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Determining the effectiveness of a virtual service / patient-based education program on patient care and clinical decision-making in nursing: A quasi-experimental study

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ABSTRACT

OBJECTIVE: The aim of this study was to determine the effectiveness of a virtual service/patient-based program (vSPBP) developed for nursing education and its effect on the development of care plan preparation and clinical decision-making skills.

METHODS: The study was conducted in a quasi-experimental design with a sample of fourth-year nursing students. Participants were assigned to the intervention group (n=44) and control group (n=51). The intervention group participated in a full-day vSPBP in addition to clinical training, whereas the control group received only the clinical training. Both groups were evaluated at the end of the intervention for care planning skills and at the beginning, middle, and end of the academic year for clinical decision-making skills. The Modified Simulation Effectiveness Tool (mSET) and focused group interview were used to evaluate the effectiveness of the vSPBP; nursing students' Clinical Decision-Making in Nursing Scale (CDM-NS) and Care Plan Evaluation Form were used to evaluate learning outcomes. Quantitative data were analyzed using the t-test and ANOVA. Qualitative data were analyzed by three researchers, and themes were identified. Ethical permissions were obtained from the relevant units.

RESULTS: The total score of the Turkish Version of the mSET was 84.39±12.08 (51-95) and the education program was found to be highly effective. The mean care plan preparation skills scores of the intervention and control groups were 44.84±2.77 and 27.75±4.28 (0-50), respectively, and the total scores of the CDM-NS (at the last measurement) were 147.90±11.28 and 146.42±12.21. While there was a significant difference between the intervention and control groups in the ability to prepare a care plan (p=0.001), there was no difference between the groups in clinical decision-making skills over time (p=0.433), between the second and third measurements over time (p>0.05), but both measurements increased significantly compared with the first measurement (p=0.000).

CONCLUSION: The vSPBP was determined to be an effective learning activity for the development of care plan preparation and clinical reasoning skills, as well as effective in closing the gap between theoretical and clinical knowledge and adaptation to the nursing process when applied in an integrated manner with the existing nursing program.

Keywords: Clinical decision-making; nursing care plan; nursing education; serious game; simulation-based learning; virtual patient.

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During clinical education in nursing, learners do not have sufficient experience with a sufficient number and variety of patients in real clinical settings to acquire the targeted competencies. In addition, there may be a disconnect between theoretical and clinical practice training; these cannot be sufficiently integrated with one another. Another

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problem is related to the learning environment offered to learners. In the literature, there is abundant evidence that current nursing education cannot provide a sufficiently interesting and motivating learning environment for learners [1]. Recently, a new one has been added to these problems. As clearly demonstrated by the COVID pandemic, clinical education processes can be interrupted by pandemics and natural disasters, which are increasing in frequency [2]. These problems make it difficult for learners to develop the competencies they need to acquire, especially competencies for creating health care plans and clinical decision-making, at the desired level. Learners' readiness for clinical education and profession is low; the quality of healthcare provided decreases; patient safety is at risk.

Many studies in the literature show that one of the solutions to these problems is to provide learners with holistic educational experiences with virtual hospitals/services and patients through simulation-based educational applications [3]. These applications are developed with the focus on selected professional tasks, problems, and related competencies using task- and competency-based education approaches [4]. In addition, these practices should be designed in accordance with the cultural characteristics and health contexts of each country and should be diversified in this respect. At this point, a task- and competency-based, culturally sensitive virtual platform was developed by taking into consideration the lack of such applications in health education in general and the limitations of virtual service/patient platforms in nursing education in particular.

