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Developing a digital nursing education model: A transformative learning approach in the COVID-19 era

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Abstract

This study explores the acceleration of a Nursing Clinical Education Model based on Preceptorship Learning Theory, focusing on learning outcomes, continuing nursing education, and nursing skills in response to the challenges posed by the COVID-19 era. The pandemic has necessitated unprecedented adjustments to nursing education, particularly in clinical practice, as students must meet competency standards in an evolving healthcare landscape. Clinical educators play a crucial role in developing flexible, safe, and effective models of care education. This research employs a mixed-methods explanatory design, comprising three stages: a cross-sectional study to identify factors influencing learning outcomes, nursing skills, and digitalized transformative learning; qualitative research to develop a model framework; and the creation of training modules. The study surveyed 2,500 respondents, with data analyzed using SEM-PLS. Results indicate that clinical education using the preceptorship model is significantly influenced by factors such as organizational characteristics, the individual traits of clinical educators and students, job characteristics, and available learning facilities. The study highlights the need for critical care systems to adapt to the COVID-19 pandemic by modifying existing processes to ensure optimal care delivery, professional satisfaction, and competency achievement.

Keyword: Clinical education; COVID-19; nursing education; preceptorship; transformative learning

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1. INTRODUCTION

Coronavirus Disease 2019 (COVID-19) has led to significant disruptions across all sectors (Kraemer et al., 2020), affecting not only the health sector (Nguyen et al., 2020) but also requiring serious attention in the education sector (Sintema, 2020), to ensure educational processes remain operable during the pandemic era (Erduran, 2020; Schneider & Council, 2021; Kaur et al., 2021). Educational activities constrained by the inability to conduct face-to-face instruction (Lim et al., 2009) have been most impacted, particularly those requiring practical engagement (Cahapay, 2020; Desai, 2020), such as higher education for prospective health professionals (Althwanay et al., 2020). The acquisition of laboratory competencies and clinical placements has been hindered, with delivery restricted to online modalities (Adedoyin & Soykan, 2023; Mishra et al., 2020; Sklar et al., 2021).

Practical laboratory competence is essential and directly influences the clinical capabilities of future health practitioners in patient care (Adedoyin & Soykan, 2023; Kintu et al., 2017). According to the Indonesian National Qualifications Framework, health education outcomes from level 5 onwards must demonstrate clinical practice competence (Nurdin, 2018; Waseso & Hidayat, 2017). Educational outcomes cannot be achieved if the learning process is disrupted (Lim et al., 2009). During the global pandemic, widespread institutional closures necessitated remote learning (Byrnes et al., 2020; Choi et al., 2020; Alawamleh et al., 2020). Consequently, 92.8% of students were unable to participate in practical sessions aligned with curriculum standards (Cahapay, 2020; Vindegaard & Benros, 2020), which negatively affected skill acquisition and raised concerns regarding future medical errors (Varjavand et al., 2012; Aditya et al., 2022; Dost et al., 2021). In response, the Health College Association initiated curriculum revisions to accommodate the constraints of the pandemic (Arifa, 2020; Mulyani, 2020), recognizing that the absence of practical skills training cannot persist.

Several instructional strategies have been implemented, including theoretical instruction conducted online, followed by staggered in-person practical sessions (Arifa, 2020). Independent practice utilizing video materials (Lim et al., 2009), virtual meetings via platforms such as Zoom (Adedoyin & Soykan, 2023) and Google Meet (Byrnes et al., 2020), as well as alternative tasks such as creating COVID-19 health promotion media (Mishra et al., 2020; Mian & Khan, 2020), have been adopted. Without appropriate intervention, clinical skills may decline, and the professional standards of future health workers may be compromised (Adedoyin & Soykan, 2020; Byrnes et al., 2020). Although the preceptorship model has been proposed as an effective instructional solution, challenges remain due to insufficient numbers of clinical preceptors relative to student demand (Nurdin, 2018; Adedoyin & Soykan, 2023; Gaur et al., 2022).

In light of these challenges, the advancement of digital media and the evolving industrial landscape have fostered innovations beneficial to education during the COVID-19 pandemic, facilitating the continuation of academic activities (Haanes et al., 2024; Alkhowailed et al., 2020; Pandey & Pal, 2020). Digitalization of educational processes has emerged as a viable solution for maintaining instruction during the pandemic (Cahapay, 2020; Mishra et al., 2020), prompting institutions to develop new curricula compatible with online systems. Thus, the development of an adaptive educational model is essential, including the implementation of preceptorship learning as a supplementary approach to online instruction, particularly for health students requiring clinical skills development.

1.1. Purpose of study

This study explores the acceleration of a Nursing Clinical Education Model based on Preceptorship Learning Theory, focusing on learning outcomes, continuing nursing education, and nursing skills in response to the challenges posed by the COVID-19 era.

