



Measuring critical thinking in pre-registration midwifery students: A multi-method approach

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ABSTRACT

Objective: Test the concurrent validity of three newly developed tools (student self-rating, preceptor rating, and reflective writing) that aim to measure critical thinking in midwifery practice.

Design: A descriptive matched cohort design was used.

Setting: Australian research intensive university offering a three year Bachelor of Midwifery programme.

Sample: Fifty-five undergraduate midwifery students.

Methods: Students assessed their ability to apply critical thinking in midwifery practice using a 25-item tool and a 5-item subscale in Motivated Strategies for Learning Questionnaire. Clinical preceptors completed a 24-item tool assessing the students' application of critical thinking in practice. Reflective writing by students was assessed by midwifery academics using a 15-item tool. Internal reliability, and concurrent validity were assessed. Correlations, *t*-tests, multiple regression and confidence levels were calculated for the three scales and associations with student characteristics.

Results: The three scales achieved good internal reliability with a Cronbach's alpha coefficient between 0.93 and 0.97. Matched total scores for the three critical thinking scales were moderately correlated; student/preceptor ($r = 0.36, p < 0.01$); student/reflective writing ($r = 0.38, p < 0.01$); preceptor/reflective writing ($r = 0.30, p < 0.05$). All critical thinking mean scores were higher for students with a previous degree, but only significant for reflective writing ($t(53) = -2.35, p = 0.023$). Preceptor ratings were predictive of GPA ($\beta = 0.50, p < 0.001, CI = 0.10$ to 0.30). Students' self-rating scores were predictive of year level ($\beta = 0.32, p < 0.05, CI = 0.00$ to 0.03).

Conclusion: The student, preceptor, and reflective writing tools were found to be reliable and valid measures of critical thinking. The three tools can be used individually or in combination to provide students with various sources of feedback to improve their practice. The tools allow formative measurement of critical thinking over time. Further testing of the tools with larger, diverse samples is recommended.

1. Introduction

The provision of midwifery care is unique, multifaceted and complex and hence requires high level technical and cognitive abilities. There is increasing recognition that midwifery care leads to optimisation of outcomes for women and newborns (Renfrew et al., 2014; ten Hoope-Bender et al., 2014). To achieve these optimal outcomes, midwives are required to provide evidence-based, safe, and individualised care in partnership with women (Mènage, 2016a; Jefford et al., 2010). Hence, midwives need well developed cognitive skills to apply critical thinking in decision making using intellectual independence. However, there is limited literature focussing on thinking processes in midwifery practice (Mong-Chue, 2000).

Critical thinking involves in-depth and higher order thinking that facilitates knowledge development, contextual decision making and problem solving skills, and analyses situations from different perspectives (Facione and Facione, 1996). Contextually appropriate decision-making is key to the provision of high quality and safe midwifery care (Jefford, 2012), and critical thinking is a crucial cognitive skill in reaching sound professional judgements.

Midwifery decision making is holistic and made in partnership with women, requiring significant interpersonal skills, whilst acknowledging and valuing the woman's autonomy to make informed choices (Davis-Floyd, 2004; Mènage, 2016b; Jefford et al., 2010). Decisions need to be based on the best available evidence, however, whilst evidence, and the production of clinical guidelines, protocols and care pathways are

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proliferating, uncertainty remains regarding 'best practice' in many scenarios (Scholes et al., 2012). In addition, not all clinical guidelines or protocols are based on the best available evidence, and may be out-of-date (Mènage, 2016b; Prusova et al., 2014). Similarly, there may be institutional barriers to the overt use of best practice guidelines, potentially limiting the midwife's capacity to use those guidelines to inform decision making (Toohill et al., 2017).