Virtual services/patients for educational purposes are screen-based computer applications that simulate real scenarios in the context of a specified phenomenon (text) and are designed to be realistic and interactive [5, 6]. Virtual service/patient applications are developed on the basis of learning theories such as situational/contextual learning, experiential learning, episodic and task-based learning, flow theory, cognitive load, and narrativity within the framework of constructivism. The aim of this course is to provide learners with realistic reflective and contextual virtual clinical experiences and to accumulate virtual memories using applications prepared in virtual environments with a holistic approach [4, 7]. Many benefits of virtual service/patient use have been identified in the literature [8–10]. These benefits include contributing to a faster and more effective learning process, improving communication skills and reducing learner anxiety, increasing competencies related to clinical decision-making, developing multiple skills, such as clinical decision-making, patient interaction, critical thinking, therapeutic approaches, and adaptation to a changing environment, and providing safe environments where clinical practice skills are transferred [11]. Among the effects listed in the literature are that they can be distributed to an unlimited number of learners and allow multiple repetitions, ensure consistency and comparability of students' learning experiences, provide real-time feedback on learner activity, and give learners the opportunity to repeat the process [12]. Other effects that have emerged from studies include enabling learners to learn at their own pace and evaluate their own progress, enabling them to test their knowledge and identify their learning needs, and supporting information processing and reflection [13]. Finally, benefits such as enabling multiple participation from various disciplines and venues, providing standardization by presenting realistic service content and patient status and thus providing equal learning opportunities for everyone, providing exposure to rare and critical situations, increasing self-confidence and self-efficacy development, and making the education process fun can be added to this list [14].

Highlight key points

- Virtual service and patient-based education programs can provide competence to learners.
- Virtual service and patient-based education programs can improve the ability to prepare a care plan.
- Virtual service and patient-based education programs can improve clinical decision-making skills.
- Virtual service and patient applications can establish a link between theoretical and clinical.

Virtual service/patient platforms also have disadvantages and numerous usage challenges. These include requiring too much collaboration in the development process, being expensive, not adequately reflecting reality, encountering technical and design difficulties, and insufficient technology literacy [13–15]. Therefore, it is important that the design process of virtual hospital/service and patient platforms be conducted as a reflexive, contextual, narrative, and self-integrated process using established design principles and virtual patient development models. It is recommended that game mechanics be developed to guide learners in the process of acquiring focused competencies (clinical reasoning, decision-making, health care planning, etc.) [13, 16–18]. Again, as a general principle, it is important to plan simulation-based education within the integrity of the current education program, integrated with other educational activities and clinical practices conducted in real environments [19].

Table 1. Research phases

Time	Applications
October 2022 Beginning of the academic year	• Data on learner characteristics were collected using the descriptive characteristic form. • Nursing students' Clinical Decision-Making scales was distributed to all students, and data were collected.
March-April 2023	Intervention group • Virtual service/patient implementation was performed in two cases. The surgical case (63 years old, male, planned operation with the diagnosis of coronary artery bypass graft surgery, comorbidities: hypertension, diabetes mellitus, Whiplle Surgery) took an average of 5 hours, and the neurology case (74 years old, female, patient diagnosed with cerebrovascular accident, comorbidities: hypertension, diabetes mellitus, hypothyroidism, pancreatic cancer) took an average of 3 hours. • Quantitative and qualitative data were collected from the experimental group using the following tools: o The nursing students' Clinical Decision-Making in Nursing Scale and Care Plan Evaluation Rubric were used to collect quantitative data on these two competencies. o After the implementation, the virtual service/patient implementation developed using the Turkish Version of the Simulation Effectiveness Tool–Modified was evaluated by the users. o A focus group interview was conducted on service/patient implementation experiences using a pre-prepared starter question.
	Control group • The data in the files filled out by the students in the control group for real cases equivalent to the two cases used in the virtual service/patient implementation in the clinics were analyzed in terms of clinical decision-making. • Quantitative data on these two competencies were collected from the control group using the nursing students' Clinical Decision-Making in Nursing Scale and Care Plan Evaluation Rubric.
June 2023 End of the academic year	• The nursing students' Clinical Decision-Making scales was distributed to all students, and data were collected for the second time at the end of the semester.