2. METHOD AND MATERIALS

2.1. Research design

This study employs a mixed methods research design utilizing a cross-sectional approach to analyze the influence of variables in the development of a clinical education model based on the preceptorship method. The research is conducted as a national study in Indonesia, aiming to evaluate health education during the COVID-19 pandemic.

2.2. Participants

Sample size determination follows a quantitative design through a cross-sectional approach, involving 2500 respondents analyzed using Structural Equation Modeling with Partial Least Squares (SEM-PLS).

2.3. Data collection instrument

The research instrument consists of a modified version of the Nursing Clinical Education Questionnaire, the Digitalization Transformative Learning instrument, and the Continuing Nursing Education instrument, all of which have been previously tested for validity and reliability. Direct observation instruments are also included. Data collection will be conducted both in person and online, with strict adherence to data confidentiality protocols and the acquisition of informed consent from all participants.

2.4. Data analysis technique

Data analysis in Phase 1 will employ Partial Least Squares (PLS) analysis to evaluate the outer model, the inner model, and the goodness of fit of the newly developed model.

2.5. Ethical considerations

Ethical approval for this study has been granted by the Research Ethics Commission (KEPK) of the Faculty of Nursing, Universitas Airlangga, on July 13, 2021, under certificate number 2329 KEPK.

3. RESULTS

3.1. Characteristics of research respondents

The results of the descriptive analysis are utilized to present an overview of the research findings for each variable under investigation. The following section outlines the outcomes of the descriptive analysis:

Table 1

Results of the description of student demographic factors

Indicator	Category	Frequency	Percentage (%)
Sex	Female	1289	62.0
	Male	790	38.0
Age	21 - 30	1471	70.8
	31 - 40	458	22.0
	41 - 50	150	7.2
Clinical Practice Station	Basic nursing	85	4.1
	Medical-surgical nursing	533	25.6
	Emergency nursing	214	10.3
	Critical Nursing	322	15.5

	Community nursing	371	17.8
	Management	106	5.1
	pediatric nursing	241	11.6
	Maternity Nursing	207	10.0
Work experience	Yes	651	31.3
	No	1428	68.7
Training that ever followed	More than 3 times	868	41.8
	1-2 times	1211	58.2
	Never	0	0

Table 1 presents the calculation results indicating that, among 2079 respondents, the majority were female students (n = 1289; 62.0%), predominantly aged 21 to 30 years (70.3%). A total of 533 respondents (25.6%) were engaged in the medical-surgical nursing clinical practice stage. Fresh graduate participants without prior work experience accounted for 1428 respondents (52.9%). The majority of health professionals completing the questionnaire were employed as nurses, totaling 376 respondents (68.7%). A total of 1211 respondents (58.2%) reported having attended training sessions one to two times.

Table 2

Results of the description of the demographic factors of clinical educators

Indicator	Category	Frequency	Percentage (%)
Sex	Female	1636	78.7
	Male	443	21.3
Age	25 - 31	55	2.6
	31 - 40	866	41.7
	41 - 50	1130	54.4
	> 50	28	1.3
Last education	Vocation	0	0
	Ners	1604	77.2
	Master/Specialist	67	3.2
	Doctor	408	24.4
Current position	Nurse manager	1115	53.6
	Deputy head of the room	307	14.8
	Primary Nurse	507	24.4
	Lecturer	150	7.2
Experience as a preceptor	Less than 1 year	79	3.8
	1-5 years	1531	73.6
	More than 5 years	469	22.6

Table 2 displays data from 2079 clinical educators, indicating that the majority were female (n = 1636; 78.7%), primarily within the age range of 41 to 50 years (54.4%). Most respondents held a nursing qualification as their highest level of education (n = 1604; 77.2%) and were currently serving in the position of Nurse Unit Manager (NUM) (53.6%). Clinical educators with one to five years of experience as preceptors totaled 1531 individuals (73.6%).

3.2. Characteristics of research variables

The characteristics of the research variables are the characteristics of the latent variables measured in this study, which consist of the latent variables of individual clinical educator characteristics, student characteristics,

organizational characteristics, job characteristics, learning facilities/learning media, continuing clinical nursing education, and clinical learning competencies (Table 3).

Table 3

Results description of organizational characteristics

Indicator	Category	Frequency	Percentage (%)
	Not enough	310	14.9
Fuction	Currently	1568	75.4
	Good	201	9.7
	Not enough	105	5.1
Regulation	Currently	1657	79.7
	Good	317	15.2
	Not enough	1769	85.1
Case management	Currently	100	4.8
	Good	210	10.1
	Not enough	511	24.6
Selection	Currently	200	9.6
	Good	1368	65.8
	Not enough	411	19.8
Training and development	Currently	507	24.4
	Good	1159	55.7
	Not enough	761	36.6
Leadership	Currently	776	37.3
	Good	542	26.1

Table 3 presents the results of calculations based on 2079 respondents. The majority received initial orientation from clinical educators with a moderate rating (n = 1568; 75.4%). Initial debriefing and explanation of standard operating procedures in hospital settings were also rated as moderate by most respondents (n = 1657; 79.7%). However, the division of case management was reported as inadequate, receiving a poor rating from 1769 respondents (85.1%). The student mapping and selection system received a good rating (n = 1368; 65.8%). Training and development efforts were rated as very good by 1159 respondents (55.7%), while leadership was assessed as sufficient by 37.3% of respondents.