In order to provide safe quality care midwives need to critically appraise all of the evidence available and assess the quality and relevance to the woman and her situation. Whilst available evidence and clinical guidelines are important resources, they need to be considered in conjunction with the woman's preferences, values and beliefs as well as the midwife's intuitive knowledge. Intuitive decision making is commonly used by highly experienced midwives who rely on pattern recognition and heuristics based on prior experience (Steinhauer, 2015). In addition, a key part of midwifery decision making is self-awareness, where the midwife reflects on their own knowledge and skills and identifies gaps, and alternative approaches or expertise needed (Mènage, 2016b).

The development and measurement of critical thinking skills in undergraduate midwifery students is vital to ensure they are able to apply critical thinking to practice and decision making. Measurement of this cognitive skill can highlight areas for development and provide academics with feedback on the efficacy of their teaching practices. Currently the measurement of critical thinking in nursing and midwifery is inconsistent or neglected (Walsh and Seldomridge, 2006). Critical thinking tools used for midwifery students need to encompass the uniqueness of midwifery decision making, be meaningful, purposeful and ultimately promote improvement in practice.

2. Background/Literature

The most commonly used measures to evaluate critical thinking abilities are standardised, commercially available tools such as the California Critical Thinking Skills Test (CCTST), California Critical Thinking Disposition Inventory (CCTDI), Health Sciences Reasoning Test (HSRT) and Watson-Glaser Critical Thinking Appraisal (WGCTA). These tools focus on the measurement of formal logic and general thinking skills, utilising a multiple-choice format. In a recent systematic review evaluating tools used to measure critical thinking development in nursing and midwifery undergraduate students, of the 34 studies reviewed 21 utilised one of these standardised tools (Carter et al., 2015). The review authors found variation of reported reliability across studies using the same measure, placing doubt about the reliability of these tools when used with nursing and midwifery students. In a further systematic review of the literature evaluating the efficacy of teaching methods used to develop critical thinking skills in nursing and midwifery undergraduate students, inconsistent results were found when testing similar interventions with these tools (Carter et al., 2016a).

Several authors have attempted to develop discipline-specific tools to measure critical thinking in nursing, but a review of these tools revealed limited reporting of reliability and psychometric testing (Carter et al., 2015). No discipline specific tools that measure critical thinking in midwifery practice were found at that time.

Several authors expressed concern about the absence of discipline specific tools that capture the complexity, richness and multi-dimensional nature of critical thinking in nursing and midwifery practice (Carter et al., 2015; Jacob et al., 2017; Paul, 2014; Zuriguel-Pérez et al., 2015, 2017). This complexity of critical thinking is even more paramount in midwifery, where midwives are recognised as partners in care which is holistic, woman centred, and promotes shared decision making (Carter et al., 2017a; Davis-Floyd, 2004; Jefford et al., 2010).

The application of critical thinking in nursing and midwifery practice is complex, and multiple lenses are required to capture its' depth and breadth (Carter et al., 2015; Raymond-Seniuk and Profetto-

McGrath, 2011; Rubenfeld and Scheffer, 2015). The use of multiple reliable and valid measures and triangulation of data would more likely capture the complex and multi-faceted nature of critical thinking in midwifery. Valid and reliable tools are needed to measure the development and refinement of students' critical thinking in practice. The current study reports on the reliability and concurrent validity of three new tools designed to measure critical thinking skills in pre-registration midwifery students.

3. Methods

3.1. Design

A descriptive, matched, cohort design was used.

3.2. Setting

The Bachelor of Midwifery programme at Griffith University in Australia has a strong woman-centred, values-based philosophy. The programme is delivered within a transformative educational framework. Aligned with the Australian Qualifications Framework, two of the core aims of the Bachelor of Midwifery programme are to produce graduates who have highly developed critical thinking skills, and are critically reflective and reflexive practitioners (Australian Qualifications Framework Council, 2013). Teaching, learning and assessment strategies in relation to critical thinking development are embedded and scaffolded throughout the three-year degree.

Students complete up to 1800 clinical placement hours primarily at one site (hospital or private midwifery practice) for the duration of their degree. Students undertake two to three shifts per week in an integrated clinical placement model which facilitates the consolidation of learning in one organisation, and enables the development of meaningful relationships with midwifery staff and preceptors. The preceptor role involves the facilitation, monitoring, support and assessment of students' learning and progress during clinical placement. Midwifery preceptors are supported by university-employed onsite practice lecturers.

