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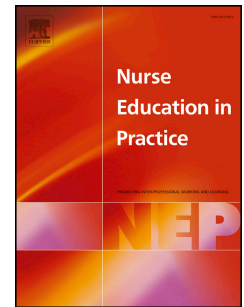
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Developing an integrated approach to the assessment of student nurse competence using the Total Client Care (TCC) assessment tool

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Title Page

Title

Developing an integrated approach to the assessment of student nurse competence using the Total Client Care (TCC) assessment tool

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Abstract

The aim of this study was to evaluate the validity and reliability of an integrated assessment of competence using the Total Client Care (TCC) assessment tool within an undergraduate Nursing programme. The Total Client Care Assessment Tool aims to assess multiple competencies in an integrated way thereby mirroring the way in which registered nurses are expected to practice. TCC is a tool designed to assess the student's ability to provide holistic care to a client over a specified period of time. TCC measures the student's performance around four constructs, these are:

Communication, Planning and Responding, Care Delivery and Assessing and Evaluating.

G-theory analysis revealed satisfactory levels of global reliability on single use G co-efficient 0.90 although this dropped to 0.76 when used on eight occasions to assess the same students over a two year period. Analysis of variance revealed that students and assessment occasions accounted for most of the variance. The TCC assessment tool is useful as it provides data about the student's performance when providing actual care. When used as part of a wider system of assessment involving triangulation of evidence from a number of sources the tool can support mentor judgements about the achievement of competence.

Highlights

- The assessment tool is a valid integrated tool to assess clinical performance.
- Its use will make evaluation of student performance more objective.
- It can enhanced the quality of clinical assessment in nursing education.

Keywords

Integrated assessment, Competency assessment, Assessment, Tool

Introduction

The assessment of clinical competence amongst nursing students in a clinical setting is a complex process which is influenced by a number of factors such as assessor training, assessor knowledge and workplace pressures (Burke et al, 2016; Franklin and Melville, 2015). Wu at al (2015b) identified problems with workplace competence assessment. The issues identified included vague competence statements, unfamiliarity with the assessment process and a lack of grading systems beyond simply achieved and not achieved. There was also a reported variation in how assessors arrived at their judgements with some seeking the views of colleagues and others making decisions alone. Similar

concerns were expressed by Bradshaw et al (2012) with assessments and competency statements containing off putting phraseology and confusing terminology causing problems for assessors.

Wu et al (2015a) conducted a systematic review to examine approaches to clinical assessment for undergraduate nursing students. They found that most assessment tools were criterion referenced to the competencies produced by nursing boards and regulators and that few tools had been subject to rigorous psychometric evaluation. Several assessment tools were very lengthy and consisted of numerous items with nursing being broken down into smaller sub-component parts. Wu et al (2015a) concluded that there was a need to develop a holistic clinical assessment tool which has a reasonable level of validity and reliability.

A systematic review was conducted in 2015 (Licen and Plazar, 2015) to identify potential competency assessment tools. They identified seven instruments which met the review inclusion criteria and of these six of the tools were developed to allow student to self-assess. Only one tool, the Clinical Evaluation Tool (CET) was designed to allow an assessor to grade a student in

terms of competence. The CET examined four domains; professional responsibility; knowledge based practice; ethical practice and the provision of care and was scored using a four point Likert scale (unacceptable, inconsistent, competent and excellent). The CET was subject to a mixed methods study to evaluate the tool (Sedgwick et al, 2013). The evaluation was relatively small scale and exploratory in nature involving just 14 students. Acceptable internal consistency was found with the CET having Cronbach alpha's ranging from 0.71 for ethical practice to 0.94 for the provision of care.

The current Nursing and Midwifery Council (UK) competencies (NMC, 2014) are divided into four domains and consist of generic and field specific competency statements. The most significant issue with the current competencies for pre-registration nursing is the sheer number of them ranging from 43 competency statement for adult nursing to 56 for mental health nursing. Having so many individual competencies is probably the most significant threat to a valid and reliable assessment process as assessors are unable to accurately assess each competency and they therefore rely on a global judgement about a student's competence for registration. The proliferation of competency

statements results from the deconstruction of competencies into smaller and smaller component parts. In part this is driven by a desire to make the components of competency measurable. Leach (2008) identified making a judgement about a learner requires the reconstruction of such statements to arrive at a judgement. The argument being that competence to practice is greater than the sum of the parts. It could be argued that competent practitioners are required to mix competence in assessment, communication, reasoning, clinical decision making and evaluation all at the same time so it therefore makes little sense to assess these as individual components. This argument is supported by Hodges and Lingard (2012) who also describe how the drive towards tick box assessments of routine skills should be avoided. According to Franklin and Melville (2015) the philosophy of competence in nursing is the interrelationship of knowledge, skills, attitudes and clinical reasoning. This represents a real life integration of various competencies which mirrors how registered nurses are expected to practice.