Two of the competencies focused on virtual service/patient applications are clinical decision-making and care plan preparation. The aim of this study, which aims to contribute to the literature on this subject, is to determine the effectiveness of the virtual service and patient-based education program developed for the development of care plan preparation and clinical decision-making for nursing education and its effect on the development of care plan preparation and clinical decision-making skills in nursing students. In this context, answers to the following research questions were sought:

1. How was the effectiveness of the developed virtual service/patient-based education program evaluated by users?
2. Is there a difference between mean scores for care plan evaluation of students who received patient care management education in the nursing process in the virtual service/patient education intervention and in the real clinical environment?
3. Is there a difference between the mean clinical decision-making scores of students who received patient care management education in the nursing process in the virtual service/patient education implementation and in the real clinical environment?

MATERIALS AND METHODS

This study with a quasi-experimental (educational intervention) design was carried out with the participation of a total of 95 students, 44 in the intervention group and 51 in the control group, selected on the basis of volunteerism among 235 students enrolled in the fourth year of the Marmara University Faculty of Nursing in the 2022-2023 academic year. The research process is presented in Table 1 with the main stages and the data collection methods and tools used.

Ethics

Ethics committee permission were obtained for the implementation: the Marmara University Institute of Health Sciences Ethics Committee (date: 18.01.2021, number: 02). The study design is in accordance with the Helsinki Declaration and conforms to the Committee on Publication Ethics (COPE) guidelines.

Statistics

Means and standard deviations of quantitative data were calculated. Analyses were performed using t-tests and ANOVA. For qualitative data, a semi-structured focus group interview form consisting of seven questions developed by the researchers was used. The scope of the questions included the interface features of the platform used, its usability level and instructional usefulness, its liked and disliked features, the emotions felt during the implementation, and suggestions for improvement. Interviews were conducted with 44 participants in 3 focus interviews lasting 30-45 minutes on average. An average of 14-16 participants took part in the sessions. The sessions were conducted by the researcher (TO). In order to eliminate bias and manage the group process well, the researcher received training on qualitative research and focus group discussions. Audio recordings were taken during the interviews with the author's permission. After transcription, the data were first manually read independently by two independent researchers (TO and MS), and then themes and sub-themes were identified using MAXQDA 24.2 Manual Qualitative Data Analysis Program to avoid errors. Then, the third researcher (MAG) was involved in the process and the themes and sub-themes were agreed upon and finalized. All statistical analyses were performed using IBM SPSS Statistics software version 29.0 (Chicago, ILL, USA). Descriptive statistics including frequency, percentage, mean, and standard deviation (SD) were used for demographic data evaluation. Quantitative variables were represented as mean±SD and median (min–max), while categorical variables were written as numbers (n) and percentages (%). A p-value of less than 0.05 was considered statistically significant.

RESULTS

Participant Qualifications

Of the 95 students who participated in the study, 56.8% (54) were female and 43.2% (41) were male. In the intervention group, 28 (63.6%) were female, the average academic grade point was 76.43 out of 100 (SD 8.32) and the success level was 70.5%. It was found that 84.1% were graduates of Anatolian High School, 72.7% had sufficient technology and access to meet their needs, 50% stayed in a state dormitory during their education, 44.7% lived with family support, 38.6% had scholarship, and 15.9% had employment. None of them had ever worked in a health institution, and none had provided long-term professional care to a person. It was determined that 26 (51%) of the control group were female, the mean academic grade point average was 76.41 out of 100 (SD 7.36), and 56.9% had an average achievement level. It was determined that 88.2% were graduates of Anatolian High School, 58.8% had sufficient technology and access to meet their needs, 41.2% stayed in a state dormitory during their education, 49% lived with family support, 45.3% received scholarship, and 17.6% received employment. None of them had ever worked in a health institution, and none had provided long-term professional care to a person.

TABLE 2. The Turkish Version of the Simulation Effectiveness Tool–Modified Data Analysis (n=44)

Sub-dimensions	Mean±SD	Min–Max
Prebriefing	9.05±1.67	4–10
Learning	21.23±4.15	9–25
Confidence	31.30±4.07	21–35
Debriefing	22.82±2.93	15–25
Total	84.39±12.08	51–95

SD: Standard deviation; Min: Minimum; Max: Maximum.