Table 4

Results description of individual characteristics of clinical educators

Indicator	Category	Frequency	Percentage (%)
	Low	543	26.1
Knowledge	Currently	433	20.8
	Good	1103	53.1
	Low	132	6.3
Clinical educator expertise	Currently	654	31.5
	Good	1293	62.2
	Low	658	31.6
Professionalism	Currently	877	42.2
	Good	544	26.2
	Low	543	26.1
Motivation	Currently	765	36.8
	Tall	711	34.2
Interpersonal relationships	Low	1201	57.8

Indicator	Category	Frequency	Percentage (%)
	Currently	765	36.8
	Good	113	5.4

Table 4 presents the calculation results from 2079 respondents. The majority demonstrated moderate levels of knowledge, with 1103 respondents (53.1%) categorized as having good moderate knowledge. Clinical educator expertise was rated as good by 1293 respondents (62.2%). Professionalism between clinical educators and respondents was assessed as moderate by 877 respondents (42.2%). Motivation provided by clinical educators was rated in the medium category by 765 respondents (36.8%), while interpersonal relationships were predominantly rated in the low category by 57.8% of respondents.

3.3. Description of Variable Characteristics of Individual Students

Table 5 presents the results of calculations indicating that, among 2079 respondents, professional skills were rated as good by 1216 respondents (58.5%). Personal quality was also rated in the good category by 1216 respondents (58.5%). However, interpersonal relationships were rated as low by 988 respondents (47.5%).

Table 5

Results description of individual characteristics of students

Indicator	Category	Frequency	Percentage (%)
Professional ability	Low	112	5.4
	Currently	751	36.1
	Good	1216	58.5
Personal Quality	Low	134	6.4
	Currently	312	15.0
	Good	1633	78.5
Interpersonal relationships	Low	988	47.5
	Currently	765	36.8
	Good	326	15.7

3.4.Overview of job characteristics variables

The calculation results in Table 6 show that from 2079 respondents, most clinical educators have objective performance in the good category as many as 1815 respondents (87.3%). The feedback given to students also showed good results as many as 1865 respondents (89.7%) and job design in a good category (62.2%). The teacher's schedule is in the good category (58.5%), and the material provided by the educator is also in the good category (64.5%).

Table 6

Results of job characteristics description

Indicator	Category	Frequency	Percentage (%)
Objective performance	Not enough	154	7.4
	Enough	110	5.3
	Good	1815	87.3
Feedback	Not enough	116	5.6
	Currently	98	4.7
	Good	1865	89.7
Correct	Not enough	100	4.8
	Enough	765	36.8
	Good	1214	58.4
Job design	Not enough	111	5.3
	Enough	674	32.4

Indicator	Category	Frequency	Percentage (%)
	Good	1294	62.2
	Not enough	551	26.5
work schedule	Enough	312	15.0
	Good	1216	58.5
	Not enough	87	4.2
Theory	Enough	651	31.3
	Good	1341	64.5

3.5. Overview of learning facilities variables

The calculation results in Table 7 show that from 2079 respondents, most of the respondents stated that the classroom management provided was in the sufficient category, namely 1850 respondents (89.0%). Teaching aids as learning facilities are also in the sufficient category (81.9%).

Table 7

Results description of learning facilities

Indicator	Category	Frequency	Percentage (%)
	Not enough	120	5.8
Classroom management	Enough	1850	89.0
	Good	109	5.2
	Not enough	222	10.7
Props	Enough	1703	81.9
	Good	154	7.4

3.6. Overview of clinical education variables with the preceptorship method

The calculation results in Table 8 show that of the 2079 respondents, most of the respondents stated that clinical educators have a high orientation (70.3%). The learning model is done well (73.1%). High category professional transition session (72%). The role of clinical supervisor is also well done (71.8%).

