PERCEPTION OF WORK ENVIRONMENT AND TEACHING PREPAREDNESS AMONGST MATHEMATICS TUTORS

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ABSTRACT

Tutors play an important role in providing quality educational experiences for students in an increasingly pedagogically demanding landscape. The comparatively small size of tutorial classes compared to lectures in most subjects often means that tutors are favourably positioned with the opportunity to provide more personalised and collaborative student-centred learning experiences. Mathematics tutors at The University of Queensland were surveyed to determine whether they felt suitably prepared for, and supported in, performing their teaching duties.

Generally, tutors were confident in their subject matter knowledge and pedagogical skills but were less certain in their ability to seek out and engage with ongoing professional learning and development. In their perception of work environment, tutors indicated that they would value support in facilitating the smooth delivery of teaching and marking activities, as well as increased inclusion in academic communities through collegial engagement, receiving feedback on their performance, and greater access to opportunities for skill development. Consequently, these results suggest that although tutors feel capable of performing their teaching duties, they may need additional institutional support to achieve their professional goals.

INTRODUCTION

Teachers employed in higher education on a casual or sessional basis contribute significantly to teaching and learning activities at Australian universities bearing responsibility for a considerable proportion of the teaching load across a broad variety of job functions, including that of the subject tutor (Percy et al., 2008). Sessional academics have increasingly diverse backgrounds and motivations and may come to the role as students of the university, industry experts, or freelancers among many new and evolving groups (Kimber, 2010) and consequently have varied experiences in teaching and teacher training (Halcomb, Andrews, Peters, Salamonson & Jackson, 2010).

The Australian Learning and Teaching Council (ALTC) *RED Report* identified five domains where institutional practices could be enhanced to better manage and support sessional teaching staff including systemic and sustainable policy and practice, employment and administrative support, induction and academic management, career and professional development, and reward and recognition (Percy et al., 2008). For each domain, several recommendations for advancement at the university level were proposed (Percy et al., 2008). Harvey (2013) composed a Sessional Staff Standards Framework aligned to these recommendations to recognise and include sessional staff in a systemised framework for the evaluation of quality teaching and learning. These standards became the foundation for the Benchmarking Leadership and Advancement of Standards for Sessional Teaching (BLASST) framework in which standards are underpinned by the three guiding principles of quality learning and teaching, support for sessional staff and sustainability (BLASST, 2013).

It has been recognised that failing to provide adequate professional development and performance management to sessional teaching staff could jeopardise student learning (Percy et al., 2008). In their review of 38 meta-analyses of variables affecting achievement in higher education, Schneider and Preckel (2017) determined that teachers could substantially affect student achievement through their choice of teaching method, but that success of these strategies was sensitive to the way in which they were implemented, thus highlighting the relevance of teacher training at the tertiary level. Brown, Goodman and Yasukawa (2010) found that the nature of casual employment constrained the personal and professional development of casual academics and shifted the burden of quality teaching from institution to the individual.

In 2010, The University of Queensland launched the Tutors@UQ program, an institution-wide initiative to provide new sessional staff with an induction to Teaching and Learning delivered at the faculty level as a partnership between the centralised teaching and learning unit and the faculties (Matthews, Duck & Bartle, 2017). As a result of completing this program, participants self-reported an increase in feelings of preparedness and confidence in tutoring (Matthews et al., 2017). It may therefore be valuable to further contextualise the professional development needs of tutors at the discipline level. The School of Mathematics and Physics provides new tutors with a brief discipline specific induction and hosts a webpage containing advice to new tutors (The University of Queensland, n.d.); however, further training and academic supervision in mathematics is predominantly the purview of individual subject coordinators. By gathering data about the mathematics tutor cohort we can better understand their needs as educators (Harvey, 2017).

This project aims to situate how mathematics tutors within the School of Mathematics and Physics at The University of Queensland perceive:
1. Their training and working environment.
2. Their preparedness for and confidence in teaching.

METHODOLOGY

A survey was used to investigate the research aims outlined above. The survey was distributed to all maths tutors employed by the School of Mathematics and Physics, of which 35 volunteered completed responses (21% of total maths tutor population). Data were collected anonymously through the *Checkbox* survey software over a period of 4 weeks between April and May 2020. Human ethics approval was obtained for this project (UQ Human Ethics Approval #2020000366).

All of the ordinal survey questions were 5-point Likert items with descriptions ascribed to scores of 1 (strongly disagree), 3 (neutral), and 5 (strongly agree). Participants were also given the option to select 'unsure' for each item which was treated as missing data and excluded from the 'valid' response set used in further quantitative analysis below. Respondents were also given the option to provide an open comment clarifying their response at their discretion.