Evaluation of Virtual Service/Patient Education Implementation

Within the scope of the first research question, the effectiveness of the virtual service/patient education implementation was evaluated using quantitative data collected using The Turkish Version of the Simulation Effectiveness Tool–Modified (the Tool SET-M in Turkish) and qualitative data obtained through focus group interviews. This tool, which was used to evaluate the effectiveness of the simulation training program, consisted of 19 5-point Likert-type questions and four sub-dimensions: prebriefing, learning, confidence, and debriefing. The Cronbach's alpha value of the measurement tool was 0.92. In this measurement with a score range of 19-95, a high score indicates that the student perception of the effectiveness of learning in the simulation environment is positive [20]. As seen in Table 2, because of the eval-

Table 3. Detailed results of qualitative data analysis

Themes	Side themes	Highlights
Provide opportunities for holistic and integrated patient care		Seeing the case from the beginning to the end of the care plan process in a holistic and detailed manner with all the steps, having an experience as if you were in the clinic, and compensating for the disconnections experienced in patient care in reality/clinic
Integration with education programs and clinical practice	Integration across years in the education program	Integration into the program, ensuring a holistic approach to education, starting from the first year of education, being compulsory, being open to the continuous use of the learner through online distance implementation and enrichment with case-based learning.
	Preparation for real clinical practice	Orientation to the clinic, reducing adaptation and transition shock, preparing for the internship with pre-internship practice, removing question marks in mind, facilitating difficult learning, starting the clinic more confidently by gaining basic knowledge/competencies, intensified/focused learning, clarification, pre-clinical recall, and increasing the learner's self-confidence.
	Clinical practice ensuring adequate case visibility	Solving the problems of not meeting the variety of cases in the clinic on time and insufficiently
Positive, instructive, and realistic learning experiences and environments	Provide fun, instructive, and innovative learning experiences	Gamified learning, fun and easy to follow, efficient, engaging, and age-appropriate
	Reinforcement of learning and acquisition of basic competencies	Supporting theoretical knowledge, using knowledge, meaningful learning, learning details, seeing, planning and eliminating deficiencies in knowledge and basic competencies, providing the opportunity to learn from our mistakes, updating knowledge, transferring theoretical knowledge to the clinic, integration and visualization of theory and practice through cases and symptoms and signs of patients, providing the opportunity to discuss through cases, increasing communication skills, contributing to individual development and revealing and eliminating learning deficits.
	Positive learning environment, emotional environment, and the emotions it elicits	Learning environment: Fun, instructive and realistic, impressive, interesting, arousing curiosity and excitement, arousing excitement for learning, engaging, anxiety, stress-free, safe, increased self-confidence, feeling more confident, comfortable, fun, not tiring, impressive, cool, communicative, openness to learning, easy to understand the subject, efficient, innovative, ahead of the curve, feeling real (like a hospital, like meeting a real patient, like a nurse), playing a game, immersive, encouraging me to use my imagination
The nature of the virtual hospital/service and patient education implementation and platform	Structure, scope, and flow of the virtual education application	Integration of theory and practice, detailed content, enrichment with visuals, instructive, developmental, simple, good and short, easy to follow, guiding, efficient, useful.
	Interactive, useful, and efficient design	Professional, well-designed, labor-intensive, simple, user-friendly, directive, concise, fluid, interactive, developmental, detailed, and colorful
	Authenticity and attractiveness	Feeling like taking care of a real patient, engaging, enjoyable, intriguing, and realistic service design, conveying the atmosphere of the clinic, using realistic visuals
	Storytelling and personalization of the script and flow	Fluent storytelling, authentic, sincere, fun, humorous, fluent, game-like, enriched with sociocultural qualities, and personalized for the user with an avatar
	Aspects of the design that can be improved	Making the encounter with the virtual patient more interactive, continuity and intermittent encounters with the virtual patient, removing redundancies, making additions to prepare for difficult/critical/emergency situations encountered in the clinic, more branching, enriching options/alternatives, directions, visuals, using more realistic, vivid visuals, more gamification, more interactive flow, 3-dimensional design, differentiation according to fields/departments, leveling, supporting evaluation activities and certificates, giving opportunity for individual and group/team learning, designing as a team-based practice, supporting the practice with additional materials such as patient booklet, individual report/feedback after the practice, simplification, reduction of steps

