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Development and psychometric testing of blended learning for nursing clinical practice

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Abstract

A Blended lesson evaluation is used to assess blended lessons preparing the nursing students for clinical practice. The objectives of this study were to develop a blended learning for nursing clinical practice (BNCP) instrument and test its psychometric properties. This study makes use of a mixed-method sequential explanatory design. Twenty-two items were developed from the review literature. The BNCP instrument was examined by five experts in terms of content validity. A quantitative study was conducted using exploratory factor analysis and confirmatory factor analysis (CFA). The sample consisted of 220 nursing students. The results showed that BNCP was composed of three factors, namely the learning process, convenience in terms of learning and ability to perform. The indicators had a range of communality, i.e., from 0.274 to 0.752. Three factors accounted for 60.29% of the variance. The remaining 16 items were analysed by CFA in secondary order in another group. The measurement model fitted the empirical data (p > 0.05). The most important indicator revealed by the BCNP model was 'ability to perform'. Finally, the instrument retained 3 subscales of 15 items that had construct validity. BNCP has good construct validity and reliability. BNCP is a tool that can be used to assess the learning of nursing students.

Keywords: Blended learning; nursing clinical practice tool; psychometric test

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1. Introduction

In the situation of the COVID-19 outbreak, teaching nursing practice to nursing students is difficult due to social distancing measures. The time for practicing various nursing procedures in the teaching room is limited. Students have few opportunities to meet with instructors. Teaching and learning practices require the use of online media technology to mix with traditional learning. Blended learning is necessary to be used in teaching situations in the era of the coronavirus pandemic. Blended learning, incorporating online lessons, is a form of learning management involving a technology medium or online through the Internet network. Blended learning involves managing online lessons by combining these with classic learning in the form of face-to-face in a classroom (Garrison & Vaughan, 2012). Initially, in this study, students were required to self-study online by watching videos. This method reduces constraints on time and place when it comes to studying. Students then come to class to ask questions and discuss the lesson topic with the teacher. This will encourage better understanding on the part of the students. Blended learning is used with nursing students in terms of both theoretical and practical learning. Some research reports suggest that the use of blended instruction can improve skills in nursing practice (Mc Cutcheon et al., 2015; Sáiz-Manzanares et al., 2020).

In this study, the instructors played a role in the development of teaching materials, creating online courses/lessons by composing content, creating a video for uploading online and evaluating student competency. The teacher develops teaching materials by using the video. The video serves as a stimulant due to its features in terms of image, sound and movement, in that these features stimulate learning in the brain faster than does reading, and they have been shown to contribute to a better and longer thinking process and to increased memorisation (Blanchette et al, 2020). In addition, instructors want to assess the learning of students exposed to blended learning. Such learning can be evaluated summatively in terms of outcome after the course is finished; however, during the learning process, the teacher was unable to undertake formative evaluations with regard to how students feel about blended learning, how they come up with this kind of learning involving the media method or online learning and how they learned.

According to information processing theories, there are three processing phases: sensory memory, working memory and long-term memory. Learning is composed of storage in the short-term memory, encoding in the working memory and transfer to the long-term memory (Çeliköz et al., 2019). In other words, the learner will have to search, link and retrieve material stored in the long-term memory in order to perform accurately. The student can retrieve information in the long-term memory to link previous knowledge with new knowledge (Davis et al., 2014). The outcome of this is reflected in the nursing students' academic performance skills (Bäwert & Holzinger, 2019). Information processing theory and its account of memory are adopted here to explain the use of blended learning. Blended learning is a form of e-learning; it is an information delivery method that puts the learning process online for students (Yilmaz & Keser, 2016). Several aspects of blended learning should be considered, including online characteristics, learning processes and competency to practice.

There is a variety of online evaluation forms that can be used to measure the thinking processes associated with the use of online teaching (Bin et al., 2021; Darius et al., 2021). Such assessment must measure whether the learners have to achieve their own learning process, which allows us to determine whether or not the learning process is related to good academic performance. This in turn lets us know that the academic results will be good. The preparing lessons and exercises evaluate the extent of learning by creating a test for the learner. The instructor will act as a mentor and will also evaluate the learning. Blended lesson evaluation is used to assess blended lessons preparing the nursing students for clinical practice. There is a lack of specific measurement and assessment tools. Blended learning assessments require tools, validity, content and specifics in order to assess the link between learning and practice.

