TITLE: Development and psychometric testing of the Carter Assessment of Critical Thinking in Midwifery (Preceptor/Mentor version)

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Introduction

Critical thinking is essential for safe, effective midwifery practice. However, there is variable understanding and use of the term across different contexts and disciplines (Petress 2004). Warnick and Inch (1994 p.11) defined critical thinking as “involving the ability to explore a problem, question, or situation; integrate all the available information about it; arrive at a solution or hypothesis; and justify one's position.”

This definition aligns to the requirements of safe autonomous midwifery practice and justifies the importance of ensuring midwives develop their critical thinking capacity. Critical thinking in midwifery practice is further characterised by the incorporation of women's preferences, and use of expert judgement informed by evidence when making clinical decisions (Fullerton and Thompson, 2005). The ability to demonstrate and apply critical thinking is particularly important when there is uncertainty regarding ‘best’ practice in clinical situations (Scholes et al., 2012). In response to growing recognition of midwifery as an autonomous profession there is a need for midwives to develop their critical thinking skills to enable effective decision-making and problem solving in complex situations where they have increased accountability (Muoni, 2012; Pucer, et al., 2014).

In order to ensure effective clinical decision making, students' cognitive competence needs to be developed and monitored throughout undergraduate education programmes. The development of students' critical thinking is recognised as important in both midwifery and nursing education, however the measurement of critical thinking skills is often inconsistent or overlooked (Walsh and Seldomridge, 2006; Carter et al., 2015). Critical thinking development is assumed to occur as students' progress through their undergraduate programme. However, in a review of curricula, Lake and McInnes (2012) found teaching and learning strategies for critical thinking were not made explicit and limited consideration was given to developing students' cognitive abilities. Furthermore, students were not aware of specific teaching and learning strategies that aimed to develop their critical thinking. It was only when students participated in a focus group discussion as part of the research

study that they recognised instances of cognitive skill development (Lake and McInnes 2012).

In practice professions such as nursing, the acquisition of knowledge and cognitive competence are demonstrated through application in the practice setting (Myrick, 2002). This understanding are applied to midwifery education programmes too, as reflected in the ICM Education Standards which specify that at least 50% of midwifery curricula needs to be based in practice (ICM, 2013). This requirement is endorsed by the Australian Midwifery Education Standards which mandate that 50% of midwifery degree programme hours are dedicated to clinical learning (ANMAC, 2014). During clinical practice placements midwifery students are supervised by practicing midwives in their role as preceptor. For the purpose of this paper the term preceptor will be used in reference to the qualified midwife who provides supervision and support to the student whilst on clinical practice. It is acknowledged that a variety of other terms are used to describe this role across countries including mentor, clinical facilitator, and clinical assessor. The preceptor makes a significant contribution to students' learning and is responsible for monitoring progress, student support, and assessment of practice (Licqurish and Seibold, 2008). Yet little explicit guidance is offered to preceptors to help them understand and assess elements of students' critical thinking. Given the preceptor's role in observing practice and providing feedback to students it is pertinent that they are involved in the measurement and development of this cognitive skill.

A recent systematic review that evaluated tools used to measure critical thinking development in midwifery and nursing undergraduate students found no measures specifically designed for use in midwifery, and no tools that measured the application of critical thinking in practice (Carter et al., 2015). Of the 34 studies that met the inclusion criteria, 16 different tools were used to measure critical thinking development. Twenty-three studies used a standardised licenced tool (such as the California Critical Thinking Disposition Inventory, California Critical Thinking Skills Test, or the Watson–Glaser Critical Thinking Appraisal and Health Services Reasoning Test). Carter et al., (2015) found limited reporting of the reliability and validity of tools and reported inconsistent results across some studies, placing doubt about the validity of these tools in midwifery or nursing contexts. An examination of

the domain concepts or factors of scales also revealed the construct validity to be narrowly conceived or not specific to the health practice context. Development of discipline-specific instruments to measure critical thinking by midwifery students was recommended, and more specifically, tools that measure the application of critical thinking to practice (Carter et al. 2015). In the absence of freely available tools specific to midwifery practice, this methodological study reports on the development and testing of a specific tool designed for use by preceptors to measure undergraduate midwifery students' critical thinking in the practice context.