Table 4a. Care plan preparation skills assessment data

	Control (n=51) Mean±SD (Min–Max)	Intervention (n=44) Mean±SD (Min–Max)	Total (n=95) Mean±SD (Min–Max)
Adequacy of data obtained using the functional health pattern model	3.20±0.53 (2–4)	4.80±0.40 (4–5)	3.94±0.09 (2–5)
Provide clear and accurate system diagnostics from top to bottom	2.47±0.50 (2–3)	4.80±0.46 (3–5)	3.55±0.12 (2–5)
Compatibility of data collected according to the functional health pattern model with the system diagnostic data	2.63±0.48 (2–3)	4.77±0.42 (4–5)	3.62±0.12 (2–5)
Consistency between patient history and theoretical knowledge	2.78±0.64 (2–4)	4.25±0.57 (3–5)	3.46±0.09 (2–5)
Acquiring adequate and complete nursing diagnoses in accordance with the holistic approach	2.84±0.64 (2–4)	4.66±0.47 (4–5)	3.68±0.11 (2–5)
To determine the etiology and definitive diagnostic criteria	2.49±0.64 (2–4)	4.57±0.58 (3–5)	3.45±0.12 (2–5)
Ranking nursing diagnoses according to priority	3.20±0.63 (2–4)	4.80±0.40 (4–5)	3.94±0.09 (2–5)
The intended and expected patient outcomes are consistent with the diagnoses.	2.57±0.57 (2–4)	4.14±0.46 (3–5)	3.29±0.09 (2–5)
Nursing interventions are adequate and consistent with the diagnosis	2.67±0.62 (2–4)	4.18±0.49 (3–5)	3.37±0.09 (2–5)
Preparation of a discharge education plan according to each case	2.90±0.53 (2–4)	3.89±0.49 (3–5)	3.36±0.07 (2–5)
Total	27.75±4.28 (20–38)	44.84±2.77 (35–48)	35.66±0.95 (20–48)

SD: Standard deviation; Min: Minimum; Max: maximum.

uation, the virtual education implementation was found to be highly effective by the participants in all subdimensions and in the total score (Table 2).

In the analysis of the qualitative data obtained from the focus group interview conducted to evaluate the experience with the virtual service/patient education implementation, positive findings were obtained regarding the virtual service/patient education experiences, and opinions and suggestions were revealed. The analysis identified four themes: "Provide opportunities for holistic and integrated patient care", "Integration with education programs and clinical practice", "Positive, instructive, and realistic experiences and environments", and "The nature of the virtual hospital/service and patient education implementation and platform", and 11 sub-themes, including suggestions for aspects of the design that could be improved (Table 3).

Comparison of Competency Scores Between the Intervention and Control Groups

Within the scope of the second research question, the data obtained with the Care Plan Evaluation Rubric were analyzed. After the t-test, it was determined that the care plan preparation skills in the education intervention group in which the virtual service/patient education application was applied were significantly better than those in the control group (p=0.001, Table 4).

Table 4b. Comparison of care plan preparation skills between study groups

	n	Mean±SD	T	df	p
Intervention	44	44.84±2.77	23.349	86.635	0.001
Control	51	27.75±4.28			

SD: Standard deviation; T: Independent-groups; df: Degrees of freedom.