Table 8

Results of the description of clinical education with the preceptorship method

Indicator	Category	Frequency	Percentage (%)
	Not enough	211	10.1
Orientation	Currently	406	19.5
	Tall	1462	70.3
	Not enough	444	21.4
Lab Learning	Currently	116	5.6
	Good	1519	73.1
	Not enough	248	11.9
Professional Transition Session	Currently	335	16.1
	Tall	1496	72.0
	Not enough	214	10.3
Clinical Learning Exchange	Currently	665	32.0
	Good	1200	57.7
	Not enough	232	11.2
Evaluation	Currently	543	26.1
	Good	1304	62.7
Clinical Advisor	Not enough	132	6.3

	Currently	454	21.8
	Good	1493	71.8

3.7. Description of competency achievement variables

Table 9 presents the calculation results from 2079 respondents. The majority demonstrated good critical thinking skills, with 73.4% falling within the good category. Patient safety targets were rated as good by 1074 respondents (82%). The achievement of leadership and communication competencies was categorized as good by 47.8% and 53% of respondents, respectively. In contrast, research and professional development-based practice were rated as moderate, with 52.5% and 47.3% of respondents, respectively, indicating this level.

Table 9

Results of the competency achievement description

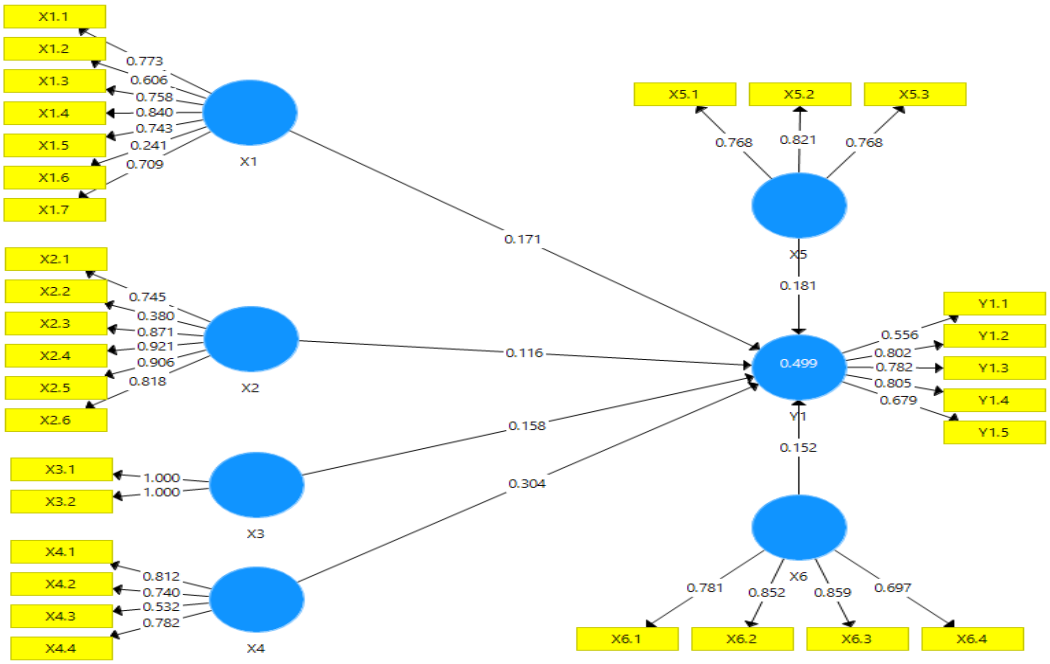
Indicator	Category	Frequency	Percentage (%)
Critical Thinking	Not enough	321	15.4
	Currently	232	11.2
	Good	1526	73.4
PCU	Not enough	244	11.7
	Currently	131	6.3
	Good	1704	82.0
Leadership	Not enough	132	6.3
	Currently	953	45.8
	Good	994	47.8
Communication	Not enough	654	31.5
	Currently	323	15.5
	Good	1102	53.0
Research-based practice	Not enough	455	21.9
	Currently	1091	52.5
	Good	533	25.6
Professional development	Not enough	342	16.5
	Currently	983	47.3
	Good	754	36.3

3.8. Evaluation of the outer model

The evaluation of the measurement model is a stage dedicated to assessing the validity and reliability of constructs. This evaluation consists of Construct Validity Evaluation and Construct Reliability Evaluation, both of which are explained as follows:

Figure 1

Outer model construct



3.9. Convergent validity test

The evaluation of construct validity is performed by calculating convergent validity. Convergent validity is assessed through the loading factor and Average Variance Extracted (AVE) values. An instrument is considered to meet the convergent validity requirement if both the loading factor and AVE exceed 0.5. The results of the convergent validity test are presented in the table below 10:

Table 10

Convergent validity test results

Variable	Indicator		*Loading Factor*	AVE
(X1) Organization	Knowledge	X1.1	0.765	0.823
	Regulation	X1.2	0.876	
	Case Management	X1.3	0.758	
	Selection	X1.4	0.840	
	Training and development	X1.6	0.899	
(X2) Individual Characteristics of Clinical Educators	Knowledge	X2.1	0.745	0.896
	Professionalism	X2.3	0.871	
	Motivation	X2.4	0.921	
	Interpersonal relationships	X2.5	0.906	
(X3) Individual Characteristics of students	Professional ability	X3.1	1,000	0.999
	Personal Quality	X3.2	1,000	
	Interpersonal relationships	X3.3	0.989	
(X4) Job characteristics	Objective performance	X4.1	0.812	0.525
	Feedback	X4.2	0.740	
	Correct	X4.3	0.532	
	job design	X4.4	0.745	
	work schedule	X4.5	0.831	
	Theory	X4.6	0.544	