Students produce three structured pieces of reflective writing per semester related to clinical events. The reflective writing pieces are uploaded by the student into an online e-portfolio and midwifery lecturers provide feedback. Students use the Bass Model of Holistic Reflection (Bass et al., 2017), which encompasses six inter-dependent phases; self-awareness, description, reflection, influences on knowing, evaluation and learning to guide their reflective writing. To encourage the development of reflection and transformational learning, students are provided with guidelines and prompts for each phase of the model (Bass et al., 2017).

3.3. Sample/Participants

The sample consisted of students enrolled in the Bachelor of Midwifery programme who had completed at least one semester of clinical placement and completed the self-rating tool ($n = 85$).

4. Measures

Development and initial testing of the student self-rating tool (Carter et al., 2017a), preceptor rating (Carter et al., 2016b) and reflective writing (Carter et al., 2017b) have been described elsewhere. In summary, tool development followed the staged model recommended by DeVellis (2017). During the tool development, items were tested for conceptual coherence, and mapped against the consensus definition of critical thinking in nursing developed by Scheffer and Rubenfeld (2000). Content validity for each tool was established using a judgement-quantification review process by an expert panel. Items with a Content Validity Index score of < 0.7 were deleted. Each tool was

administered to a convenience sample and psychometric testing was performed to establish construct validity and reliability. A brief description of each tool is outlined below.

4.1. Student Self-rating Tool

The student self-rating tool was designed for pre-registration students to self-assess their critical thinking skills in midwifery practice. The 25 items require responses on a 6 point Likert scale of 1 = strongly disagree to 6 = strongly agree. The total possible maximum score is 150. An example of items include, 'I question the 'unwritten rules' in midwifery practice that are not evidence-based' and 'I choose relevant literature and education strategies to facilitate the woman's decision making'.

Psychometric testing of the student self-rating tool indicated good internal reliability with a Cronbach's alpha coefficient of 0.92 (Carter et al., 2017a). Exploratory factor analysis revealed four factors which were named according to the underlying construct: 'seeks information', 'reflects on practice', 'facilitates shared decision making' and 'evaluates practice'. Cronbach's alpha coefficients for the factors ranged from 0.73 to 0.88, (Carter et al., 2017a).

4.1.1. Motivated Strategies for Learning Questionnaire

Construct validity of the student self-rating tool was tested using a five-item subscale of the Motivated Strategies for Learning Questionnaire (MSLQ) (OERI/DE, 1991). The MSLQ has been extensively tested and validated, has a reported Cronbach's alpha of 0.80, and subscales can be used collectively or singularly (Credé and Phillips, 2011; Garcia Duncan and McKeachie, 2005). The five-item subscale aims to assess students' critical approach to learning. Examples of items include, 'I often find myself questioning things I hear or read in this programme to decide if I find them convincing'; and 'I treat the course material as a starting point and try to develop my own ideas about it'.

4.2. Preceptor Rating Tool

The preceptor rating tool was designed for use by preceptors (mentors) to measure the extent to which undergraduate midwifery students apply critical thinking in the practice context. The scale contains 24 items on a six point Likert scale, of 1 = strongly disagree to 6 = strongly agree. The total possible maximum score is 144. Examples of items include, 'Uses evidence to plan care according to the woman's individual circumstances', and 'Effectively explores multiple solutions to a given situation'.

Testing with a convenience sample indicated good internal reliability with a Cronbach's alpha coefficient of 0.97 (Carter et al., 2016b). Exploratory factor analysis revealed three factors which were named according to the underlying construct: 'partnership in care', 'reflection on practice', and 'practice improvements'. Cronbach's alpha coefficients for the factors ranged from 0.90 to 0.96.