Many competence assessment tools are limited because they fail to view competence as a continuum (Franklin and Melville, 2015) and there is a view that the reliability and validity of competence assessment can be improved with repeated assessments over

time rather than a reliance on a single snapshot (Boritz and Carnaghan, 2003).

Development of the Total Client Care Assessment Tool (TCC)

The Total Client Care Assessment Tool seeks to assess a student's competence in an integrated way. TCC is a tool designed to assess the student's ability to provide holistic care to a client over a specified period of time. TCC measures the student's performance around four constructs;

- Communication
- Planning & Responding
- Care Delivery
- Assessing & Evaluating

TCC assessment relates to sixteen Nursing and Midwifery Council (NMC) competencies (NMC, 2014). Table 01 provides detail of which NMC competencies are mapped to the tool based on the 2014 Standards.

The TCC assessment scores a student's performance using a scale of competence against seven elements these are:

- Communication with the patient
- Assessment / re assessment of needs
- Care delivery

- Timeliness of the care delivered
- Observation and reporting
- Safe administration of medicines, safe use of medical devices etc.
- Evaluation of the care, record keeping and handover

Performance against each of the above elements is graded using a scale of competence (Figure 01). The scale of competence was developed by the team in order to promote criterion referenced assessment against the standards for registration. The scale is based on the criterion based scale developed in the 1980's by Bondy (1983). The original Bondy scale was a five item scale using the labels of *dependent*, *marginal*, *assisted*, *supervised* and *independent*. The scale was adapted by adding criterion detailing the level of support the student would be requiring this provided a behavioural anchor for the scale to assist the assessor to identify the appropriate level of performance. An additional sixth item was added at the top of the scale (accomplished) to match with '*exceeds expectations*'. The additional layer above skilled provides an incentive to extend beyond the minimum level of competence for registration. Finally the words *independent* and *supervised* were changed to *skilled* and *supported* as it was felt

that in reality students were never truly independent and were always supervised until they become registered nurses.

The TCC tool needed to be sufficiently flexible to be used in different care settings and by students from different fields of practice. This required the development of constructs common to all care settings with guidance for mentors and students which contextualised the approach. So for example, observation and reporting could include both vital observations as well as observations of a patient's mental state, behaviour or interaction with others.

Developing an integrated assessment

TCC would be used as part of a wider criterion referenced approach to the assessment of competence. Evidence from TCC assessment and from other sources including observation of practical skills, structured reflection, discussions, multi-source feedback and other assessment tools would be used to inform a mentor's judgement about the achievement of the NMC's competencies. This approach would enable mentors to utilise a system of triangulation to inform their judgements.

Using TCC as part of a wider system enabled the development of a lower stakes assessment which would be developmental in

nature. The assessment could then be undertaken multiple times across the registered nurse programme providing feedback to both the student and their mentors with the ultimate aim of being competent at the point of registration.

An expert reference group was convened to develop and refine the new Total Client Care (TCC) assessment tool. The group was made up of experienced academics, placement leads, practice educators and mentors. The group initially considered a range of competency scales and eventually settled on adapting the Bondy scale for use across the whole process of competence assessment and for the TCC assessment tool.

Implementation of the assessment

The Total Client Care (TCC) assessment tool was implemented alongside a new criterion referenced approach to competency assessment across all four fields of practice on both the undergraduate and integrated Masters pre-registration nursing programmes. The assessment tool was produced as a paper-based form for ease of use and to enable students to receive instant feedback and to file a copy of the assessment in their portfolio of evidence. Students would be assessed providing care over a span of duty. Each TCC assessment related to one of three

categories of complexity. These were defined as low complexity care where patient requires intermittent interventions over the span of duty for between 40-90 minutes in total, medium complexity where the patient requires care for five or more problems for more than 90 minutes and high complexity where the patient requires continuous care or monitoring during the span of duty. Students were expected to progress from low complexity cases in the first placements through to high complexity cases towards the end of their programme.