Research Questions

1. To what extent is the XXXX Assessment of Critical Thinking in Midwifery (CACTiM) (Preceptor version) a reliable and valid tool for use by preceptors to measure critical thinking in practice by undergraduate midwifery students?
2. What is the level of students' critical thinking in practice identified by preceptors?
3. In which areas do preceptors perceive students have well developed and less developed critical thinking skills?

Methods

Design

A descriptive cohort design was used to test the new tool.

Setting

Within the three-year Bachelor of Midwifery programme, students complete up to 1,800 clinical practice hours mostly in the same organisation for the duration of their degree. During their clinical practicum, midwifery students are commonly allocated to work with a registered midwife who becomes the student's named preceptor. The preceptor facilitates, monitors, supports and assesses the student's learning in the clinical environment. Preceptors are prepared for their role through attendance at an education session provided by the University. Preceptors are further supported in their role by the presence of at least one University lecturer available five days per week at the clinical site. This model of clinical support and preceptorship facilitates the development of a close working relationship between students and preceptors

over time. The preceptor is therefore ideally placed to assess students' clinical skills and competence, including the development of their critical thinking skills.

Ethical considerations

Ethical approval for the study was granted by the Human Research Ethics Committee of XXXX University. Participants were informed about the aim of the study, that participation was voluntary; their responses would be anonymous; reported in group aggregate form; and not released to the individual student. Completion of the survey implied consent.

Participants

Criteria for inclusion were midwives practising either in a hospital setting or private midwifery practice and had preceptored at least one student within the last six months (or semester). Potential participants were initially identified through attendance lists at the preceptor education workshops offered by the participating university. Preceptors were also identified by university lecturers at each clinical site.

Instrument Development

This study followed a staged model for tool development recommended by DeVellis (2012). This included: generation of items; content validity testing through mapping of draft items to critical thinking concepts and expert review; administration of items to a development sample; and psychometric testing. The approach to psychometric testing of the tool is outlined in Table 1.

Literature review and generation of item pool

According to DeVellis (2012) Stage 1 of the tool development process involves having a clear understanding of what is to be measured and Stage 2 concerns generation of an item pool. Items were generated through a comprehensive review of the literature to identify possible item content and establish relevant conceptual domains. This process also involved an examination of items included in the National Competency Standards for the Midwife (ANMC, 2006). In the absence of tools specifically for midwifery, a review of nursing literature identified two tools relevant to measuring critical thinking and approaches to learning in nursing practice. The Nursing Executive Center Critical Thinking Diagnostic (Berkow et al., 2011) and the

Competency Inventory for Nursing (Hsu and Hsieh, 2013) were reviewed. Both tools were designed to measure critical thinking in nursing practice but were characterised by items that focussed on recognising changes in a patient's condition and initiation of nursing interventions. Therefore, we developed items that reflected midwifery values and practice where the woman and midwife work in partnership and informed decision making and choice is promoted (ACM, 2011; Renfrew et al., 2014).

Content validity

Content validity was established through a two staged process which involved preliminary expert view and mapping the draft items to the concepts of critical thinking. The preliminary review of draft pool of items was conducted by two experienced midwifery researchers and an experienced midwifery practitioner. The wording of items were further refined in minor ways according to feedback received.

Mapping

The items were then tested for conceptual coherence. Items were mapped against the consensus definition of critical thinking in nursing developed by Scheffer and Rubenfeld (2000), who identified and defined 10 habits of mind (affective components) and 7 skills (cognitive components) (see Table 2). For example the item 'Explores a woman's preferences of care and plans care accordingly' was considered to measure the affective domains of contextual perspective, creativity, flexibility and open mindedness and the cognitive domains of analysing and information seeking.

This mapping ensured that all identified concepts underpinning critical thinking were reflected in the tool. The mapping identified the need for further refinement of existing items as well as development of new items as not all domains of critical thinking had been addressed. Following this mapping process, the response option for the tool was selected (Stage 3). The tool was formatted using a six point Likert scale of 1 = strongly disagree to 6= strongly agree. A six-point response option precludes equivocation (DeVellis, 2012). The draft tool contained 25 items.

