retrieved on 11 December 2015 from:
http://www.research.ed.ac.uk/portal/files/14426330/ENTWISTLE_Taking_Stock.pdf

Getztlaf, B., Perry, B., Toffner, G., Lamarche, K., and Edwards, M. (2009). Effective Instructor Feedback: Perceptions of Online Graduate Students. Journal of Educators Online, 6(2). Retrieved on 2 December 2015 from:
http://webcache.googleusercontent.com/search?q=cache:ZUFzmrHMo0QJ:www.thejeo.com/Archives/Volume6Number2/GetzlafetalPaper.pdf+&cd=1&hl=en&ct=clnk&gl=au

Hepplestone, S., Parkin, H., Irwin, B., Holden, G., and Thorpe, L. (2010). Using technology to help students engage with their feedback – technology, feedback, action! A short report. Sheffield Hallam University, Sheffield.

Ladyshewsky, Richard K. (2013) Instructor Presence in Online Courses and Student Satisfaction. International Journal for the Scholarship of Teaching and Learning: Vol. 7: No. 1, Article 13. DOI: https://doi.org/10.20429/ijsotl.2013.070113

Linacre, J.M. and Wright, B.D. (2000). A user's guide to WINSTEPS: Rasch Model Computer Program. Chicago: MESA Press.

Lim, D. H., and Morris M. L. (2009). Learner and instructional factors influencing learning outcomes within a blended learning environment. Educational Technology & Society, 12 (4), 282–293.

Mory, E. H. (2004). Feedback research revisited. In D. H. Jonassen (Ed.), Handbook of research on educational communications and technology: A project for the Association for Educational Communications and Technology (Second ed., pp. 745-783), Lawrence Erlbaum Associates, Mahwah, New Jersey.

Naaj, M. A., Nachouki, M., and Ankit A. Evaluating student satisfaction with blended learning in a gender-segregated environment. Journal of Information Technology Education: Research, 11, 185-200.

Nguyen, T. (2015). The effectiveness of online learning: beyond no significant difference and future horizons. MERLOT Journal of Online Learning and Teaching, 11, 309-319.

Nicol, D. (2010). From monologue to dialogue: improving written feedback processes in mass higher education. Assessment and Evaluation in Higher Education 35(5), 501–517.

Palmer, S.R., & Holt, D.M. (2009). Examining student satisfaction with wholly online learning. Journal of Computer Assisted Leaning, 25(2). DOI: 10.1111/j.1365-2729.2008.00294

Race, P. (2002) Using feedback to help students to learn. The higher education academy, UK. Retrieved on 13 December from;
http://wap.rdg.ac.uk/web/FILES/EngageinFeedback/Race_using_feedback_to_help_students_learn.pdf.

Richardson J, Swan K. (2003). Examining social presence in online courses in relation to students' perceived learning and satisfaction. JALN, 7, 68 – 88.

Sales, G. C. (1993). Adapted and adaptive feedback in technology-based instruction. In J. V. Dempsey & G. C. Sales (Eds.), Interactive instruction and feedback (pp. 159-175), Educational Technology Publications, Englewood Cliffs, N.J.

Schell, G. P. and Janicki T. J. (2013). Online Course Pedagogy and the Constructivist Learning Model. Journal of the Southern Association for Information Systems, 1, 26-36.

Scott, S. (2008). Improving Student satisfaction with Feedback: Report on a Project Undertaken in the Faculties of Arts & Social Sciences and of Law at UNSW. Retrieved on 15 January 2016 from https://teaching.unsw.edu.au/sites/default/files/upload-files/scottreport.pdf

Shannon, C. E. and Weaver, W. (1964). The Mathematical Theory of Communication. University of Illinois Press, Illinois.

Sher, A. (2009). Assessing the relationship of student-instructor and student-student interaction to student learning and satisfaction in web-based online learning environment. Journal of Interactive Online Learning, 8, 102-120.

Smith, E., Jr. (2000). *Rasch Measurement Models.* Paper presented at An Introduction to Rasch Measurement: Theory and Applications, Chicago.

Suen, H. (2014). Peer assessment for massive open online courses (MOOCs). The International Review of Research in Open and Distributed Learning, 15(3). Retrieved on 13 December 2015 from http://www.irrodl.org/index.php/irrodl/article/view/1680/2904

Tudor, J., and Penlington, R. (2009). Perceptions and their influences on approaches to learning. The Higher Education Academy Engineering Subject Centre, UK.