The rationale for the question design of the Likert items is tied to the criteria outlined in the Sessional Staff Standards Framework that maths tutors may be positioned to comment on. This is reflected in the wording of questionnaire items assessing how tutors perceive their working environment and to a lesser extent their teaching practice (BLASST, 2013). The remaining survey questions sought to clarify tutor self-perception of their confidence and preparedness to teach, and their willingness to identify and participate in professional development. Questions relating to the tutors' perceptions of external factors that impact their working environment are henceforth referred to as question set A (questions A1-A27) and questions relating to tutors' self-perception of their teaching preparedness are referred to as question set B (questions B1-B14) as outlined in Tables 1 and 2 respectively.

The Likert items were bookended by open response questions examining participants' motivation to begin tutoring and their view of the role that tutors and tutorials play in student learning, as well as their perceptions of what might prevent tutors from accessing professional development and what school level support they would value. Responses to these questions were interpreted on a question by question basis through an inductive, essentialist approach to thematic analysis (Braun & Clarke, 2006; Braun & Clarke, 2012). It is, however, worth noting that these responses cannot be divorced from the context of the overall survey and hence may be influenced by concepts highlighted in other questionnaire items.

Table 1: Likert items in question Set A with n_1 valid Likert responses and n_2 open comments.

Item	Answer the following questions based on your perception of the policies and practices affecting mathematics tutors within the School of Mathematics and Physics at The University of Queensland (UQ).	n_1	n_2
A1	The employment and educational skills required to become a maths tutor are clear.	33	4
A2	UQ provides and supports professional development in learning and teaching for maths tutors.	32	3
A3	I receive sufficient communication from UQ to be able to complete my job successfully.	32	2
A4	I have been provided with an induction to learning and teaching.	31	4
A5	I am kept updated about standards, procedures and policies affecting learning and teaching.	33	0
A6	Maths tutors are provided with opportunities to share good learning and teaching practice.	32	0
A7	Maths tutors are consulted in decision making on learning and teaching issues.	32	5
A8	Maths tutors are involved in teaching teams which promote collaborative development of learning and teaching strategies.	32	5
A9	Maths tutors receive professional academic supervision and mentoring.	32	5
A10	Maths tutors are adequately supported in enacting quality assured assessment processes.	31	5
A11	The teaching performance of maths tutors is monitored and evaluated in a transparent way.	33	5
A12	Maths tutors receive comprehensive feedback on their teaching performance.	32	8
A13	Maths tutors receive individualised feedback on their teaching performance.	32	4
A14	The recruitment and appointment processes for maths tutors are consistent.	30	4
A15	The recruitment and appointment processes for maths tutors are transparent.	31	0
A16	The recruitment and appointment processes for maths tutors are fair.	29	1
A17	The recruitment and appointment processes for maths tutors are efficient.	31	2
A18	The recruitment and appointment processes for maths tutors are timely.	33	2
A19	The recruitment and appointment processes for maths tutors are proactive.	26	0
A20	UQ has clearly communicated to me my rights, responsibilities and entitlements as a maths tutor.	32	0
A21	Maths tutors receive an appropriate orientation to the workplace (such as OH&S induction).	31	3
A22	Maths tutors are provided with resources necessary to perform their roles.	33	5
A23	Teaching excellence by maths tutors is recognised.	33	3
A24	Maths tutors are included in academic communities of practice through invitation to academic seminars and other events.	29	6
A25	Maths tutors are included in academic communities of practice through contribution to faculty events.	29	2
A26	Maths tutors are included in academic communities of practice through participation in research on learning and teaching.	30	4
A27	Good maths tutors are identified and retained.	30	4

Table 2: Likert items in question Set B with n_1 valid Likert responses and n_2 open comments.

Item	Answer the following questions based on your perception of your own practice as a mathematics tutor.	n_1	n_2
B1	I actively engage with ongoing professional development in learning and teaching.	32	3
B2	I am able to identify my own professional development needs and seek out relevant professional development opportunities.	33	2
B3	I maintain my professional role as a teacher and a disciplinary expert (by keeping up to date with policies, research and other developments in my field).	33	0
B4	I maintain communication with departments and other staff members as necessary.	33	0
B5	I provide feedback to my department/subject coordinator.	33	0
B6	I feel confident in my disciplinary knowledge as a maths tutor.	33	0
B7	I feel confident in my pedagogical knowledge as a maths tutor.	33	0
B8	I feel confident that I am knowledgeable in teaching and learning strategies relevant to maths tutoring.	33	0
B9	I feel confident in my classroom management skills.	33	0
B10	I feel confident team-teaching (i.e. teaching when more than 1 tutor is in the room).	31	3
B11	I feel confident that I can tell when my students are learning.	33	0
B12	I feel confident in facilitating group work.	33	0
B13	I feel confident in my skills as a maths tutor.	33	0
B14	I feel I have been provided with enough training to succeed in my role as a tutor.	33	5