(X5) Study facilities	Classroom management	X5.1	0.768	0.618
	Props	X5.2	0.821	
(Y1) Clinical education with preceptorship method	Orientation	Y1.1	0.556	0.534
	Lab learning	Y1.2	0.802	
	Professional transition session	Y1.3	0.782	
	Clinical learning exchange	Y1.4	0.805	
	Evaluation	Y1.5	0.679	
	Clinical guidance	Y1.6	0.554	
(Y2) Competency achievement	Critical thinking	Y2.1	0.912	0.876
	PCU	Y2.2	0.882	
	Leadership	Y2.3	0.895	
	Communication Research-based practice	Y2.4	0.766	
	Professional development	Y2.5	0.853	

Based on Table 10 and Figure 1, all indicators exhibit loading factor values exceeding 0.5. In addition, all variables yield Average Variance Extracted (AVE) values greater than 0.5. Therefore, based on convergent validity, all indicators are confirmed as valid for measuring the respective variables.

3.10. Discriminant validity test

Discriminant validity is assessed using cross-loading analysis. An indicator is considered valid in measuring a specific variable if the cross-loading value for that indicator is greater than its correlation with indicators of other variables. The results of the cross-loading analysis are presented in the following table 11:

Table 11

Results of cross-loading discriminant validity testing

	X1	X2	X3	X4	X5	Y1	Y2
X1.1	**0,771**	0,187	0,060	0,097	0,089	0,209	0,189
X1.2	**0,590**	0,142	0,030	0,148	0,160	0,273	0,223
X1.3	**0,783**	0,174	0,066	0,123	0,169	0,221	0,121
X1.4	**0,827**	0,175	0,091	0,134	0,212	0,237	0,236
X1.6	**0,750**	0,197	0,013	0,097	0,211	0,295	0,293
X2.1	0,223	**0,742**	0,227	0,242	0,268	0,313	0,113
X2.3	0,176	**0,873**	0,214	0,266	0,159	0,303	0,203
X2.4	0,183	**0,923**	0,241	0,279	0,235	0,355	0,375
X2.5	0,185	**0,907**	0,323	0,265	0,267	0,387	0,380
X3.1	0,074	0,298	**1,000**	0,148	0,176	0,299	0,279
X3.2	0,072	0,297	**1,000**	0,147	0,176	0,298	0,291
X3.3	0,037	0,233	**0.989**	0,309	0,136	0,201	0,301
X4.1	0,117	0,188	0,083	**0,812**	0,354	0,540	0,440
X4.2	0,134	0,254	0,151	**0,740**	0,499	0,428	0,473
X4.3	0,129	0,228	0,059	**0,532**	0,253	0,264	0,234
X4.4	0,235	0,296	0,355	**0,745**	0,297	0,171	0,448
X.4.5	0,267	0,248	0,387	**0,831**	0,303	0,287	0,445

X4.6	0,176	0,116	0,299	**0,544**	0,208	0,315	0,347
X5.1	0,084	0,219	0,084	0,347	**0,768**	0,376	0,386
X5.2	0,193	0,259	0,160	0,462	**0,821**	0,440	0,420
Y1.1	0,297	0,353	0,171	0,305	0,235	**0,555**	0,347
Y1.2	0,303	0,313	0,287	0,510	0,419	**0,802**	0,286
Y1.3	0,208	0,295	0,315	0,448	0,431	**0,782**	0,375
Y1.4	0,207	0,251	0,212	0,445	0,442	**0,805**	0,337
Y1.5	0,164	0,242	0,052	0,347	0,400	**0,680**	0,378
Y1.6	0,084	0,219	0,084	0,347	0,376	**0,768**	0,386
Y2.1	0,185	0,164	0,430	0,425	0,540	0,160	**0,912**
Y2.2	0,185	0,164	0,430	0,539	0,428	0,164	**0,882**
Y2.3	0,329	0,168	0,549	0,211	0,264	0,164	**0,895**
Y2.4	0,297	0,353	0,171	0,305	0,235	0,347	**0,766**
Y2.5	0,303	0,313	0,287	0,510	0,419	0,386	**0,853**

Based on the cross-loading measurements presented in Table 11, all indicators exhibit loading values that are greater for their respective variables compared to their loadings on other variables. This confirms that, according to the discriminant validity test, each indicator appropriately measures the corresponding latent variable.