Expert Review: judgement-quantification

Judgement-quantification (Stage 4) involves an evaluation of survey items by a panel of experts. The soundness of this process depends largely on the recruitment and selection of content experts (DeVellis, 2012). In the current study, eleven content experts provided a review. The experts were invited because of their (1) recognised clinical expertise, (2) academic expertise, and (3) commitment and understanding of the development of critical thinking in midwifery. The number of content experts necessary for content validity depends on the desired level of expertise and diversity of knowledge needed (Grant and Davis, 1997). A panel of 2 to 20 experts has been suggested in the literature (Gable and Wolf, 1993; Walz et al., 1991). Of the nine academics involved, mean years as an academic was 8.3 years with a range of 1-15 years. Years of experience as a midwife ranged from 8-31 years with a mean of 20.3 years. The two midwifery clinicians had a mean length of experience as a midwife of 19 years with a range of 14-24 years.

Members of the expert panel were briefed on the purpose of the study and provided with instructions. A Content Validity Index (CVI) was completed by each member of the panel to assess validity of items. Expert reviewers rated items on a scale of 1 to 4 according to relevance (1= not relevant, 2= needs major revision to be relevant, 3= needs minor revision to be relevant, 4 = relevant). They were also asked to comment on the clarity of items, identify any complex or ambiguous phrases and recommend any changes. The CVI was calculated by the proportion of items rated by experts as either 3 or 4; a CVI above 0.8 was considered to be valid (Polit and Beck, 2006). This study required nine of the eleven expert ratings to be 3 or 4, giving a minimum score of 0.8.

Item CVI scores ranged from 0.73 and 1. The CVI analysis revealed that 24 out of 25 items achieved CVI above 0.8. The one item that did not achieve the CVI cut-off score was removed. Written comments regarding the clarity of items were analysed. Ambiguous and / or complex phrases were rephrased. Following the removal of the one item, the CVI score for the total scale (average item CVI) was 0.97, representing good content validity. The draft tool had 24 items in the domains of “habits of mind”, and “skills in critical thinking” and was ready for pilot testing. The results of this pilot test are outlined below.

Survey and psychometric testing

A link to the online version of the CACTiM was distributed via email to preceptors. Paper copies of the survey were also distributed during preceptor workshops, hospital site visits, and professional meetings. Preceptors were requested to complete the tool by assessing the critical thinking skills of any 2nd or 3rd year midwifery student whom they had supervised in the current semester/term. It was estimated that 215 preceptors were invited to participate. Data was collected between November-December 2014.

Sample size

There is a lack of agreement on establishing a minimum desirable sample size for factor analysis. Sample size was calculated according to the ratio of 2, in that there were at least twice as many participants as variables for the factor analysis with a minimum 100 participants (Kline, 1979). According to Costello and Osborne (2005) uniformly high communalities without cross loadings, plus several variables loading strongly on each factor are desirable. As long as communalities are high, the number of expected factors is relatively small, and model error is low (a condition which often goes hand-in-hand with high communalities), researchers should not be overly concerned about small sample size.

Approach to analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) 22.0 (2014) personal computer version. Descriptive statistics were used to analyse characteristics of the sample and survey responses. An alpha level of 0.05 was used for all statistical tests.

Item Analysis

Higher correlation among items reflects a stronger relationship between each item and the nature of content being measured (DeVellis, 2012). Items with an average inter-item correlation of above 0.30 were considered valid.

Construct Validity

The 24 items were analysed using principal components analysis (PCA) with varimax rotation and exploratory factor analysis (Tabachnick and Fidell, 2013). First an inspection of the correlation matrix was performed to assess feasibility for factor analysis, screening for coefficients of 0.3 and above (Costello and Osborne, 2005). Prior to performing the PCA, the adequacy of data was assessed using Kaiser-Meyer-Olkin (KMO) with a recommended value of .6 (Kaiser, 1974). The Bartlett's Test of Significance (Bartlett, 1954) was used to determine the suitability of the correlation matrix. For factor analysis, the cut-off level for item values of communality was 0.45. The criterion for factor extraction was an eigenvalue >1 and item factor loading of >0.30 (DeVellis, 2012).