Students were expected to complete two assessments on each clinical placement throughout their programme and the first cohort to complete was the integrated Masters programme.

Students were asked to ensure that each assessment was at least two weeks apart to allow them time to act upon the feedback and to enable them to develop their skills in providing holistic patient / client care.

As the TCC assessment tool was designed to assist a mentor to make a judgement about the student's achievement of competence students were informed that any registered nurse could complete the assessment. This may, or may not, be the student's mentor and indeed there are advantages to having the TCC assessment completed by another registered nurse who was

not the student's mentor insomuch as it would provide the mentor with feedback from another registrant as to the student's achievement of competence. Such feedback was a key element of the process of triangulation which enabled mentors to make judgements about a student's overall progress towards registration.

The development team produced a range of user guides, short videos and teaching materials which allowed lead educators and practice placement facilitators to undertake cascade training. Academic staff also ran workshops on both the tool and new system of practice assessment within NHS Trusts prior to implementation.

Evaluation methods

The overall aim of the evaluation was to identify the reliability of the TCC assessment tool as an integrated assessment of competence. More specifically, the evaluation aimed to:

- a. Identify the measurement precision of the TCC assessment tool when applied to different fields of practice.
- b. Ascertain the sources of error in measurement when using the TCC assessment tool.

- c. Explore the impact on student mean scores when assessments were conducted in different clinical areas.
- d. Examine how the measurement precision of the TCC assessment tool may be enhanced.

Method

G-Theory methods

The most widely used tests for the reliability of a measurement tool are grouped together under the title of Classical Test Theory (CTT). G-Theory is a statistical approach to the estimation of measurement precision in situations where there are multiple sources of error. G-Theory is derived from analysis of variance (ANOVA) and it is an evolution from CTT. G-Theory has the aim of portioning the total variance in a data set into a number of potential explanatory sources (Cardinet, Johnson and Pini, 2010). Prior to commencing a G-Theory study the observational and measurement designs need to be considered.

Observational design

From the data set four facets were identified, these were students, fields, assessment occasions and attributes. Data from a maximum of 25 students per field would be used in the study. The link between students and their fields of nursing meant that one

facet e.g. students was nested in the facet field. Within G-Theory nested facets are those where the levels of one facet are associated with another facet (Cardinet, Johnson and Pini, 2010). The remaining facets were assessment occasions (labelled as occasions) with a maximum of eight assessments across the two years of the programme based on two assessments on each placement. Occasions are also related to rater and sometimes the same rater assessed the student twice during their placement. However, this was not consistent for every student and this is the reason why raters have not been selected as a facet in this evaluation study. The final facet identified was that of attributes. There were seven attributes assessed during each assessment these attributes relate to the elements assessed by the TCC assessment tool e.g. communication, assessment and re-assessment, care delivery, observing and reporting etc. The facets of occasions and attributes were crossed in this study. In G-Theory a crossed facet is one where every level of a facet is combined with every other. For example, all students attempted TCC on all occasions and had a rating on all seven attributes on the tool.

Measurement design

The measurement design requires identification of the differentiation facets and the instrumentation facets. As one of

the aims of the evaluation was to examine the degree of measurement precision the TCC assessment tool had when used to assess students from different nursing fields the facet of field was identified as the differentiation facet. The measurement design was therefore, field (with students nested within it) as the differentiation facet and occasions and attributes as the instrumentation facets. The instrumentation facets are described as fixed with 8 occasions (O) and 7 attributes (A). Fields are fixed at 3 and students are random and infinite allowing for larger sample sizes.

Data was entered into EduG software and a G-Theory study performed requesting both ANOVA and coefficient G calculations. The purpose of a G-study is to evaluate the characteristics of a measurement procedure and to identify the strengths and weaknesses of that procedure, test or tool. Once the G-study is complete it is then possible to see which areas concentrate to variance and error and a D-study, or decision study, can be performed to optimise the design. The D-study is based on asking the question 'what if?' For example what if we assessed more or less attributes? What if the sample of students was larger or smaller? What if we performed the assessment less frequently or

more frequently? Following the G-study a D-study was performed to test these assumptions.