Wright, B. D., & Masters, G. N. (1982). Rating scale analysis. Chicago, IL: MESA Press.

Appendix 1 – Descriptive statistics

```
INPUT: 66 PERSON  20 ITEM  REPORTED: 66 PERSON  20 ITEM  6 CATS  MINISTEP 3.74.0
-------------------------------------------------------------------------------

     SUMMARY OF 46 MEASURED (NON-EXTREME) PERSON
-------------------------------------------------------------------------------
|          TOTAL                          MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN     101.6      20.0        2.38     .39       .98    -.1   1.00     .0 |
| S.D.      11.5        .0        1.50     .16       .43    1.2    .46    1.2 |
| MAX.     119.0      20.0        5.89    1.02      2.16    2.6   2.34    2.9 |
| MIN.      65.0      20.0        -.48     .21       .33   -2.5    .36   -2.3 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .45 TRUE SD    1.44  SEPARATION  3.21  PERSON RELIABILITY  .91 |
|MODEL RMSE    .43 TRUE SD    1.44  SEPARATION  3.38  PERSON RELIABILITY  .92 |
| S.E. OF PERSON MEAN = .22                                                   |
-------------------------------------------------------------------------------
  MAXIMUM EXTREME SCORE: 20 PERSON

     SUMMARY OF 66 MEASURED (EXTREME AND NON-EXTREME) PERSON
-------------------------------------------------------------------------------
|          TOTAL                          MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN     107.2      20.0        3.82     .83                                |
| S.D.      12.8        .0        2.52     .68                                |
| MAX.     120.0      20.0        7.13    1.83                                |
| MIN.      65.0      20.0        -.48     .21       .33   -2.5    .36   -2.3 |
|-----------------------------------------------------------------------------|
| REAL RMSE   1.08 TRUE SD    2.28  SEPARATION  2.12  PERSON RELIABILITY  .82 |
|MODEL RMSE   1.07 TRUE SD    2.28  SEPARATION  2.13  PERSON RELIABILITY  .82 |
| S.E. OF PERSON MEAN = .31                                                   |
-------------------------------------------------------------------------------
PERSON RAW SCORE-TO-MEASURE CORRELATION = .93
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .96

     SUMMARY OF 20 MEASURED (NON-EXTREME) ITEM
-------------------------------------------------------------------------------
|          TOTAL                          MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN     353.7      66.0         .00     .23      1.02     .1   1.00    -.1 |
| S.D.      10.2        .0         .51     .02       .31    1.3    .28    1.0 |
| MAX.     372.0      66.0         .92     .27      1.86    2.9   1.66    1.6 |
| MIN.     333.0      66.0       -1.06     .19       .38   -3.2    .36   -3.0 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .24 TRUE SD     .45  SEPARATION  1.84  ITEM   RELIABILITY  .77 |
|MODEL RMSE    .23 TRUE SD     .46  SEPARATION  2.01  ITEM   RELIABILITY  .80 |
| S.E. OF ITEM MEAN = .12                                                     |
-------------------------------------------------------------------------------
```

Table 1: Rasch analysis of learners survey responses

```
INPUT: 66 PERSON  20 ITEM  REPORTED: 66 PERSON  20 ITEM  6 CATS  MINISTEP 3.74.0
-------------------------------------------------------------------------------
PERSON: REAL SEP.: 2.12  REL.: .82 ... ITEM: REAL SEP.: 1.84  REL.: .77

        ITEM STATISTICS:  MISFIT ORDER

-------------------------------------------------------------------------------------------------------------------
|ENTRY   TOTAL  TOTAL          MODEL|   INFIT  |  OUTFIT  |PT-MEASURE |EXACT MATCH|                              |
|NUMBER  SCORE  COUNT  MEASURE  S.E. |MNSQ  ZSTD|MNSQ  ZSTD|CORR.  EXP.| OBS%  EXP%| ITEM                         |
|--------------------------------+----------+----------+-----------+-----------+------------------------------|
|    11    372     66   -1.06     .27|1.86   2.9|1.66   1.6|A .47   .59| 58.7  67.2| beenprovidedinatimelymanner  |
|     5    366     66    -.65     .25|1.46   1.7|1.34   1.0|B .57   .64| 50.0  64.9| challengedmetothinkindepthaboutt|
|    10    358     66    -.18     .23|1.43   1.6|1.14    .6|C .64   .69| 63.0  60.4| stimulatedfurtherlearningaboutth|
|    16    362     66    -.40     .24| .95   -.1|1.34   1.1|D .66   .66| 67.4  63.3| increasedmylevelofknowledgeabout|
|     2    357     66    -.12     .23| .99    .1|1.28   1.0|E .67   .69| 52.2  59.9| encouragedmetointeractwithmyinst|
|     9    350     66     .23     .22|1.20    .8|1.03    .2|F .71   .72| 65.2  57.6| supportedmyselfdirectedlearning |
|    18    345     66     .45     .21|1.16    .7|1.18    .8|G .70   .74| 47.8  55.8| builtmyconfidence            |
|     4    354     66     .03     .22|1.13    .6|1.07    .3|H .68   .70| 52.2  59.1| hasbeenprovidedfrequentlythrough|
```