Subscale analysis

As a measure of internal consistency, an evaluation of each subscale extracted from the factor analysis was conducted. Correlations between factor scores and total scale score as well as the item-subscale correlation were calculated.

Internal reliability

The Cronbach's alpha coefficient is the one of the most commonly used indicators of internal consistency. A reliability coefficient of above 0.7 is ideal (DeVellis, 2012).

Findings

Participant Characteristics/Sample

A response rate of 49% (n=106 out of 215) was achieved. Preceptor midwives had qualifications ranging from certificate to Master degree. Age ranged from 26 – 64 years with a mean age of 45.6 years. This age range is representative of the Australian midwifery workforce where the average age is 48.1 years (AIHW, 2013). Most preceptors had significant clinical experience as a midwife with a mean of 15

years, ranging from 1-42 years. All respondents were female but one. Midwives practiced in a variety of settings and roles included midwives employed within a hospital setting, midwives working in caseload practice, self-employed midwives, midwifery educators and managers.

Findings of item analysis

All items had positive and statistically significant item-total correlation coefficients (Table 3). No items had an average inter-item correlation of less than 0.3 and no items were removed (DeVellis, 2012). All corrected item-total correlations were 100% positive, with corrected item total correlations between 0.674 and 0.815.

Findings of construct validity

The scale demonstrated good sampling adequacy for factor analysis. The Kaiser-Meyer-Olkin (KMO) using a r value was .930 which exceeds the recommended value of .6 (Kaiser, 1974). The Bartlett's Test of Significance (Bartlett, 1954) was statistically significant enabling factorability of the correlation matrix.

Evaluation of construct validity through principal components analysis with varimax rotation revealed the presence of three components with eigenvalues exceeding 1, explaining 59.9%, 7.1%, and 4.6% of the variance respectively (Table 3). Factor loadings of all items were sufficient (> 0.3). The three factors were named according to the underlying construct: 'partnership in care' (Factor 1); 'reflection on practice' (Factor 2); and 'practice improvements' (Factor 3). Three items (items 10, 12, 19) were spilt loaded, however from a conceptual and practical perspective a decision was made to allocate them to the factor according to their highest loading.

Internal reliability

The coefficient alpha for the total scale was .97, demonstrating good internal consistency (DeVellis, 2012). Cronbach's α coefficient for each subscale ranged from 0.90 to 0.96 (Table 3).

CACTiM (Preceptor version) scores

The mean total score for the CACTiM scale was 116.77 (SD = 16.68) with a range of 60-144. The mean item score was 4.87 (SD 0.89), with a range of 1-6. This high item mean indicated that overall preceptors assessed midwifery students as displaying a reasonably high level of critical thinking in practice. Table 4 presents a summary of the mean scores and valid percentages for all items.

Factor 1: Partnership in care

This 12 item factor had good internal reliability (Cronbach's alpha .96). The factor total mean score was 58.4 (SD = 8.8) out of a possible 72. The item mean for this factor was 4.86.

The highest scoring item in this factor was 'explores the woman's preferences of care and plans care accordingly' with a mean score of 5.21. The majority of preceptors (83%) agreed/strongly agreed that students explored women's preferences when planning care. Another high scoring item related to the student's ability to demonstrate insight into providing individualised care, with a mean score of 5.08, and 73.6% of preceptors agreed/strongly agreed with this item. The third highest scoring item related to liaison and negotiation of care with colleagues with an item mean of 4.97.

This factor also contained the lowest scoring item of the CACTiM scale of 'seeks root cause if problems arise whilst caring for the woman', with a mean item score of 4.59, and 16% of preceptors tending to disagree that students demonstrated this cognitive skill. The ability of students to explore multiple solutions to a given problem also scored less with a mean item score of 4.62, and only 59.5% of preceptors agreed/strongly agreed with this item.