RESULTS

Data were analysed in *Excel* and *SPSS*. The sparsity of the data was examined, and two participants' responses were excluded from further quantitative analysis where missing values comprised 49% and 59% of the Likert responses, respectively, bringing the total number of cases to 33. A missing values analysis was conducted in *SPSS* and Little's MCAR test, which assumes a null-hypothesis that the data is missing completely at random (MCAR), returned a p-value of 0.990, indicating that any 'unsure' responses could be classified as MCAR and hence list-wise deletion of missing values was implemented where relevant in further *SPSS* analyses (Garson, 2015).

QUANTITATIVE
Given the ordinal nature of the Likert items, frequencies were used to compare responses to individual questions. Here, a rating of 1 or 2 is considered together as a general disagreement with the presented statement and a rating of 4 or 5 is likewise grouped to represent agreement. A summary of the percentage of valid responses achieved in each category (disagree, neutral and agree) for question sets A and B are presented in Figures 1 and 2 respectively.

In response to the questions in set A, the items with greatest agreement were those relating to communication and resourcing (A3, A22), the efficiency/timeliness of the appointment process (A17, A18), and the provision of an initial induction to teaching and learning (A4). Regarding the latter point, it is relevant to note that of the total respondents, 69.7% had completed the Tutors@UQ program. The greatest percentage of disagreement arose from statements regarding feedback on performance and mentoring (A9, A11, A12, A13), as well as inclusion in academic communities of practice (A24, A25). Item A12, which achieved the greatest proportion of low scoring Likert responses, attracted the most accompanying open comments where tutors elaborated that it was often difficult to get students to complete tutor teaching evaluations which limited the feedback received. Concern about these evaluations and how they might be used was also evident in open comments regarding A11 and A13.
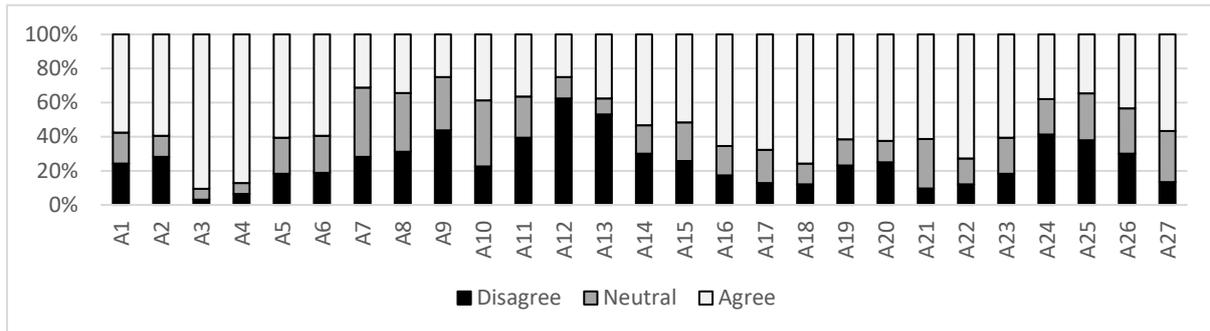
Figure 1: Frequency of responses for Likert items comprising question set A.

Regarding set B, tutors generally appear to agree with the statements presented indicating that they do feel confident in both their relevant knowledge and teaching skills. The questions with the greatest percentage of disagreement were those describing tutors' abilities to identify and engage in their own programs of ongoing professional development and learning (B1, B2, B3). The responses for question set A are considerably more varied than for set B.
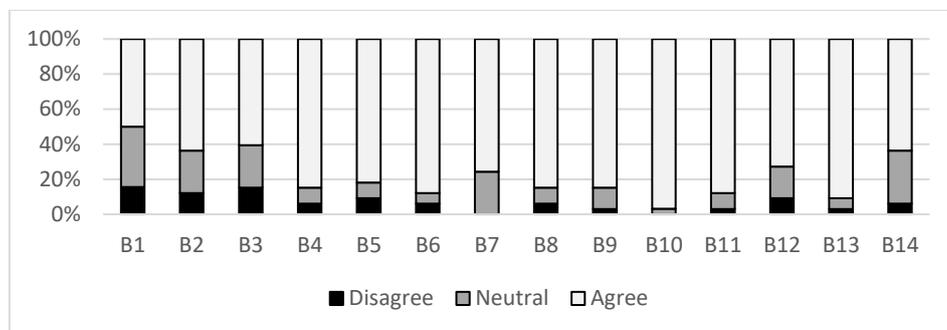

Figure 2: Frequency of responses for Likert items comprising question set B.