20	364	66	-.52	.25	1.13	.6	.90	-.2	I .65	.65	63.0	64.2	includedbothpositivecommentsandc
8	367	66	-.71	.26	1.12	.5	.92	-.1	J .62	.63	60.9	65.2	helpedmetobuildnewknowledgeabout
15	337	66	.77	.19	.92	-.3	1.11	.5	j .76	.76	65.2	53.7	helpedmeidentifyareasofneededimp
17	355	66	-.02	.23	1.07	.4	.84	-.5	i .70	.70	65.2	59.2	provideddirectionofthelearningpr
12	345	66	.45	.21	.97	.0	.99	.0	h .75	.74	50.0	55.8	stimulatedmetoreflectonwhatistil
1	361	66	-.35	.24	.78	-.9	.95	-.1	g .70	.67	63.0	62.6	motivatedmetocontinueinthecourse
13	350	66	.23	.22	.90	-.3	.81	-.7	f .72	.72	60.9	57.6	providedinanencouragingmanner
6	354	66	.03	.22	.87	-.4	.81	-.6	e .72	.70	56.5	59.1	helpedmeevaluatemyprogressinthec
14	333	66	.92	.19	.84	-.6	.83	-.7	d .80	.77	58.7	53.0	helpedmeidentifymystrengths
19	338	66	.74	.20	.66	-1.5	.79	-.9	c .79	.76	56.5	53.8	beenindividualizedtomyperformanc
7	350	66	.23	.22	.67	-1.4	.59	-1.8	b .80	.72	67.4	57.6	promotedmyactiveinvolvementinlea
3	356	66	-.07	.23	.38	-3.2	.36	-3.0	a .84	.70	76.1	59.8	stimulatedmetoreflectonwhatihave
MEAN	353.7	66.0	.00	.23	1.02	.1	1.00	-.1			60.0	59.5	
S.D.	10.2	.0	.51	.02	.31	1.3	.28	1.0			7.0	4.0	

Table 2: Infit-Outfit measures

```
MEASURE     PERSON - MAP - ITEM
                <more>|<rare>
     6     ##########  +
                   .   |
                       |
                       |
                     T |
                  .#   |
     5                +
                       |
                  .#   |
                       |
                   #   |
                       |
     4                 +
                     S |
                   .   |
                   .   |
                   .   |
                   .   |
     3                 +
                  .#   |
                   .   |
                   #   |
                   .  M|
                  .#   |
     2                 +
                   .   |
                   .   |
                 ####  |
                  .#   |
                  .#   |
     1                 +T helpedmeidentifymystrengths
                   # S|  helpedmeidentifyareasofneededimp
                  .#  |  beenindividualizedtomyperformanc
                   .  |S builtmyconfidence
                      |  stimulatedmetoreflectonwhatistil
                      |
                      |  promotedmyactiveinvolvementinlea
                      |  providedinanencouragingmanner
                      |  supportedmyselfdirectedlearning
     0                +M hasbeenprovidedfrequentlythrough
                      |  helpedmeevaluatemyprogressinthec
                      |  provideddirectionofthelearningpr
                      |  stimulatedmetoreflectonwhatihave
                      |  encouragedmetointeractwithmyinst
                      |  stimulatedfurtherlearningaboutth
                      |  increasedmylevelofknowledgeabout
                      |  motivatedmetocontinueinthecourse
                   .  |S includedbothpositivecommentsandc
                     T|  challengedmetothinkindepthaboutt
                      |  helpedmetobuildnewknowledgeabout
                      |
    -1                +T beenprovidedinatimelymanner
                <less>|<frequent>
EACH "#" IS 2. EACH "." IS 1.
```

Figure 2: variable mapping for student perception on efficient instructor feedback.