Factor 2: Reflection on Practice

This seven item factor had good internal reliability (Cronbach's alpha .93). The factor total mean score was 34.5 (SD = 5.4) out of a possible 42. This factor achieved the highest mean item score of 4.92. The highest scoring item related to students debriefing following complex situations to improve practice. The majority of preceptors (84.9%) agreed/strongly agreed with this item. The item related to students initiating professional dialogue around midwifery practice also scored a high item mean score of 4.98 with 74.6% of preceptors agreeing/strongly agreeing with

this item. The lowest scoring item in this factor (mean item score 4.74) related to students recognising their attitudes, biases and values about their practice. Only 63.2% of preceptors agreed/strongly agreed with this item.

Factor 3: Practice Improvements

This five item subscale had good internal reliability (Cronbach's alpha .90). The factor total mean score was 23.9 (SD = 4.1) out of a possible 30. The item mean for this factor was 4.87. Two items scored a high mean of 5.06. The first item related to recognising inappropriate or non-evidence based practice and 75.5% of preceptors agreed/strongly agreed. Additionally, the majority of preceptors (77.4%) reported students sought clarification about interventions that were not appropriate or unnecessary. The lowest scoring item was identification of organisational improvements, with only 58.5% of preceptors agreeing or strongly agreeing that students demonstrated this skill in practice.

Discussion

This paper reports on the development of a new tool for use by preceptors to assess midwifery students' critical thinking skills in practice. The CACTiM (Preceptor/Mentor version) was found to have good reliability and validity. Analysis revealed three factors, which comprised: partnership in care, reflection on practice, and practice improvements. The CACTiM sub-scales were also tested and found to be internally reliable and theoretically and practically coherent.

The CACTiM is the first instrument specifically designed to enable preceptors to measure students' application of critical thinking in midwifery practice. The range of items attempted to reflect the multiple facets of critical thinking in practice. This tool has numerous potential applications in facilitating assessment of individual midwifery students by preceptors within the clinical curriculum; longitudinal measurement of the development of critical thinking by students throughout a midwifery education programme, and measurement of midwives' critical thinking skills in practice following graduation and commencement in practice.

The key role of a midwifery preceptor is to teach students to incorporate critical thinking when providing individualised, evidence based care to women and their families (Raisler, et al., 2003). Currently the assessment of midwifery students in

practice is largely focussed on assessment of clinical skills (ANMC, 2014). The CACTiM provides an additional framework that may assist preceptors to measure students' ability to apply critical thinking to practice, identify areas of deficit, and monitor change over time.

Partnership in Practice

The items within this factor related to critical thinking around the provision of care in partnership with women. Several items focussed on measuring students' ability to place the woman in the centre of care while respecting and facilitating her decision making. Other items pertained to students' ability to consult, collaborate and seek alternative approaches/solutions to care when problems arose. These factors are well aligned with qualities of woman centred midwifery care (Renfrew et al., 2014).

High scoring items in this factor included 'explores the woman's preferences of care and plans care accordingly' and 'demonstrates insight in providing individualised care to the woman'. This finding was reassuring as the Bachelor of Midwifery curriculum is underpinned by meta-values one of which is a woman-centred approach to care that promotes informed choice where the woman's rights around decision making are prioritised, promoted and respected (Sidebotham, et al., 2015; Bass, et al., 2015).

Items that scored less than the factor mean included, 'seeks the root cause if problems arise whilst caring for the woman' and 'effectively explores multiple solutions to a given situation'. Both concepts involve high level critical thinking skills and decision making. These findings are supported by Jefford and Fahy (2015) who found a lack of decision making skills in the narratives of over half of practising midwives in their study, which may adversely affect the safety and effectiveness of midwifery practice. Further teaching strategies to exemplify problem solving skills in complex situations may be required for students, as well as continuing professional development activities for preceptor midwives.

Reflection on Practice

Items within this factor related to students' ability to critically reflect on their own practice and identify strengths, limitations and practice improvements. The highest

item mean for the CACTiM was achieved for 'debriefs with a professional colleague following complex situations to improve future practice'. Reflection and critical thinking are encouraged in midwifery and nursing practice, where reflection on rich clinical experience facilitates critical thinking development (Kennison, 2006). The high mean on this item is not surprising considering the focus of the curriculum on reflection. Students submit three written reflective pieces each semester with a focus on identification of individual practice improvements. This ongoing emphasis on reflection appears to be subsequently demonstrated in students' clinical practice and may explain the high ratings by preceptors.