3.11. Construct reliability

Construct reliability is assessed using Cronbach's alpha and composite reliability values. According to the test criteria, a construct is considered reliable if the composite reliability exceeds 0.7 and Cronbach's alpha exceeds 0.6. The results of the composite reliability and Cronbach's alpha calculations are summarized in the following table 12:

Table 12

Construct reliability test results

Variable	*Cronbach's Alpha*	*Composite Reliability*
(X1) Organization	0.844	0.884
(X2) Individual Characteristics of Clinical Educators	0.906	0.931
(X3) Individual Characteristics of students	0.999	1,000
(X4) Job characteristics	0.696	0.812
(X5) Study facilities	0.691	0.829
(Y1) Clinical education with preceptorship method	0.812	0.876
(Y2) Competency achievement	0.776	0.849

Based on Table 12, each variable yields a Cronbach's alpha value greater than 0.6 and a composite reliability value exceeding 0.7. Therefore, based on the results of both Cronbach's alpha and composite reliability calculations, all indicators are considered reliable for measuring their respective variables.

3.12. Evaluation of the inner model

Evaluation of the structural model, or inner model, involves assessing the model's goodness of fit. This evaluation includes the coefficient of determination (R^2), predictive relevance, and hypothesis testing. Each component is explained as follows:

- ***Coefficient of Determination (R^2)***

The coefficient of determination (R^2) is utilized to assess the extent to which endogenous variables can be explained by the variance in exogenous variables. In other words, it measures the contribution of exogenous variables to the variance of endogenous variables. The R^2 results are presented in the following table.

Table 13
Results of the coefficient of determination (R2)

Dependent Variable	R Square	R Square Adjusted
(Y1) Clinical education with preceptorship method	0.498	0.483
(Y2) Competency achievement	0.274	0.213

Table 13 presents the R-square (R^2) value for preceptorship-based nursing clinical education, which is 0.772 or 77.2%. This indicates that 77.2% of the variance in the nursing clinical education variable based on preceptorship is explained by organizational characteristics, individual characteristics of clinical educators, individual characteristics of students, job characteristics, and learning facilities. In other words, the contribution of these five constructs to the model is 77.2%, while the remaining 22.8% is attributable to other variables not included in this study.

- ***Predictive Relevance (Q^2)***

The Q^2 value is used to assess the model's predictive relevance, indicating how well the observed values are reconstructed by the model along with its estimated parameters. A Q^2 value greater than 0 suggests that the model has acceptable predictive relevance, whereas a Q^2 value less than 0 indicates insufficient predictive capability. The results of the Predictive Relevance (Q^2) test are presented in the following Table 14:

Table 14
Predictive relevance test results (Q2)

Variable	SSO	SSE	Q^2 (=1-SSE/SSO)
(X1) Organization	1,242,000	768,255	0.381
(X2) Individual Characteristics of Clinical Educators	1.035,000	448,239	0.567
(X3) Individual Characteristics of students	414,000	121,329	0.707
(X4) Job characteristics	828,000	625,903	0.244
(X5) Study facilities	621,000	462,921	0.255
(Y1) Clinical education with preceptorship method	828,000	504.788	0.390
(Y2) Competency achievement	1.035,000	709,465	0.315

The results presented in Table 14 show that all variables yield a Predictive Relevance (Q^2) value greater than 0, indicating that the model possesses adequate predictive capability.

3.13. Hypothesis Testing

Significance testing is conducted to evaluate the influence of exogenous variables on endogenous variables. According to the test criteria, a significant effect is indicated if the T-statistic exceeds the T-table value (1.96) or if the P-value is less than the significance level of 5% (0.05). The results of the significance testing and overall model evaluation are presented in the following figures and tables.