This study aims to identify the dimensions of blended learning for clinical practice for nursing students. The dimensions of blended learning are used for developing the instrument and testing the psychometric properties. This new developing instrument will be useful for measuring and assessing blended learning in clinical practice among nursing students.

1.1 Materials and methods

In terms of the method design, this study explored related studies in this area in order to develop a valid instrument for subsequent analysis for use in future research. A sequential mixed-method design was used to develop such an instrument in two phases: the first involved scale development, beginning with Step 1 associated with developing the items to be used in the scale. The generation of scale items was undertaken using a relevant literature review. The second step involved testing the psychometric properties of the newly developed instrument (Figure 1). Draft 1 of the scale incorporated 25 items that were generated from the review literature. In Step 2, the content validity of the instrument was examined by five experts (Zamanzadeh et al., 2015) and (Taherdoost, 2020).. Nineteen items were eliminated owing to a low content validity index for the item (I-CVI) <0.86). Draft 2 consisted of 22 items that had a content validity index for scale (S-CVI) of 0.88. In Step 3, the clarity and readability of the instrument were assessed by five students. As a result, four items were adjusted in terms of content to allow better understanding. As a result, 22 items remained in Draft 3. Each item was on a 5-point Likert rating scale ranging from 1 (strongly disagree) to 5 (strong agree).

In terms of ethical considerations, prior to data collection, the study was approved by the Research Ethical Committee, Faculty of Medicine, Ramathibodi Hospital, COA. MURA2021/713. Before collecting data, information describing the research objectives, potential risks/benefits, confidentiality and anonymity was provided to the participants. The researcher gave informed consent to participate in the study.

In the development of the scale (Steps 3 and 4), nursing students were purposively recruited based on the following inclusion criteria: 1) aged 18–23 years and 2) having a history of blended learning. The following stage of the study (Steps 3 and 4) involved testing the psychometric properties of the newly developed instrument. An online lesson instrument was conducted before testing the psychometric properties with the aid of exploratory factor analysis (EFA). For a study using EFA, the sample size is calculated using 5 participants per item; thus, 18 items multiplied by 5 equals 165, which was in a range of sample sizes (Kyriazos, 2018). Consequently, 224 participants were used for the EFA purpose. The average age of the nursing students was 19.77 years (SD = 1.00), with a range of 19–22 years.

For a study using confirmatory factor analysis (CFA), the sample size is calculated using 10 participants per item; thus, 15 items multiplied by 10 equals 150 (Kyriazos, 2018). Two hundred and four participants were used for the CFA. The average age of the nursing students was 19.73 years (SD = 0.57), with a range of 19–22 years.

1.2 Results

Twenty-one items were analysed using EFA. The findings from EFA initially suggested four factors with factor loadings that were ≥0.30. The commonalities of 16 items had a range from 0.214 (item 12) to 0.752 (item 3), with most of them being >0.50 with the exception of items 10 and 12. Thus, item 2 was deleted.

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60.29% of the variance in the BNCP model. According to the criteria for the determination of each factor, one factor should have at least three observed variables (IBM, 2018; Pett et al., 2011). When considering each factor of the BNCP Instrument, factor 3 has three items (Table1).

1.2.1 Testing the psychometric properties of the BNCP instrument

The BNCP instrument incorporating the 15 retained items was assessed for construct validity by using CFA. The CFA was conducted using the analysis of a moment structures (AMOS) program version 21. Finally, data from 204 participants were used for CFA. The average age of the students was 21.02 years (SD = 0.5), with a range of 20–23 years.

The BNCP instrument with the 15 retained items was assessed for construct validity by using CFA. The CFA was conducted using the analysis of a moment structures **(**AMOS) program, Version 8.80. The remaining 16 items of the BNCP were further tested for psychometric properties using CFA. All the variables violated the assumption as they were not distributed by a multivariate normal distribution. When the data are not normally distributed, the number of samples is increased by 1:10. The 15 items of the BNCP were tested to confirm three individual measurement models (Table 2). Three factors (15 items) were analysed by using second-order CFA. The results of the CFA confirmed that each factor (1–3) fitted the empirical data and that they had construct validity.