To overcome the limitations of the ordinal data recorded, principal component analysis (PCA) was conducted on question sets A and B as a data reduction method to identify any groupings of four or more Likert items that could be aggregated into Likert scales to facilitate further analysis (Boone & Boone, 2012; Sullivan & Artino, 2013). PCA was completed with promax rotation and suppression of component loadings $< |0.4|$. For set A, PCA revealed three components with appropriately many non-cross-loading items with sufficient loading score. To create a simplified component structure items with cross-loading greater than 75% were eliminated sequentially starting with loadings of least magnitude including items A8, A10, A13, and A17, and item A27 was eliminated as it did not have strong loadings across any factor (Samuels, 2017). Consequently, the resulting outcomes are intended to support and not replace the initial item-wise analysis. For set B, two components with appropriately many non-cross-loading items were identified. The resultant components from both question sets are summarised in Table 3, and account for approximately 65% and 61% of the variance of the questionnaire data in set A and set B, respectively. Item A12 loaded onto components two and three but is included only in component three for all further analysis.

Table 3: Promax rotated components identified from PCA of question sets A and B.

Item	Loadings set A			Item	Loadings set B	
	Component 1	Component 2	Component 3		Component 1	Component 2
A3	0.87			B5	0.86	
A22	0.83			B6	0.86	
A5	0.83			B10	0.85	
A4	0.80			B4	0.84	
A2	0.70			B13	0.74	
A21	0.67			B12	0.72	
A23	0.66			B9	0.62	
A6	0.63			B7	0.54	
A1	0.50			B14		0.97
A20	0.43			B2		0.89
A15		1.01		B8		0.74
A16		0.86		B3		0.70
A14		0.85		B1		0.51
A19		0.70		B11		0.45
A11		0.65				
A18		0.53				
A26			0.93			
A25			0.90			
A24			0.80			
A9			0.78			
A12		0.48	0.68			
A7			0.46			

There appears to be some consistency in the theme of the items linked with the resulting components, as suggested in Table 4 alongside the mean and standard deviations of each group. A higher mean suggests a greater proportion of high scoring Likert responses (greater agreement) across the scale. Cronbach's alpha is also presented as a measure of the internal consistency of the emergent scales. The relatively high values of Cronbach's alpha suggest that the scales are somewhat reliable, although the values close to 0.9 may suggest some redundancy in the groupings (Takavol & Dennick, 2011). It is noted that the small sample size in this study somewhat reduces the robustness of this parameter. However, Yurdugül (2008) found that if the first eigenvalue of the PCA is greater than 6, Cronbach's alpha is unbiased even at sample sizes as low as 30. In this study, the first eigenvalues for both sets A and B were >6.

Table 4: Descriptive statistics for Likert scales derived from PCA of question sets A and B.

Component	Theme of scale	Mean	S.D.	Cronbach's α
	Question set A			
1	Workplace communication, orientation and training	3.80	1.08	0.89
2	Recruitment and performance evaluation	3.45	1.22	0.84
3	Academic management and inclusion in academic communities	2.92	1.14	0.89
	Question set B			
1	Teaching and professional practice	4.22	0.85	0.90
2	Engagement with professional development	3.85	1.00	0.85

These results further elucidate the variation in agreement across set A, with items tied to the theme of communication and training performing the best and those relating to academic management and inclusion achieving the lowest Likert scores. There is generally greater agreement across the components identified from set B compared to set A, as observed in the individual item results.

QUALITATIVE

Here we examine tutor responses to the open-ended survey items (this excludes the open comments accompanying each Likert item). The question 'Briefly describe what motivated you to become a maths tutor within the School or Mathematics and Physics' received 32 responses which describe a cohort that were motivated to become maths tutors by a desire and aptitude to contribute to quality teaching and learning experiences for others:

'I am really passionate about mathematics education and want students to feel supported and cared for in their maths experience. I have had the incredible privilege of having some incredible maths educators and teachers in general throughout school and uni, and it's amazing what difference a good educator can make to a students' (sic) experience.' – Respondent 8.

Another motivator was the potential for skill development and enhancement of their own career readiness, as well as tutoring presenting a convenient employment opportunity for many:

'I thought maths tutoring was an excellent opportunity for part time employment as well as reaffirming my own knowledge in the course material.' - Respondent 17.