Figure 2
Inner model construct

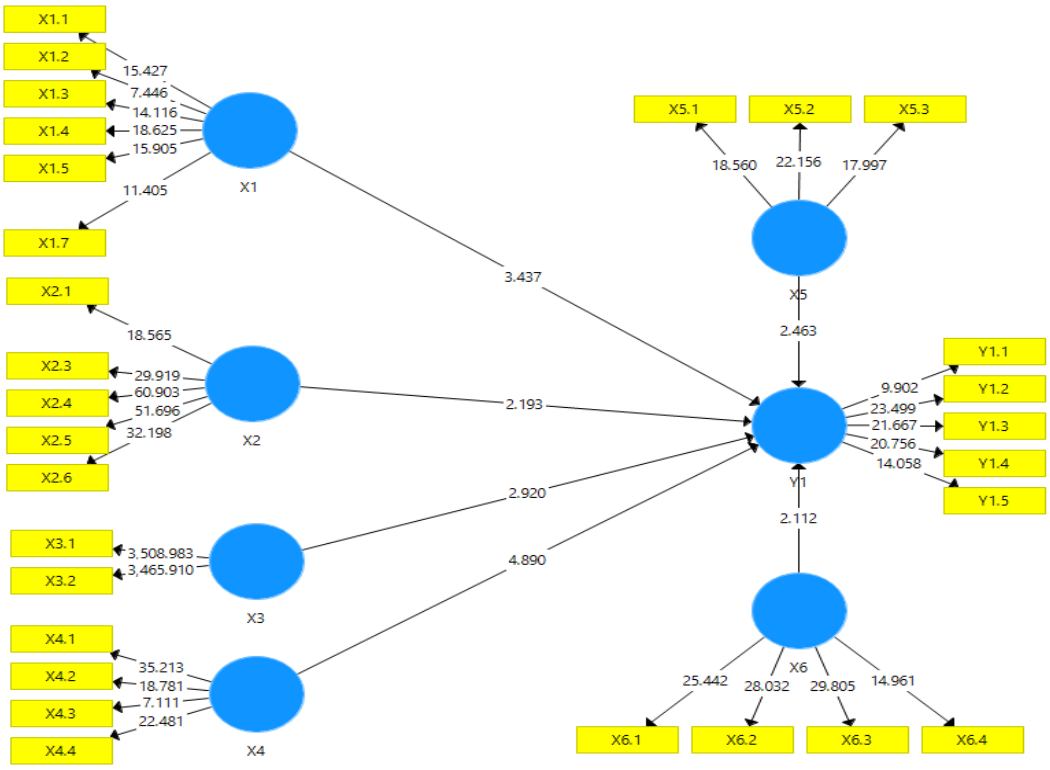


Table 15

Hypothesis testing results

Influence	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
Organizational characteristics ➔ Education in the clinical preceptorship method	0.167	3,437	0.001
The individual characteristics of clinical educators ➔ Education in the clinical preceptorship method	0.119	2,193	0.029
The individual characteristics of learners ➔ Education in the clinical preceptorship method	0.156	2,920	0.004
Job characteristics ➔ Education in the clinical preceptorship method	0.303	4,890	0.000
The learning facilities ➔ Education in the clinical preceptorship method	0.184	2,463	0.014
Clinical preceptorship education methods➔ achievement of competence	0.151	2,112	0.035

The test results indicate that the T-statistic values for all variable relationships exceed 1.96, and the associated p-values are less than 0.05. These findings confirm a statistically significant influence of organizational characteristics, individual characteristics of clinical educators, individual characteristics of students, job characteristics, and learning facilities on clinical education utilizing the preceptorship method (Table 15; Figure 2).

Among all hypothesized pathways, the path from job characteristics to integrated discharge planning and subsequently to clinical education using the preceptorship method demonstrates the strongest and most statistically significant effect (Table 15; Figure 2). These findings support the formulation of a new model termed the *Clinical Preceptorship-Based Nursing Education Model*. Originally applied exclusively within the scope of

nursing practice in hospital settings, the preceptorship approach is now integrated into the academic environment for nursing students.

This integration results in the development of a model grounded in preceptorship learning theory, encompassing clinical learning outcomes, continuing nursing education, and enhancement of nursing skills. The primary objective of this model is to improve competency achievement among nursing students. The model development process has included a rigorous validation phase and will proceed with the identification of strategic issues, followed by expert consultation across relevant disciplines.

4. DISCUSSION

This study offers insight into the advancement of a preceptorship-based learning model, developed as a strategic response to the digitization of education during the COVID-19 health crisis, particularly within the context of Indonesian nursing education. The primary objective was to reinforce nursing students' competency development. Through a pilot implementation of this model, a continuous learning process for clinical skills was established. Students reported feeling supported and benefited from an integrated system that bridged theoretical knowledge and practical experience, even amid the disruptions of the pandemic. Clinical educators, in turn, reported feeling valued and actively contributed to refining the model, highlighting its potential as a foundational framework for nursing education.

The findings carry significant implications for global nursing education, especially as concerns persist about potential COVID-19 surges and the emergence of more infectious variants. Uncertainty remains around vaccine efficacy and rollout (Hotez & Bottazzi, 2020; Lauck et al., 2022; Lurie et al., 2020). According to data from the International Council of Nurses (ICN), 73% of National Nursing Associations reported that nursing education was disrupted in 2020. These disruptions led to delays in graduation and posed challenges for the sustainability of the nursing workforce. This underscores the need for preparedness and adaptability in response to evolving health crises.

This study presents strategies to sustain educational outcomes through a preceptorship framework. The research emphasizes the collaborative role of nursing students and clinical educators in upholding effective educational standards and achieving optimal learning outcomes. The preceptorship program, which includes components such as orientation, laboratory-based learning, professional development sessions, clinical exchanges, evaluation, and mentorship, has demonstrated effectiveness in enhancing student competencies. Key influencing factors identified include organizational characteristics, the individual traits of clinical educators and students, job features, and the availability of learning resources.