Within the scope of the third research question, data were obtained from all participants using the Clinical Decision-Making in Nursing Scale in three measurements at the beginning, middle, and end of the 2022-2023 academic year, and the calculations and analysis results are presented in Table 5. As seen in Ta-

Table 5A. The Clinical Decision-Making in Nursing Scale analysis

Sub-dimensions	1st measurement			2nd measurement			3rd measurement		
	Intervention Mean±SD	Control Mean±SD	General Mean±SD	Intervention Mean±SD	Control Mean±SD	General Mean±SD	Intervention Mean±SD	Control Mean±SD	General Mean±SD
Search for alternatives or options	36.95±3.69	36.72±4.19	36.83±3.95	38.04±3.40	38.74±3.80	38.42±3.62	39.27±4.00	37.52±3.80	38.33±3.97
Canvassing of objectives and values	36.52±3.87	33.82±2.92	35.07±3.64	37.25±3.22	35.19±2.49	36.14±3.02	36.90±3.70	35.03±3.23	35.90±3.56
Evaluation and reevaluation of consequences	33.65±3.12	36.41±5.18	35.13±4.54	35.65±2.81	38.90±4.53	37.40±4.14	36.36±3.36	34.98±3.49	35.62±3.48
Search for information and unbiased assimilation of new information	34.29±3.17	33.76±3.47	34.01±3.33	36.20±3.46	35.31±3.49	35.72±3.49	36.36±3.36	34.98±3.49	35.62±3.48
Total	141.43±11.50	140.72±13.78	141.05±12.72	147.15±10.25	148.15±12.20	147.69±11.29	147.90±11.28	145.13±12.93	146.42±12.21

SD: Standard deviation.

Figure 1. The Clinical Decision-Making in Nursing Scale total scale scores and follow-up changes.

ble 5A and Figure 1, the measurement means in the obtained data were close to each other.

Mixed-effect ANOVA was performed to evaluate the effect of virtual service/patient implementation on the total scale score of the Clinical Decision-Making Scale in the intervention group. When Tables 5A and 5B were analyzed, no significant difference was observed between the mean scores in the intervention (145.50±1.34) and control group (144.67±1.24) regardless of time ($F(1;178.92)=0.203$; $p=0.653$; $\eta2=0.002$). Regardless of the group, at least one of the time effects means was significant ($F(1,92;178,92)=11.54$; $p=0.000$; $\eta2=0.110$). Considering the calculated partial eta squared value of 0.110, the study determined that the virtual service/patient education implementation showed a moderate effect of time, regardless of the groups. Although there was an increase in the second and third follow-ups compared with the first, no difference was observed between the second and third follow-ups (Table 5C).

DISCUSSION

Effectiveness of Virtual Service/Patient Education Implementation and Learner Experiences

It is of great importance to evaluate the effectiveness of simulation-based education implementation, including virtual service/patient implementations, using a standardized measurement tool. The learners' perception of the effectiveness of the developed virtual service/patient education implementation was evaluated with the Modified Simulation Effectiveness Tool, and the implementation was found effective by the learners in all subdimensions. In the literature, the Modified Simulation Effectiveness Tool is generally used to evaluate the effectiveness of phys-

Table 5b. Analysis results of nursing students' Clinical Decision-Making in Nursing Scale scores

	Type III sum of squares	df[1]	Mean square	F	p	Effect size[2]
Group	48.44	1	48.44	0.203	0.653	0.002
Time1	2337.47	1.92	1214.98	11.54	0.000	0.110
Time*group	168.34	192	87.50	0.831	0.433	0.009
Error	18828.59	178.92	105.23			

1: The sphericity assumption is not satisfied (p=0.033) and the covariance matrix equality assumption is satisfied (p=0.307); 2: Partial eta squared; df: Degrees of freedom; *: Interaction.

Table 5c. Multiple comparisons for the intervention group at each time point

(I) Time	(J) Time	Mean difference (I-J)	Std. error	p[b]	95% CI for difference[b]	
					Lower bound	Upper bound
1	2	-6.579*	1.361	<0.001	-9.898	-3.261
	3	-5.445*	1.648	0.004	-9.462	-1.427
2	1	6.579*	1.361	<0.001	3.261	9.898
	3	1.135	1.364	1.000	-2.191	4.460
3	1	5.445*	1.648	0.004	1.427	9.462
	2	-1.135	1.364	1.000	-4.460	2.191

Std. error: Standard error; *: The significance level was set at 0.05. CI: Confidence interval; b: Correction for multiple comparisons: Bonferroni.