Repeated Measures ANOVA

In order to see if there was a statistical difference between the students' assessment means on different placements two repeated measure ANOVA tests were conducted. The first test examined the three placements across Year 2 of the programme to see if there was any statistical difference between placement types. During Year 2 students are streamed into three groups and each group rotates between acute care, community care and intensive care clinical settings. Therefore, each group of students complete their placements in a different order. In adult and children's nursing intensive care was a critical care setting and in mental health it was a low or medium secure environment. The researchers were interested in ascertaining whether more specialist clinical placements would rate students lower on the competency scale given the specialist nature of their clinical practice. The second repeated measures ANOVA examined whether the mean scores were statistically significant across all eight assessments.

Sample

57 students undertaking an integrated Masters in Nursing programme were recruited to the study. These students were studying across three fields of nursing within 25 adult nursing students, 23 mental health and 9 children's nursing students.

Ethics

This evaluation was granted ethical approval by the Faculty's ethics committee. While students were not able to opt out of the system for practice assessment they were able to withdraw from this evaluation by indicating that they did not wish to have their assessment data processed as part of the research. No students withdrew either during the course of the programme or subsequently.

Results

All of the students ($n = 57$) successfully completed the programme.

The initial assessments

Following the first placement a G-theory study was conducted on the first two assessments undertaken by the cohort. This enabled the development team to ascertain whether the tool had satisfactory rates of measurement precision and to identify those areas which were creating variance between scores.

Table 02 shows the EduG results concerning the variances values of the sources of variation and the interactions between them for the crossed and nested four facet design based on the two assessments conducted on the first placement. This table shows that 54.9% of the variance comes from students (nested in fields of practice) this means that more than half of the variance relates to the difference in mean score between the students which could either be accounted for by student variation or by differences between assessors (raters). The issue of differences between assessors (raters) is supported by the amount of variance reported between fields of practice 20.4%. This could suggest issues about the preparation of mentors and assessors in certain areas of practice who were often rating students lower than their counterparts in other areas. The next largest variance relates to occasions with 14.0% in this study this related to variance between the two assessments which were only 2-3 weeks apart. Again this could be related to variance between assessors (raters) on the two occasions. The G-Study table (Table 03) shows that the relative error occurs in the nested facet of student (s) which is nested in field (F). The nesting means that it is not possible to distinguish the student effects from the field effects. Other facets return no variance relationship and confirm a

null hypothesis. On this occasion the coefficient G relative is 0.90 and the coefficient G absolute is also 0.90 showing good global reliability and a satisfactory level of measurement precision.

All assessments in the programme

Table 04 shows the EduG results concerning the variance values of the sources of variation and the interactions between them for a crossed and nested four facet design using data from all eight assessments. Table 04 shows that the variance value for students was the largest component accounting for 71.7% of the total variance and students crossed with occasions was the second largest component account for a further 20.1% of the total. The G-study table (Table 05) shows the sources of variance with the greatest negative effect on instrument provision. Students nested in fields accounts for 100% of this variance this suggested that the variance is attributable to differences between students as they progress through their programme towards becoming competent (to the level of skilled or above on the competency scale). In this case the relative error originates in the nested facet (students (S) nested in fields (F)) and it is therefore impossible to separate out the student effects from the field effects. It can be noted that the

two crossed facets occasions (O) and attributes (A) are both null and account for no variance.

Overall the Coefficient G relative is 0.76 and the Coefficient G absolute is also 0.76 showing that the measurement precision of the TCC assessment tool falls just slightly short of the 0.80 recognised cut off. However, Bloch and Norman (2012) suggest that for formative tool values of 0.70 and above are acceptable. In addition, Schuwirth and van der Vleuten (2012) suggest that we should not get too concerned about values which fall slightly outside of the normally recognised acceptable level.

The D-study explored what if we increased the sample of students to a larger cohort? And what would happen if we reduced the number of assessments to one per placement e.g. four of the course? Table 06 details the results of the D-study optimization. You can see that where we increase the sample size to 100 students (option 1) the Coefficient G relative increases to 84. With the larger sample it is also possible to reduce the assessment occasions to 4 (e.g. one per placement) without reducing the overall measurement precision Coefficient G 83 relative and 82 absolute (option 2).

Repeated Measures ANOVA

A repeated measures ANOVA was conducted to compare the effect of placements on the student's mean competency scores in Year 2. The results show that there was a statistically significant difference in the scores between placements $F(2,56) = 4.670$, $p = 0.013$. Pairwise comparisons suggest that the statistical difference ($p = 0.033$) occurs between placement period 1 (the first placement) and the placement period 3 (the third placement). There appears to be no statistically significant difference between period 1 and 2 ($p=0.325$) and periods 2 and 3 ($p=0.349$). This suggests that the statistically significant difference is likely to be attributable to student progression towards competence rather than changes in the assessment ratings between clinical areas / specialisms.