4.3. Reflective Writing Tool

The reflective writing tool measures the extent to which students think critically in their reflective writing. The 15-item scale, intended for use by academics, uses a five point Likert scale of 1 = not at all to 5 = to a great extent. The total maximum possible score is 75.

Testing the tool on 100 pieces of reflective writing indicated good internal reliability with a Cronbach's alpha coefficient of 0.93 (Carter et al., 2017b). Two independent raters established good inter-rater reliability, with a Kappa coefficient $K = 0.43$ ($p < 0.0001$) (Carter et al., 2017b). Exploratory factor analysis revealed three factors: 'analyses context', 'reasoned inquiry', and 'self-evaluation', with Cronbach's alpha coefficients ranging from 0.77 to 0.91 for these subscales. Examples of items include, 'Critically analyses the quality of the literature and its' relevance to the individual woman's situation' and 'Explores

alternative approaches to the situation'.

5. Procedure

As part of an initial pilot study, 85 students completed the student-rated survey and MSLQ, which included demographic data including sex, age, year level, previous qualifications, and current Grade Point Average (GPA). During the same time period, 106 clinicians completed the preceptor rating tool on students' application of critical thinking in practice (Carter et al., 2016b); and 100 pieces of reflective writing by students were analysed (Carter et al., 2017b). Reflective writing pieces were submitted during July–November 2014. Completion of student and preceptor tools occurred in November–December 2014.

The measurement of critical thinking development where the three critical thinking tools were completed assessing one student, could be matched for 55 students. Matching could occur because names were provided by both the preceptor (to identify the student they were assessing) and the student themselves (to receive feedback on their critical thinking development). Students and preceptors were informed that for research purposes their responses would be anonymised using a code and results would be reported in a group aggregate form. Archived pieces of reflective writing by students were matched to student and preceptor surveys, coded, and de-identified prior to analysis.

5.1. Ethical Considerations

Ethical approval for the study was granted by the Human Research Ethics Committee of Griffith University.

5.2. Approach to Analysis

The Statistical Package for the Social Sciences (SPSS) 24.0 (2016) personal computer version was utilised to analyse data. Descriptive statistics were used to analyse characteristics of the sample and survey responses. Internal consistency of each scale and factors was assessed using Cronbach's alpha coefficient. Total and factor scores were calculated. Pearson's correlation and *t*-tests were used. Multiple regression analysis was conducted to identify the impact of critical reflection on academic outcomes (GPA and year level). Confidence intervals were calculated. An alpha level of 0.05 was used for all statistical tests.

6. Data/Results

6.1. Participant Characteristics/Sample

Matched data were available for 55 (64.7%) students from the cohort of 85, who completed the student survey. All students were female with an average age of 30.75 (SD = 7.038, range 20–55 years). Approximately half (50.9%, $n = 28$) of the students were in year three and the remainder (49.1%, $n = 27$) were in year two. Around 50% (50.9%, $n = 28$) of students had completed a previous Bachelor's Degree, with 7.3% ($n = 4$) having completed post-graduate qualifications in disciplines other than midwifery. Students had a relatively high GPA with an average of 5.41 (SD = 7.04, range 4.17–6.94) out of a possible 7. A grade of 4 generally indicates a passing grade.

6.2. Student Self-rating Tool Results

The mean total score for the student self-rating scale was 129.33 (SD = 10.905) with a range of 104–147. The mean item score was 5.17 out of 6. This high item mean indicated that students considered they applied a reasonably high level of critical thinking in their midwifery practice. Table 1 presents a summary of the total and subscale means. The coefficient alpha for the total scale was 0.93, demonstrating good internal consistency (DeVellis, 2017). Cronbach's alpha coefficient for the subscales ranged from 0.75 to 0.90 (see Table 1).

Table 1
Internal reliability of 3 tools.