ical models and manikin-based simulation training and is used in very few virtual patient simulation-based education programs. In Sharoff's [21] study evaluating student perception of the effectiveness of learning using vSim for Nursing® virtual patient implementation on nursing students, all items were evaluated between 50 and 79.7%, and a moderate-to-high degree of effectiveness was determined. In the study conducted by Kuszajewski et al. [22] with the participation of 50 nursing students and aiming to measure student perception of the effectiveness of virtual simulations in the nursing curriculum, it was found that student perception of the effectiveness of learning was very high in the analysis sub-dimension and generally high. The fact that the student perception of the effectiveness of learning in the virtual education implementation used in our study was very high is thought to indicate that the conceptual and design ground was well structured in the development process, the development was made by considering the evaluation tools, the content was detailed, the reality was reflected to a high degree, it did not interrupt the users during the experiences with its holism, it was developed according to the best simulation standards of INACSL, and it was well designed to reduce the cognitive load on the user and facilitate learning.

Second, to evaluate the implementation, a semi-structured focus group interview was conducted to obtain the experiences of the students after the virtual hospital/service and patient education, the use of the platform, and their opinions in terms of improvement. Because of the analysis of these interviews, 4 main themes and subthemes were identified.

It is stated that with the developed virtual service/patient applications, the patient's condition, family members, living environment, and physical examination should be evaluated in detail, and it should be possible to address the kind of needs the patient needs with a holistic approach [23]. Because of the analyses conducted in our study, the theme of providing the opportunity for holistic and integrated patient care emerged prominently. There are very few findings in the literature on the theme of holistic and integrated patient care. Among the reasons for this, it is

possible to list points such as the short duration of the virtual patient applications developed, focusing on a single skill/health condition, and not developing an application for the analysis of holistic health problems [18, 24].

The second main theme identified by qualitative analysis in our study was integration with the education program and clinical practice. The 3 sub-themes belonging to this main theme were "integration across years in the education program," "preparation for real clinical practice," and "clinical practice ensuring adequate case visibility." Similarly, in the literature, students stated that virtual patient applications should be implemented especially at the beginning of their educational and professional lives and that they make them ready for the clinical environment by building their competencies, that virtual patients are an integral part of the curriculum, and that they provide more practice opportunities in case of not being able to witness patient education and behavior in emergency situations [25]. It has also been stated that these applications can be complementary to existing teaching and learning approaches [26], complement in-class learning, enable more in-depth study with different scenarios that allow more practice to be ready for the clinic, contribute to the elimination of fears and psychological barriers by eliminating the problem of not having enough practice time in the clinical environment, provide preparedness for real situations, provide self-confidence in real clinical practice, and are more efficient when used integrated with mannequin-based simulations [27].

The third main theme that emerged from our study was positive, instructive, and realistic learning experiences and the environment. The three subthemes of this theme were "provide fun, instructive, and innovative learning experiences", "reinforcement of learning and acquisition of basic competencies", and "positive learning environment, emotional environment, and the emotions it elicits". Similar results to our study were found in the literature. Virtual patient implementations provide a motivating learning environment without stress, eliminate the fear of making mistakes and real patient pressure, its fun nature facilitates learning, virtual reality has a fascinating, innovative, and empowering nature, creates a safe learning environment, provides positive learning experiences and environments, facilitates learning with the fun arising from interaction, and enables confrontation with incomplete learning [26–29]. Virtual patient implementations help the development of problem identification and solving skills (critical thinking, independent thinking, etc.) along with nursing skills, encourage learning with feedback by transforming theoretical knowledge into clinical reasoning, increase learning motivation and help to establish an emotional bond with patients to be encountered in real life [23, 30].