A repeated measures ANOVA was conducted on all eight placements across the two years. This showed a statistically significant difference $F(7, 175) = 10.859$ $p=0.000$. Pairwise comparison revealed that there was little difference between each concurrent assessment. However, between the first and the third assessment in year two ($p=0.011$) and thereafter for the final

two assessments ($p=0.003$ and $p=0.001$ respectively) there was a statistically significant difference.

Discussion

The development and testing of the TCC assessment tool has highlighted the complexities of developing reliable and valid assessments which can be used in the placement setting. The TCC assessment tool is designed to assess competence in an integrated way and it brings together a range of NMC competencies into a single assessment centred on care delivery for a single patient for a specified period of time. However, there are a large number of NMC competencies not assessed through the use of this tool and whether it would be possible to devise an assessment tool which could examine such a large number of individual competency statements is debatable. The initial testing of the TCC assessment tool showed good levels of global reliability with a Co-efficient G of 0.90 when used twice during a single placement. Analysis of the variance revealed that 20.4% of the variation in the assessment occurred as a result of the student's field of practice. This probably occurred as a result of staff within a single NHS Trust applying 'norm' referenced criteria when

assessing the student. Initial analysis revealed that staff believed that students on their first placement should not score above Assisted on the scale of competence. Analysing the TCC assessment tool following the first placement enabled the development team to correct misconceptions and provide additional assessor training particularly around the use of criterion referenced assessment.

Later analysis of the TCC assessment tool following eight periods of assessment suggests that the global reliability is reduced with a Co-efficient G of 0.76 below the normally accepted cut-off of 0.80 (Bloch and Norman, 2012). Analysis of the variance in this study shows the variance attributed to students nested in fields. It is not possible to see whether the variation in scores is as a result of the field of practice or the student. Hodges and Lingard (2012) describes how one of the problems with variation in assessment scores is that we attribute variation to measurement error rather than to the student variation or indeed progression. In this study the variation may be down to the fact that we expect students to make progress towards the level of skilled before they reach the end of their programme of study.

The D-study suggests that reliability may be improved with a larger sample / cohort of students. A larger cohort of 100 students would produce a Co-efficient G of 83 - 84 even if the frequency of assessment was reduced to four occasions rather than eight.

Another interesting finding from this study is the tendency for raters to rate all aspects at the same level on the scale of competence. This is interesting as it suggests that assessors may apply global ratings during their assessments thinking about the student's own performance against that of a registered nurse rather than considering individual elements of performance. The notion of global ratings by assessors is an area worthy of further study.

The TCC assessment tool is useful as it provides data about the student's performance when providing actual care. When used as part of a wider system of assessment involving triangulation of evidence from a number of sources the tool can support mentor judgements about the achievement of competence. The tool and, the wider criterion referenced assessment process, may provide insight into students who may not be progressing as expected and thereby allow for earlier intervention to prevent failure. This is an

area which would require further research to see if it does in fact predict failing students.

Further work is required to retest the tool with a larger sample as suggested in the G-study to see if the hypothesised improvement in reliability can be achieved. In addition, the proposed new standards and competency framework will require further tool revision to ensure that it remains fit for purpose.

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Table 01: NMC Competencies Mapped to the Total Client Care Assessment Tool