	Factor names	Factor Cronbach's α	Scale Cronbach's α	Mean scores for each subscale	Total mean score (possible max score)
Student self-rating	Seeks information	0.83	0.93	5.11	129.33 (150)
	Reflects on practice	0.77		5.16	
	Facilitates shared decision making	0.90		5.41	
	Evaluates practice	0.75		5.01	
MSLQ	Critical Thinking	0.80	0.80	4.6	22.83 (30)
	Partnership in care	0.96		4.92	
Preceptor rating	Reflection on practice	0.94	0.97	4.98	118.91 (144)
	Practice improvements	0.92		5.0	
	Explores context	0.91		3.6	
Reflective writing	Reasoned inquiry	0.88	0.93	3.0	50.36 (75)
	Self-evaluation	0.85		3.5	

6.3. Preceptor Rating Tool Results

The mean total score for the preceptor scale was 118.91 (SD = 16.77) with a range of 80–144. The mean item score was 4.96 out of 6. Although still high, this mean indicated that preceptors rated students' ability to apply critical thinking in midwifery practice slightly lower than students themselves. Table 1 presents a summary of total and subscale means. The alpha coefficient for the total scale was 0.97, demonstrating good internal consistency (DeVellis, 2017). Cronbach's alpha coefficient for the subscales ranged from 0.92 to 0.96 (see Table 1).

6.4. Reflective Writing Tool Results

The mean total score for the reflective writing scale was 50.36 (SD = 13.70) with a range of 21–72. The mean item score was 3.6 out of 5. This mean is slightly higher than found in the original pilot of the tool (Carter et al., 2017b). Table 1 presents a summary of the total and subscale means. The alpha coefficient for the total scale was 0.93, demonstrating good internal consistency (DeVellis, 2017). Cronbach's alpha coefficient for the subscales ranged from 0.85 to 0.91 (see Table 1).

6.5. Concurrent Validity

To examine concurrent validity, the relationship between the mean scores of the student and preceptor rating tool was investigated using Pearson product-moment correlation coefficient. There was a moderate correlation found between these two scales ($r = 0.36, p < 0.01$). Cohen (1988) suggests an r value between 0.30 and 0.49 is indicative of a medium effect. Student and reflective writing scores revealed a moderate correlation ($r = 0.38, p < 0.01$). Finally, preceptor and reflective writing scores also revealed a moderate correlation ($r = 0.30, p < 0.05$). See Table 2.

MSLQ and student self-rating scores were investigated using Pearson product-moment correlation coefficient. A moderate correlation was found between these two scales ($r = 0.38, p < 0.01$). Further testing also revealed moderate correlations between MSLQ and preceptor tool scores ($r = 0.35, p < 0.01$). The correlation between the MSLQ and reflective writing tool was small but not significant ($r = 0.29, p = 0.078$). See Table 2.

6.6. Associations Between Critical Thinking Scores and Student Characteristics

Pearson's product-moment correlation coefficient identified a large correlation between preceptor scores and GPA ($r = 0.51, p < 0.01$). A small correlation was also found between reflective writing scores and GPA ($r = 0.26, p = 0.05$). No relationship was found between student self-rating scores and GPA. See Table 2.

Multiple regression analysis assessed the extent to which student,

Table 2
Correlations between tools and student characteristics.

	r Value	p
Student self-rating/preceptor rating	0.36	0.007*
Student self-rating/reflective writing	0.38	0.004*
Preceptor rating/reflective writing	0.30	0.03**
Student self-rating/MSLQ	0.38	0.004*
Preceptor rating/MSLQ	0.35	0.009*
Reflective writing/MSLQ	0.34	0.078
Student self-rating/GPA	0.130	0.35
Preceptor rating/GPA	0.51	0.000*
Reflective writing/GPA	0.26	0.05**
Student self-rating/year level	0.30	0.03**
Preceptor rating/year level	0.30	0.03**
Reflective writing/year level	-0.31	0.82

* Significant at the 0.01 level.
** Significant at the 0.05 level.

preceptor, and reflective writing scale scores predicted students' GPA. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. A significant regression equation was found ($F(3,51) = 6.63, p = 0.001, \text{adjusted } R^2 = 0.27$). Only preceptor ratings were found to be predictive of GPA ($\text{beta} = 0.50, p < 0.001, \text{CI} = 0.10 \text{ to } 0.30$). See Table 3.