Practice Improvements

Items within this factor related to identification of possible practice improvements of self, others, and/or the organisation. The highest item mean in this factor related to recognising inappropriate practice, that may be non-evidence based or non-woman centred. This item was designed to measure students' ability to critically examine practice and assess appropriateness. A students' ability to apply standards to practice is also recognised as an essential component of critical thinking (Scheffer and Rubenfeld, 2000).

One of the lowest scoring items was 'identifies organisational/service improvement opportunities'. This item was designed to measure students' ability to use critical thinking to identify practice or system improvements. Challenging practices or processes can be difficult for students as they tend to want to conform to the expectations of the organisation in an attempt to fit-in (Begley, 2001). However, the implementation of quality improvement initiatives is a vital process to continually refine existing practices and systems to promote safe care (Cronenwett et al., 2007). The introduction of an assessment item specifically designed to encourage students to identify practice improvements may be beneficial to foster their ability to bring about cultural change in the future as clinicians.

Implications for education, research, and practice.

The CACTiM has utility for education, future research, and practice. Given the importance of critical thinking skills for midwifery practice, mapping and assessing

critical thinking development in practice across the course of a degree programme is vital. Furthermore, a formative approach to measuring the development of critical thinking over time is important to determine the efficacy of teaching approaches and identify potential areas in need of improvement to promote students' cognitive capacities (Carter et al., 2015). It is anticipated that once a valid and reliable tool is developed, preceptors will share their assessment with students in a formative process and use the tool as a point of discussion and learning to enhance critical thinking in practice.

It is possible that some clinicians may not know the elements of critical thinking. Just as students were not aware of strategies used to develop critical thinking in curricula (Lake and McInnes 2012), some clinicians in a preceptor role may also give limited consideration to developing students' critical thinking abilities. The use of the CACTiM may be useful to clinicians in their preceptor role by providing explicit cues about evidence of students' critical thinking in practice. There may also be the potential for preceptors to use the cues to reflect on their own use of critical thinking and this process may lead to professional development opportunities for midwives in practice. Jefford and Fahy (2015) identified the need for midwives to apply cognitive processes to guide decision making in clinical practice. Use of the CACTiM tool by preceptors to assess students in practice may foster self-review about their practice.

Preceptorship plays a critical role in developing critical thinking in students (Myrick and Yonge, 2004). The tool may also provide feedback to preceptors on the effectiveness of their role in teaching and developing students' ability to assess clinical situations and respond appropriately. Students learn critical skills through observation of their preceptor who ideally 'thinks aloud' to make their thinking processes explicit (Myrick, 2002). As a student's critical thinking skills may to some extent reflect the level of critique demonstrated by their preceptors, it is essential to provide guidance to preceptors to promote their own development and that of students.

Although the CACTiM demonstrated sound reliability and validity, further research is required. The tool needs to be validated with different cohorts of preceptors supporting students undertaking different curricula and working across different

practice settings. Results of such studies would not only validate the tool, but allow for international comparisons and guide the development of curricula and teaching strategies in different countries. The extent to which preceptors need training and support to effectively use the tool also needs to be investigated.

Limitations

The results of this study need to be considered in light of limitations. Although a response rate of 49% was acceptable for an anonymous survey, the findings may not reflect the views of all preceptors involved in the programme. It could be that preceptors who perceived they worked effectively with a certain student may have been more likely to respond. The sample was also relatively homogeneous with preceptors commenting on the clinical performance of students enrolled in one Australian University. Although testing indicated that the sample size was adequate, replication of this study with a larger, diverse sample of preceptors is recommended to confirm the reliability and validity of the tool.

Results may have also been influenced by recall bias. Preceptors were asked to think about the performance of a particular student and may have recalled certain aspects more positively than was really the case. Furthermore, given that the preceptors knew the survey was assessing students' critical thinking skills, the preceptor may have been inclined to choose a high performing student. A predominance of reports on high-performing students may have skewed results, highlighting the need for further research with diverse student groups.

Ideally, the CACTiM should be provided to preceptors at the commencement of the student's placement. The completed tool could then be used as a guide for feedback and a teaching tool between preceptor and student as well as a research measure of critical thinking development.