Domain	Competencies
Professional Values	<p>A2 All nurses must practise in a holistic, non-judgmental, caring and sensitive manner that avoids assumptions, supports social inclusion; recognises and respects individual choice; and acknowledges diversity. Where necessary, they must challenge inequality, discrimination and exclusion from access to care.</p> <p>A4 All nurses must work in partnership with service users, carers, families, groups, communities and organisations. They must manage risk, and promote health and wellbeing while aiming to empower choices that promote self-care and safety.</p> <p>A9 All nurses must appreciate the value of evidence in practice, be able to understand and appraise research, apply relevant theory and research findings to their work, and identify areas for further investigation.</p>
Communication & Interpersonal skills	<p>B2 All nurses must use a range of communication skills and technologies to support person-centered care and enhance quality and safety. They must ensure people receive all the information they need in a language and manner that allows them to make informed choices and share decision making. They must recognise when language interpretation or other communication support is needed and know how to obtain it.</p> <p>B3 All nurses must use the full range of communication methods, including verbal, non-verbal and written, to acquire, interpret and record their knowledge and understanding of people's needs. They must be aware of their own values and beliefs and the impact this may have on their communication with others. They must take account of the many different ways in which people communicate and how these may be influenced by ill health, disability and other factors, and be able to recognise and respond effectively when a person finds it hard to communicate.</p> <p>B6 All nurses must take every opportunity to encourage health-promoting behaviour through education, role modelling and effective communication.</p> <p>B7 All nurses must maintain accurate, clear and complete records, including the use of electronic formats, using appropriate and plain language</p> <p>B4 All nurses must recognise when people are anxious or in distress and respond effectively, using therapeutic principles, to promote their wellbeing, manage personal safety and resolve conflict. They must use effective communication strategies and negotiation techniques to achieve best outcomes, respecting the dignity and human rights of all concerned. They must know when to consult a third party and how to make referrals for advocacy, mediation or arbitration.</p>

	B5 All nurses must use therapeutic principles to engage, maintain and, where appropriate, disengage from professional caring relationships, and must always respect professional boundaries.
Nursing Practice & Decision making	<p>C1 All nurses must use up-to-date knowledge and evidence to assess, plan, deliver and evaluate care, communicate findings, influence change and promote health and best practice. They must make person-centred, evidence-based judgments and decisions, in partnership with others involved in the care process, to ensure high quality care. They must be able to recognise when the complexity of clinical decisions requires specialist knowledge and expertise, and consult or refer accordingly.</p> <p>C3 All nurses must carry out comprehensive, systematic nursing assessments that take account of relevant physical, social, cultural, psychological, spiritual, genetic and environmental factors, in partnership with service users and others through interaction, observation and measurement.</p> <p>C4 All nurses must ascertain and respond to the physical, social and psychological needs of people, groups and communities. They must then plan, deliver and evaluate safe, competent, person-centred care in partnership with them, paying special attention to changing health needs during different life stages, including progressive illness and death, loss and bereavement.</p> <p>C6 All nurses must practise safely by being aware of the correct use, limitations and hazards of common interventions, including nursing activities, treatments, and the use of medical devices and equipment. The nurse must be able to evaluate their use, report any concerns promptly through appropriate channels and modify care where necessary to maintain safety. They must contribute to the collection of local and national data and formulation of policy on risks, hazards and adverse outcomes.</p> <p>C10 All nurses must evaluate their care to improve clinical decision-making, quality and outcomes, using a range of methods, amending the plan of care, where necessary, and communicating changes to others.</p>
Leadership, Management & Team Working	<p>D4 All nurses must be self-aware and recognise how their own values, principles and assumptions may affect their practice. They must maintain their own personal and professional development, learning from experience, through supervision, feedback, reflection and evaluation.</p> <p>D6 All nurses must work independently as well as in teams. They must be able to take the lead in coordinating, delegating and supervising care safely, managing risk and remaining accountable for the care given.</p>

Figure 01: The Scale of Competence used in the Total Client Care Assessment Tool

Criterion Reference	Competency Level	Behavioural Anchor
MEETS EXPECTATIONS FOR REGISTRATION	Accomplished	Demonstrates capability for independent practice and often exceeds expectations
	Skilled	Demonstrates capability for independent practice
BORDERLINE FOR REGISTRATION	Supported	Needs occasional direct supervision or support
NEEDS DEVELOPMENT FOR REGISTRATION	Assisted	Needs regular direct supervision or support
	Dependent	Needs constant direct supervision or support

Table 02: First assessments using the TCC Assessment Tool – Analysis of Variance

Source	Sums Sq	df	Means Sq	Random	Mixed	Components		
						Corrected	%	SE
F	842.697	2	421.349	1.116	1.123	0.749	20.4	0.851
S:F	2030.731	72	28.205	1.755	2.015	2.015	54.9	0.334
O	3.661	1	3.661	-0.003	0.000	0.000	0.0	0.009
A	38.960	6	6.493	0.036	0.042	0.036	1.0	0.022
FO	10.110	2	5.055	0.009	0.008	0.003	0.1	0.021
FA	13.423	12	1.119	0.019	0.017	0.010	0.3	0.009
SO:F	258.229	72	3.587	0.482	0.512	0.512	14.0	0.084
SA:F	114.189	432	0.264	0.026	0.132	0.132	3.6	0.012
OA	0.926	6	0.154	0.000	-0.001	0.000	0.0	0.001
FOA	1.423	12	0.119	-0.004	-0.004	-0.001	0.0	0.002
SOA:F	91.651	432	0.212	0.212	0.212	0.212	5.8	0.014
Total	3406.000	1049					100%	