Moderate correlations were found between both student scores and year level ($r = 0.30, p < 0.05$) and preceptor scores and year level ($r = 0.30, p < 0.05$). No correlation was found between reflective writing scores and year level. See Table 2.

Multiple regression analysis assessed the extent to which individual student, preceptor, and reflective writing scale scores predicted students' year level. Preliminary analyses indicated no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. A significant regression equation was found ($F(3,51) = 3.31, p < 0.05, \text{adjusted } R^2 = 0.11$). Only student scores were found to be predictive of year level ($\text{beta} = 0.32, p < 0.05, \text{CI} = 0.00 \text{ to } 0.03$). See Table 4.

Table 3
Regression of critical thinking scores on GPA.

	GPA			95% confidence intervals for beta	
	Adjusted R^2	Beta	p	Lower bound	Upper bound
Student scores	0.27	-1.1	0.417	-0.25	0.10
Preceptor scores		0.50	0.000*	0.10	0.30
Reflective writing scores		0.16	0.229	-0.05	0.26

* Significant at the 0.01 level.
** Significant at the 0.05 level.

Table 4
Regression of critical thinking scores and year level.

	Year level			95% confidence intervals for beta	
	Adjusted R ²	Beta	p	Lower bound	Upper bound
Student scores	0.11	0.32	0.031**	0.00	0.03
Preceptor scores		0.21	0.142	-0.00	0.01
Reflective writing scores		-0.23	0.105	-0.02	0.00

* Significant at the 0.01 level.

** Significant at the 0.05 level.

An independent samples *t*-test found that students who had completed a previous degree had higher mean critical thinking scores on each tool. However, this increase was significant only for reflective writing scores for students who possessed a previous degree ($M = 54.41, SD = 11.26$) compared to those who did not ($M = 45.96, SD = 15.49$) ($t(53) = -2.35, p = 0.023$, two tailed). The magnitude of mean difference (mean difference = 8.45, 95% CI, -15.68 to -1.22) was moderate (eta squared = 0.09). Cohen (1988) suggests an eta squared value between 0.06 and 0.14 is indicative of a moderate effect. See Table 5.

7. Discussion

The three tools (student self-rating, preceptor rating and reflective writing) and subscales were found to have good reliability and validity. Concurrent validity which estimates the individual performance on different tests at the same time (DeVellis, 2017), was established producing moderate correlations between all scales.

Positive correlations were also found between the MSLQ subscale and the preceptor and student tools. The items within this MSLQ subscale relate to the ways students apply previous knowledge to new situations in problem solving, make decisions, or make critical evaluations in their approach to learning (Credé and Phillips, 2011). The MSLQ is a widely utilised and validated tool. Comparing the new critical thinking tools with the MSLQ helped to establish concurrent validity.

A large correlation was found between GPA and the preceptor scores, with a small correlation found with the reflective writing scores. A number of studies examining nursing students' critical thinking scores also found a positive correlation between GPA and critical thinking scores when using standardised measurement tools such as CCTST (Bowles, 2000; Kennison, 2006) and HRST (Pitt et al., 2015). The current findings are encouraging and indicate that preceptor's assessment of student's critical thinking in practice accurately reflects their academic performance.

Student year level and student and preceptor critical thinking scores were positively related, with student scores predictive of year level. This finding is not surprising, indicating that students' critical thinking developed as they progressed through the degree programme. However,

Table 5
t-Tests of previous qualifications and critical thinking scores.