In the absence of a freely available tool to assess students' critical thinking abilities in practice, it was not possible to establish concurrent validity. Future research could compare results on the CACTiM to standardised measures of critical thinking related to the health sciences such as the Health Services Reasoning Test (Facione, et al., 2010) or a general measure such as the Watson-Glaser Critical Thinking Appraisal (Watson and Glaser, 1980).

The reliability of this tool may be affected by the subjectivity of the tool as it solely relies on preceptors' perceptions of students' critical thinking abilities. A multi-method approach and triangulation of data may improve validity, reliability, and insight into CT development. This may include measuring students own perceptions of their CT. Furthermore, Kennison (2006) suggests that reflection and critical thinking are intrinsically linked in nursing practice and that students' reflections are ideally placed to measure CT. A combination of these methods may improve assessment of midwifery students CT skills.

As the nature of critical thinking is complex and multidimensional, exploring students' abilities using the CACTiM may not reflect all views. Even though the items were informed from a variety of sources such as a critical review of the literature and the consensus definition of critical thinking in nursing developed by Scheffer and Rubenfeld (2000), some respondents may have different perspectives not reflected in the CACTiM.

Conclusion

Assessing the development of critical thinking of undergraduate midwifery students is important. Preceptors are ideally situated to assess critical thinking skills of midwifery students' performance in practice. This initial analysis suggests the CACTiM (Preceptor version) is a reliable and valid tool for this purpose. The tool could be utilised over time to assess development of critical thinking in practice or as a single measure. It is recognised that this tool only measures preceptors' perception of midwifery students' critical thinking in practice. Considering the complexity of critical thinking in midwifery practice robust measurement requires a multi-method approach.

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Table 1 Approach to development and testing procedures

Aim	Analyses	Approach
Content validity	Items mapped against consensus definition of critical thinking in nursing Item content validity index (CVI) score for each item Average item CVI score for total scale	Process to ensure content validity Items with a low CVI score <0.8 were deleted
Item analysis (item-total/item-subscale/subscale-total correlation)	Pearson product-moment correlation	Items with low item-total correlation 0.3 deleted
Construct validity	Exploratory factor analysis (principal component analysis)	Sample adequacy for factor analysis: Kaiser Meyer Olkin using an r value (0>.6). Suitability of data for factor analysis; Bartlett's sphericity test (p<0.05). Variance described by each factor; eigenvalue >1. Factors should explain 50-60% of total variance. Factor loadings > 0.30
Internal reliability (for total scale and subscales)	Cronbach's coefficient	α 0.60-0.79 good, 0.80-1.00 high reliability

Ref: Adapted from Gungor and Beji (2012)

Table 2: Consensus definition of critical thinking in nursing

Habit	Definition
Confidence	Assurance of one's reasoning abilities
Contextual perspective	Considerate of the whole situation, including relationships, background and environment, relevant to some happening
Creativity	Intellectual inventiveness used to generate, discover, or restructure ideas, imagining alternatives
Flexibility	Capacity to adapt, accommodate, modify or change thoughts, ideas and behaviours
Inquisitiveness	An eagerness to know by seeking knowledge and understanding through observation and thoughtful questioning in order to explore possibilities and alternatives
Intellectual Integrity	Seeking the truth through sincere, honest processes, even if the results are contrary to one's assumptions and beliefs
Intuition	Insightful sense of knowing without conscious use of reason
Open-mindedness	A viewpoint characterised by being receptive to divergent views and sensitive to one's biases
Perseverance	Pursuit of a course with determination to overcome obstacles
Reflection	Contemplation upon a subject especially one's assumptions and thinking for the purpose of understanding and self-evaluation
Skill	
Analysing	Separating or breaking a whole into parts to discover their nature, function and relationships
Applying Standards	Judging according to established personal judgement, professional or social rules or criteria
Discriminating	Recognising differences and similarities among things or situations and distinguishing carefully as to category or rank
Information Seeking	Searching for evidence, facts and knowledge by identifying relevant sources and gathering objective, subjective, historical, and current data from these sources
Logical Reasoning	Drawing inferences or conclusions that are supported in or justified by evidence
Predicting	Envisioning a plan and its consequences
Transforming Knowledge	Changing or converting the condition, nature, form, or function of concepts among contexts