The measurement model of the BCNP was fitted to the empirical data (χ^2 = 85.89, df = 72, χ^2/df = 1.91, p = 0.126, comparative fit index [CFI] = 0.998, root mean square error of approximation [*RMSEA]* = 0.029 and standardised root mean square residual [SRMR] = 0.031). The standardised factor loadings ranged from 0.187 to 0.83. The standardised factor loadings of 15 items were in the range of 0.63**–**0.91. Item 20 has 0.91 standardised factor loadings. Squared multiple correlations (R^2) were in the range of 0.04**–**0.95. The most important indicator of the BCNP model was factor 2 in terms of ability to perform. The result demonstrated that the measurement model of the BCNP model had construct reliability in terms of all indicators, ranging from low to moderate (R^2 = 0.40**–**0.80). The findings were shown in Figure 1 and Table 2.

1.3 Discussion

The objectives of this study were to develop BNCP to evaluate a blended learning approach. The initial 25 items were generated from a review of the literature, using items based on information processing theories. Although all items were not derived from the population, they were determined by experts and laypersons. These populations of interest were able to provide insights into construct definition and measurement (Netremeyer et al., 2003; Zamanzadeh et al., 2015). Thus, these enhanced the validity of the instrument.

When 16 items were analysed using EFA, it was possible to reduce the number of items and organise groups of items. The results showed that BNCP was composed of three factors (dimensions) in the form of the learning process, the convenience to learn and the ability to perform. The indicators most closely related to BNCP were the learning process which was composed of the following items: stimulation of the desire to learn the nursing practice, making learning fun and enjoyable, the memorisation of nursing procedures and improving the ability to draw from ideas and turn them into practice. These items do not exist in other instruments which have been designed to measure blended learning. These make the instructor aware that the student has occurred learning when they got blended learning methods. Out of 16 items in total, factor 3 had 3 items, which accounted for 60.29% of the variance. This was reasonable since the BNCP explained 60.29% of the total variance. Since the total variance explained was >60%, it was accepted as an accounting variance in social science (Gunzler et al., 2020). The estimation of commonality represents the proportion of variance of the observed variables which were able to account for substantial variance in all factors. The indicators had a range of communality from 0.274 to 0.752, which were the

variance commonalities of 0.50 or better. The factor loadings of 16 items were between 0.214 and 0.787. One of them was deleted due to it being less than 0.3. The remaining items had factor loadings greater than 0.30. This indicated a fair measure of the subscales (Cleare et al., 2018). Item 16 indicates better memorisation in terms of nursing procedures; the items had factor loadings. This is related to learning online by video and is the most important indicator in that it has the greatest correlation with BNCP.

The psychometric evaluation of an instrument is an important consideration when determining which measurement tools have construct validity. Construct validity is able to measure behaviours and performance in various fields according to the goals which are defined in compliance with the principles of information processing theory. BNCP was tested for construct validity with an *a priori* hypothesis of the relationship among it by CFA. It was also tested in other sampling groups. These results support the originally hypothesised structure. BNCP is a tool that can be used to assess the learning process, the features of online learning and the degree of ability in practice. The evaluation process can assess whether or not students are actually learning and part of the learning process.

With regard to all items that were investigated in relation to BNCP, the factor loading for every item exceeded 0.5. They were accepted for newly developed items (Gunzler et al., 2020; Pett et al., 2011). The factor 'learning process has the highest factor loading related to BNCP. This shows how important it is as an indicator in this model. Moreover, item 1 also shows that online learning helps students remember content and put it into practice. Based on CFA, BNCP has good construct validity and reliability overall.

Our findings support the use of the BNCP model in terms of test construct validity using CFA. It would be reasonable and justifiable to use. The results of the present analysis provide further evidence for the use of the BNCP as an online assessment instrument. The overall Cronbach's alpha coefficient with regard to BNCP was 0.89, which is acceptable for a newly developed instrument. Three subscales have coefficients >0.70 which is acceptable for preliminary research (Netremeyer et al., 2003; Taher, 2016).