When asked to describe the role that both tutors and tutorials play in student learning (receiving 32 and 30 responses respectively) a common theme of bridging the academic divide was observed where the smaller, less formalised setting of tutorials and the subsequent opportunity for tutors to provide personalised support to students in a relatable/non-intimidating way were highlighted:

'I think tutorials are really important. They are the space where students get to have a more genuine and close connection with the tutors and with other students. Because lectures are so large, tutorials can really act as a space where individuals can show more personality and are also able to test out ideas and express their thoughts and feelings.' – Respondent 28.

They also identified that tutorials provided opportunities for learning support and extension, and promoted an environment conducive to student reflection on their learning progress. Another theme that arose to describe the role of the tutor was that of the facilitator of learning which encompasses many aspects of professional teaching practice including establishing the classroom environment, navigating both student-directed and tutor-directed learning, and the provision of feedback:

'Tutors are there to guide students in learning, introduce them to problems and practical methods of solving these problems introduced in the course. They are also there to keep the students productive and on topic.' – Respondent 23.

The question 'What would you consider to be the primary barriers preventing maths tutors from accessing professional development?' received 18 responses which identified that there was often a lack of awareness and opportunity to be able to attend professional development. As Respondent 4 commented, there can be a *'Lack of advertising to tutors, and a lack of time and ability to schedule it to suit many casual employees.'* Furthermore, some opportunities were lacking in perceived value:

'In many cases it seems as if teaching professional development courses are not targeted towards casual tutors and are more so towards full-time academics. Additionally, there does not often seem to be maths-specific sessions, where a lot of the teaching methods and content is highly specific to the discipline.' – Respondent 8.

Despite this, five respondents listed professional development activities (outside of Tutors@UQ) that they were enrolled in or had completed.

Finally, in response to the question 'In your opinion, what would be the most valuable thing that the School of Mathematics and Physics could do to support you in your role as maths tutor?' the 25 responses revealed that tutors would value support in facilitating a smooth teaching experience, and greater inclusion in academic communities. The former theme incorporates concepts such as marking and assessment support, guidance on approaches to teaching and approaches to learning, and potential administrative changes regarding the allocation of roles or hours. The latter theme represents a desire for greater collegial engagement, access to feedback and enhanced involvement in academic communities including access to opportunities for skill development. Both themes are encapsulated in this comment:

'…I think I am fairly well supported. However some more engagement with tutoring team and group professional development sessions specific to courses could be useful. It is also nice to be supported

with timely access to assignment solutions for marking purposes and tutorial sheet solutions as well. Tute sheet solutions are useful ensure all points in the problem working that lecturers want emphasised to students get communicated clearly to students in tutorials when they are asking about tute problems.' – Respondent 4

DISCUSSION AND CONCLUSIONS

Tutors perceived many aspects of their working environment positively: criteria regarding communication and training were rated highly and when asked if they hoped to tutor again, 100% of participants responded affirmatively. However, statements tied to themes of inclusion in academic communities were met with less agreement and enhanced opportunities for feedback, mentoring and inclusion in communities of practice present potential avenues for improving the tutoring experience. The qualitative data supports the notion that tutors would like to be included in collegial activities relevant to teaching and learning and receive feedback on their performance. Similar themes concerning feelings of academic marginalisation amongst sessional teachers are evident in the literature (Brown et al., 2010; Ryan, Burgess, Connell & Groen, 2013) and this appears to be an ongoing area of development across higher education. The qualitative results also identified that tutors would value support in ensuring that tutorial activities and associated marking run smoothly and are aligned to their intended learning outcomes.

With respect to the second aim of this investigation, the quantitative results demonstrate that tutors were generally in agreement with statements thematically linked to self-perception of confidence in their own teaching practice and their preparedness to teach. Of the criteria examined, their greatest challenge appears to be in seeking out and engaging with continued professional learning beyond initial induction/tutor training programs, although this concern was marginal relative to the results for set A. The qualitative data suggests that there is a willingness and desire from tutors to participate in ongoing professional development. However, they may need support in helping to identify and access relevant opportunities. Similar outcomes have been reported in the literature; Higgins and Herreveld (2013) found that professional development and mentoring were valued among a group of casual distance education academics, but that university-sponsored opportunities for development were not always clearly communicated to this audience. Similarly, Brown, Kelder, Freeman and Carr (2013) found in a survey of casual teaching staff at the University of Tasmania that a majority of respondents were not aware of professional development days and formal inductions targeted at casual teaching staff. Consequently, it may be productive to establish mechanisms to actively promote and link tutors to relevant and accessible professional development opportunities which may in turn help to foster a greater sense of academic inclusion.

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