Ref: Scheffer and Rubenfeld (2000, p358)

Table 3: Factor summary of the CACTiM (Preceptor/Mentor version) scale

			Item Analysis			Construct validity (factor analysis)			Internal reliability Cronbach's α
		Number of Items	Item-total correlation range	Item sub-scale correlation range	Subscale – total correlation range	Eigenvalue	% explained variance	Loading range	
Factor 1	Partnership in Care	12	0.38-0.81	0.54-0.81	0.95	14.37	59.86	0.42-0.96	0.96
Factor 2	Reflection on Practice	7	0.38-0.87	0.45-0.87	0.88	1.11	4.62	0.35-0.88	0.90
Factor 3	Practice Improvements	5	0.38-0.77	0.57-0.77	0.87	1.70	7.08	0.65-0.95	0.93

Table 4: Proportion of preceptor responses on each item and item mean

Factors and items	Strongly Disagree %	Disagree %	Tend to Disagree %	Tend to Agree %	Agree %	Strongly Agree %	Mean Score
Factor 1 – Partnership in Care							
Explores the woman's preferences of care and plans care accordingly			3.8	13.2	48.1	34.9	5.14
Sequences care and education to meet the individual needs of the woman			2.8	30.2	40.6	26.4	4.91
Suggests relevant literature and education strategies to facilitate the woman's decision making			8.5	25.5	41.5	24.5	4.82
Shares relevant evidence and clinical guidelines related to the woman's individual choices			10.4	21.7	45.3	22.6	4.80
Uses evidence to plan care according to the woman's individual circumstances		.9	3.8	21.7	47.2	26.4	4.94
Demonstrates insight in providing individualised care to the woman			2.8	23.6	36.8	36.8	5.08
Liaises and negotiates with colleagues at different levels about processes to optimise outcomes for the woman			9.4	16.0	42.5	32.1	4.97
Consults and utilises resources (e.g. literature, guidelines, etc.) to improve care for the woman			7.5	19.8	45.3	27.4	4.92
Seeks the root cause if problems arise whilst caring for the woman			16.0	22.6	47.2	14.2	4.59
Effectively explores multiple solutions to a given situation			11.3	29.2	45.3	14.2	4.62
Demonstrates an understanding of the rationale for following (or departing from) established guidelines and policies		0.9	10.4	20.8	44.3	23.6	4.79
Where needed, negotiates a collaborative intervention plan with relevant health care providers			9.4	24.5	43.4	22.6	4.79
Mean Item Score for Factor 1							4.86
Factor 2 – Reflection on Practice							

Analyses own strengths and limitations in skills, knowledge and experience		.9	1.9	25.5	44.3	27.4	4.94
Addresses own limitations in skills, knowledge and experience		.9	4.7	22.6	43.4	28.3	4.92
Initiates professional dialogue around midwifery practice			3.8	21.7	47.2	27.4	4.98
Evaluates own practice and its effect on the woman and others	.9	.9	11.3	18.9	41.5	26.4	4.78
Adjusts own practice based on feedback from the woman and others		1.9	6.6	23.6	43.4	24.5	4.82
Recognises own attitudes, biases and values and their potential impact on practice	.9	.9	9.4	25.5	38.7	24.5	4.74
Debriefs with a professional colleague following complex situations to improve future practice			1.9	13.2	39.6	45.3	5.28
Mean Item Score for Factor 2							4.92
Factor 3 Practice Improvements							
Recognises non-evidence based or non- woman centred practice by self and others		.9	4.7	18.9	38.7	36.8	5.06
Voices concerns about non-evidence based or non- woman centred practices by self and others			6.6	25.5	39.6	28.3	4.90
Identifies organisational/service improvement opportunities	.9	.9	12.3	27.4	39.6	18.9	4.60
Seeks clarification about interventions that appear inappropriate or unnecessary			3.8	18.5	45.3	32.1	5.06
Questions the 'unwritten rules' in midwifery practice that are not evidence- based		.9	11.3	22.6	41.5	23.6	4.75
Mean Item Score for Factor 3							4.87