As the ability to perform subscale has three items, the items on some subscales need to be modified by improving the wording in order to enhance the construct reliability and construct validity. The revised version of the BNCP needs to be re-tested for psychometric properties by using a more heterogeneous sample of students. The sample used in this study was recruited using non-probability sampling. All participants were from only one set. Using homogenous samples might not offer adequate information to allow us to generalise the results to all. Moreover, the individual items should also be further ameliorated to improve the psychometric properties. The BNCP will be useful for measuring and assessing blended learning and it relates to clinical practice among Thai nursing students.

1.4. Conclusion

This study was to develop a BNCP instrument and test its psychometric properties. BNCP was composed of three factors, namely the learning process, convenience in terms of learning and ability to perform. The measurement model fitted the empirical data. BNCP has good construct validity and reliability. BNCP is a tool that can be used to assess the learning of nursing students. Moreover, further studies are suggested using non-probability sampling. All of them were nursing students from the same school therefore the need to test the heterogeneous samples this will represent. The difference in other psychometrics includes criterion-related validity (convergent, and discriminant validity and reliability [test–retest]). The BNCP will be useful for the evaluation of both nursing practice and research. It can also be applied to develop interventions for nursing study.

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2.

Tables 1 *Second-Order CFA*

Variables	Factor loading score				Square multiple correlation R^2
	b	*B*	SE (*b*)	*t*	
BNCP					
Convenient to learn	0.70	0.72**	0.72	9.72	0.51
Ability to perform	1.03	0.98**	0.09	11.00	0.95
Learning process	1.00	0.91**			0.83
Convenient to learn					
Item7	1.00	0.79**			0.62
Item 8	1.19	0.87**	0.08	14.24	0.76
Item 9	1.21	0.84**	0.09	13.77	0.71
Item 10	0.93	0.64**	0.09	9.87	0.40
Item 12	1.02	0.63**	0.11	9.76	0.40
Item 13	0.99	0.73**	0.08	11.55	0.53
Ability to perform					
Item 19	1.00	0.81**			0.66
Item 20	1.16	0.91**	0.07	15.95	0.83
Item 21	1.06	0.86**	0.07	15.49	0.73
Learning process					
Item 1	1.00	0.90**			0.72
Item 2	1.07	0.87**	0.05	19.97	0.76
Item 3	1.07	0.87**	0.06	16.91	0.76
Item 4	1.09	0.89**	0.06	17.83	0.80
Item 5	1.09	0.81**	0.07	14.95	0.65
Item 6	1.01	0.79**	0.07	14.49	0.63

χ^2 = 85.89, df = 72, χ^2/df = 1.91, p = 0.126, CFI = 0.998, RMSEA = 0.029 and SRMR = 0.031. *p > 0.05 (n = 204).

BNCP = blended nursing clinical practice, CL = convenient to learn, LP = learning process
and SE = Standard error. b = unstandardized factor loading and B = standardized factor loading.

3 Figures

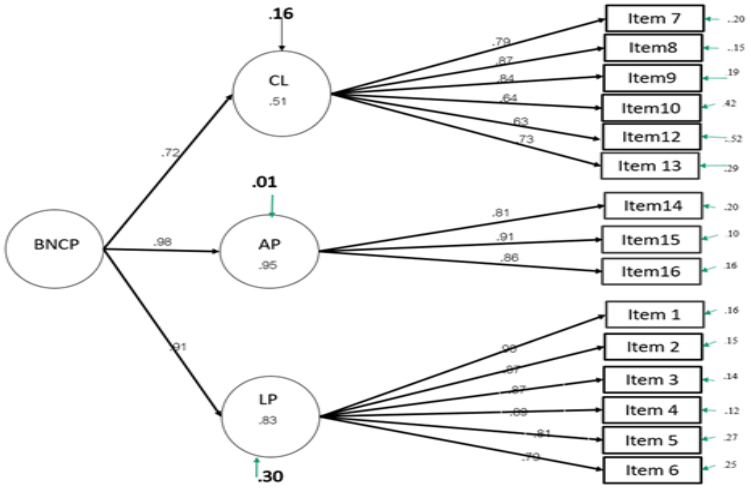

Figure 1. *BNCP Model*

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