The study found that stronger individual and organizational attributes contribute positively to the effectiveness of clinical education via the preceptorship model. These insights can inform policy and curriculum development within educational institutions, especially during ongoing or future public health emergencies. Notably, over half of the clinical educators in the study held at least a bachelor's degree and leadership roles with prior preceptorship experience. Previous research supports that experienced preceptors and unit managers can adequately address students' learning needs (Lethale et al., 2019).

Interviews with clinical educators revealed that high-quality instruction must integrate scientific knowledge, technical skills, practical judgment, and relationship-building, despite obstacles such as student disengagement, high workloads, and the need for collaboration between academic and healthcare institutions (Öhrling & Hallberg, 2000; Ebu Enyan et al., 2021). The mental well-being of students was also found to have deteriorated during the pandemic, reinforcing the necessity for an educational approach that incorporates psychosocial support, resilience training, and post-traumatic growth (Thomas, 2022).

Additionally, orientation to institutional policies during the pandemic is critical. To enhance vaccine uptake among nursing students, educational campaigns aimed at building vaccine confidence are essential (Zhou et al., 2021). Pandemic-adjusted case management strategies should ensure that students' clinical learning remains effective despite public health restrictions. E-learning platforms can support remote consultations, guide learning processes, and track outcomes, serving as valuable tools to strengthen distance education.

A structured preceptorship process should encompass initial orientation, simulation labs, professional transition experiences, clinical rotations, performance evaluations, and guided mentorship. The pivotal role of preceptors in nurse retention and patient safety cannot be overstated. During the orientation phase, preceptors serve as role models, balancing clinical teaching best practices with academic rigor (Berland et al., 2020).

The learning outcomes align with interpersonal learning models that emphasize reflective practice, critical thinking, and patient safety, as well as contextual frameworks involving peer learning, co-teaching, student-centered supervision, and a supportive learning environment (Koldestam et al., 2021). Virtual simulation was well-received by students and viewed as a valuable alternative for clinical practice (Fogg et al., 2020).

To support continued competency development in the post-pandemic era, nursing students can engage in structured learning pathways such as the Professional Credit Unit (PCU) system, which requires 25 credits over five years. This system promotes ongoing professional development through seminars, training, and workshops, many of which can be conducted online. Additionally, elements such as leadership, evidence-based practice, communication, and professional growth must be incorporated to ensure comprehensive nurse preparation, as reflected in improved competency outcomes.

5. CONCLUSION

The COVID-19 pandemic has served as a significant catalyst for transforming nursing education by necessitating the adoption of innovative strategies to address challenges in a rapidly evolving healthcare environment. The pandemic has highlighted the pressing need for adaptive learning approaches that facilitate collaboration between clinical educators and nursing students in transitioning to new learning methods. These strategies are crucial for maintaining the continuity of clinical education and enhancing practical nursing skills during periods of uncertainty and disruption.

In this context, the relationship between clinical educators and students is central to fostering resilience, ensuring academic progression, and promoting safe, effective practice. The pandemic has underscored the importance of integrating flexible, responsive teaching models that support experiential learning while adhering to evolving public health protocols. Consequently, structured support mechanisms such as peer-led support groups, reflective practice forums, and mentorship networks are essential in assisting both educators and students in managing stress, sharing experiences, and maintaining professional motivation.

To implement these strategies, a variety of resources have been developed to assess and support the competencies of clinical mentors. These tools are designed to ensure mentors possess the necessary pedagogical, emotional, and leadership skills to guide students effectively through transitional learning phases. Additionally, professional development frameworks that emphasize competency based learning provide a structured pathway for both students and mentors to achieve defined learning outcomes. These frameworks include targeted training modules, digital learning platforms, feedback mechanisms, and performance assessments aligned with current clinical demands and educational standards.

Moreover, the implementation of structured professional development opportunities such as webinars, online certifications, and virtual workshops ensures that both mentors and students remain current with the latest clinical practices, infection control measures, and technological tools in healthcare delivery. These learning

experiences not only enhance technical skills but also foster critical thinking, communication, and interprofessional collaboration, competencies increasingly vital in complex healthcare systems.

Ultimately, by leveraging lessons learned during the pandemic, nursing education can evolve toward a more resilient, student centered model that prioritizes adaptability, continuous learning, and the mutual empowerment of educators and learners, ensuring the development of competent, confident nursing professionals prepared to thrive in both routine and crisis situations.

Availability of data and materials: The datasets used and/or analyzed in the present study are available from the corresponding author on reasonable request.

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Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: Ethics approval and consent to participate. This study was conducted in adherence with the principles of the Declaration of Helsinki and the ethical principles followed at Faculty of Nursing, Airlangga University. This research has been approved by the Research Ethics Commission (KEPK) of the Faculty of Nursing, Airlangga University, on July 13, 2021 with certificate number 2329-KEPK .All participants provided written informed consent.

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