Scale	Group						95% CI for mean difference			
	Previous degree			No previous degree			<i>t</i>	<i>p</i>	<i>df</i>	
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>				
Student scores	131.93	10.34	32	126.26	10.89	23	-11.51, 0.15	-1.95	0.056	53
Preceptor scores	121.22	16.95	32	112.35	18.02	23	-18.41, 0.67	-1.87	0.068	53
Reflective writing scores	54.41	11.26	32	45.96	15.49	23	-15.68, -1.22	-2.35	0.023*	53

* $p < 0.05$.

the poor correlation between year level and reflective writing scores was unexpected, as it was assumed that with appropriate feedback on regular reflections, these skills would improve. This finding may indicate that greater depth and breadth of feedback is required. However, it is acknowledged that the reflective writing pieces analysed were formative assessments and not graded which may have affected students' prioritisation and effort expended on this task (Carter et al., 2017b). Findings related to year level also need to be considered with caution due to the small sample and inclusion of only two year groups (2nd and 3rd year). Testing with a larger, more diverse sample is recommended. It would also be useful to test the reflective writing tool on graded assessment and evaluate the difference in critical thinking scores.

Positive correlations were found between reflective writing scores and previous qualifications. This finding may be explained by the likelihood that students were exposed to the concepts of reflection in their previous studies and familiar with the format, writing style and level of critical reflection required. Indeed, the use of reflection as a teaching and assessment strategy is frequently noted in the broader education and health professional education literature (Mann et al., 2009).

The concurrent use of the three tools provides a multifaceted measurement of students' critical thinking in midwifery practice. This multi-method approach provides feedback to the student from three different sources (self, preceptor and midwifery academic). Through self-assessment, students have opportunities to reflect on their own practice and learn more about critical thinking in midwifery practice because the items provide explicit examples of good practice. The preceptor tool can also facilitate formative feedback to students if used as a point of discussion and identification of strategies to enhance critical thinking in practice. The reflective writing tool provides students with objective formative feedback on their critical thinking from teaching staff as they deconstruct challenging and complex clinical scenarios.

Best midwifery practice is characterised by the use of quality evidence, combined with and balanced by women's preferences and choices, along with expert judgement based on well-developed critical thinking skills (Fullerton and Thompson, 2005). Midwifery critical thinking and decision making also encompasses the use intuitive knowledge (Steinhauer, 2015), along with reflection and self-awareness (Ménage, 2016b).

The measurement of critical thinking skills is an important step in improving decision making abilities. A multi-method approach to measurement of critical thinking aligns with the complexity of midwifery care and decision making. Items within the three scales encompass the depth and breadth of the unique aspects of midwifery practice including: facilitating shared decision making; critical analysis of the research literature; intuitive decision making, self-awareness and reflection on practice.

8. Limitations

This study aimed to validate three different tools to assess the development of midwifery students' critical thinking skills. Although

matching of participants' responses is a strength, a relatively small sample was used. The sample was also homogenous being recruited from a single programme at one University. Sampling bias is also likely because participants could be described as "high achieving" given the high proportion with a prior degree, their relatively high GPAs, and their willingness to complete the student scale. The reported results may differ from those of students who did not wish to participate. The scales are new and need to be tested further with large diverse samples of undergraduate midwifery students. Although concurrent validity was established through a comparison of the three scales with the MSLQ, this work should be repeated with larger diverse samples.

9. Conclusion

The application of critical thinking in midwifery practice is important to direct decision making and facilitate high quality and safe midwifery care. Tools that measure the development of critical thinking in midwifery students need to encompass the unique facets and context of midwifery care. The tools should promote scaffolded learning through the provision of targeted feedback to students highlighting areas for further development. In this study, three newly developed tools (student-rating, preceptor rating and reflective writing) were tested for concurrent validity and reliability. This study suggests that the three tools are reliable and valid measures of critical thinking skills in pre-registration midwifery students. To capture the complexity of critical thinking in midwifery practice, and provide feedback from several sources, a multi-method approach is recommended using the three tools. These three tools can be routinely implemented into undergraduate midwifery programmes and used in the longitudinal measurement of critical thinking development throughout midwifery education programmes. The tools could also be used to measure critical thinking of midwifery graduates and midwives in practice. Further testing of these tools with large, more diverse samples is recommended.

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