Table 03: First Assessments using the Total Client Care Assessment Tool – G- Study Table

Source of Absolute Variance	Differentiation Variance	Source of Variance	Relative Error Variance	% Relative	Absolute Error Variance	%
F	0.749		.....		.....
	.....	S:F	0.081	100.0	0.081	100.0
	.....	O	.....		(0.000)	0.0
	.....	A	.....		(0.000)	0.0
	.....	FO	(0.000)		(0.000)	0.0
	.....	FA	(0.000)		(0.000)	0.0
	.....	SO:F	(0.000)		(0.000)	0.0
	.....	OA	.....		(0.000)	0.0
	.....	FOA	(0.000)		(0.000)	0.0
	.....	SOA:F	(0.000)		(0.000)	0.0
Sum of Variances	0.749		0.081	100.0%	0.081	100%
Standard Deviation	0.865		Relative SE: 0.284		Absolute SE: 0.284	
Coef_G relative	0.90					
Coef_G absolute	0.90					

Table 04: All assessments using the TCC Assessment Tool – Analysis of Variance

Source	Sums Sq	df	Means Sq	Random	Mixed	Components		
						Corrected	%	SE
F	1466.373	2	733.186	0.179	0.179	0.120	3.7	0.154
S:F	203024.978	177	130.085	2.240	2.233	2.233	71.7	0.246
O	109.930	7	15.704	0.008	0.009	0.008	0.2	0.006
A	31.514	6	5.252	0.003	0.004	0.003	0.1	0.002
FO	77.816	14	5.558	0.002	0.002	0.001	0.0	0.005
FA	9.895	12	0.825	0.001	0.001	0.001	0.0	0.001
SO:F	5642.700	1239	4.554	0.635	0.651	0.651	20.1	0.026
SA:F	213.270	1062	0.201	0.011	0.025	0.025	0.8	0.001
OA	7.616	42	0.181	0.000	0.000	0.000	0.0	0.000
FOA	11.927	84	0.142	0.001	0.001	0.000	0.0	0.000
SOA:F	818.635	7434	0.110	0.110	0.110	0.110	3.4	0.002
Total	31414.655	10079					100%	

Table 05: All Assessments using the Total Client Care Assessment Tool – G- Study Table

Source of Absolute Variance	Differentiation Variance	Source of Variance	Relative Error Variance	% Relative	Absolute Error Variance	%
F	0.120		.....		.....
	.....	S:F	0.039	100.0	0.039	100.0
	.....	O	.....		(0.000)	0.0
	.....	A	.....		(0.000)	0.0
	.....	FO	(0.000)		(0.000)	0.0
	.....	FA	(0.000)		(0.000)	0.0
	.....	SO:F	(0.000)		(0.000)	0.0
	.....	OA	.....		(0.000)	0.0
	.....	FOA	(0.000)		(0.000)	0.0
	.....	SOA:F	(0.000)		(0.000)	0.0
Sum of Variances	0.120		0.039	100.0%	0.039	100%
Standard Deviation	0.346		Relative SE: 0.197		Absolute SE: 0.197	
Coef_G relative	0.76					
Coef_G absolute	0.76					

Table 06: – D-study – Optimisation for All Assessments

	G study		Option 1 [increase sample]		Option 2 [increase sample & decrease occasions]	
	Lev	Univ	Lev	Univ	Lev	Univ
F	3	3	3	3	3	3
S:F	60	INF	100	INF	100	INF
O	8	8	8	8	4	4
A	7	7	7	7	7	7
Observ.	10080		16800		8400	
Coef_G rel	0.756		0.837		0.833	
rounded	0.76		0.83		0.84	
Coef_G abs	0.756		0.837		0.833	
rounded	0.75		0.84		0.83	
Rel. Err.						
Variance	0.039		0.023		0.024	
Rel. Std.						
Err. of M	0.197		0.152		0.155	
Abs. Err.						
Variance	0.039		0.023		0.024	
Abs. Std.						
Err. of M	0.197		0.152		0.155	

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