The fourth main theme that emerged from the analysis of the qualitative data was the quality of the virtual hospital/service and patient education implementation and platform. The five subthemes of this main theme were "structure, scope, and flow of the virtual education application," "interactive, useful, and efficient design," "authenticity and attractiveness," "storytelling and personalization of the script and flow," and "aspects of the design that can be improved". There are many studies on the quality of virtual patient platforms. The findings of these studies support the results of our study. It has been stated in the literature that virtual patients should be easy to use [25]. It has been stated that it facilitates learning through its realistic and interesting content, provides contextual transfer, and is a learning tool that increases retention [28]. With the elimination of the difficulty of use, it has been observed that these teaching technologies can be fun, immersive, and memorable, and can create a sense of being present and in the flow with high realism and interaction [26]. It has been stated that virtual patient applications should be fluent and compatible with personal learning speed and should carry learners forward with feedback [31]. Again, points such as including auditory and visual clues and providing a more realistic experience with interactive scenarios were emphasized [30].

Virtual Service/Patient Education Implementation, Patient Care Plan, and Clinical Decision-Making Competencies

The evaluation of virtual hospital/service and patient applications is generally based on user knowledge, skills, attitudes, and satisfaction. In the literature, situations such as patient care planning and clinical decision-making are not evaluated much due to the lack of holistic and integrated cases, the short-term and low interaction level of the virtual patient applications developed, and the lack of long-term follow-up of the outputs as a result of virtual patient-based education [32].

One of the outcomes of the virtual hospital/service and patient-based education programs is the ability to prepare a patient care plan for perioperative and chronic patient management. In this study, the learners' achievements related to this competency were evaluated using a rubric at the end of the one-day virtual education program in the intervention group and in the control group regarding cases in the real environment. It was found that the care plan prepara-

tion skills of the intervention group were better than those of the control group, and that the virtual implementation provided gains at the targeted level. In the literature, there are not enough direct studies showing the effect of virtual patient-based education on the development of care plan preparation skills. In one of these limited studies, care plan preparation skill was measured at the perceptual level. Garcia-Pazo et al. [33] evaluated the usefulness of virtual reality in teaching the nursing process for the care of critically ill patients in a cross-sectional study with the participation of 111 nursing students. In the evaluation of self-efficacy perceptions related to planning nursing care, it was determined that the reality technology used moderately helped students plan the nursing care process for critically ill patients.

Similar to our results, many studies have found that the effects of VR technologies on learning are superior to traditional learning and assessment methods [34, 35]. In our study, it is possible to explain the high level of acquisition of skills for preparing a care plan in the intervention group by analyzing the entire process of the patient from hospitalization to discharge in a holistic and integrated manner.

Another outcome targeted by the virtual hospital/service and patient-based education programs is the development of clinical decision-making skills in learners. In this study, the measurements of the learners regarding this competency were made three times: at the beginning of the academic year, at the time of the virtual implementation, and at the end of the academic year. As a result of the evaluations, no significant change was found between the intervention group and the control group in any measurement, and between the post-intervention and pre-intervention measurements of the intervention group. On the other hand, it was observed that clinical decision-making skills improved after the web-based virtual patient implementation developed by Georg and Zary [36] for nursing education. Again, Liaw et al. [37] found an improvement in nurses' ability to recognize and intervene in patients whose condition deteriorated in the clinical environment after training using virtual patient-based education application they developed [37, 38]. In a study conducted by Padilha et al. [10] with the participation of 42 nursing students, significant progress was made in knowledge with virtual patient-based and low-quality simulator-based education. A high level of learning satisfaction was found, but no significant difference was found in the self-efficacy perceptions of learners [39]. In a quasi-experimental design study conducted by Kow et al. [40] in which 124 nurses participated and compared virtual patient-based education with online didactic education to evaluate clinical decision-making skills, it was stated that the clinical decision-making skill scores of the intervention group that received virtual patient-based education were significantly higher than those of the control group and that virtual simulations can be used as an effective teaching strategy for the development of clinical decision-making skills.

In a meta-analysis study including randomized controlled trials examining the effects of virtual patient implementations on clinical decision-making in the field of nursing, it is recommended that virtual patient implementations should include patient care management, sessions should be at least 30 minutes, feedback should be given after implementation, more than one scenario should be used, and it should be immersive to reduce cognitive load and improve clinical decision-making skills [18]. Although the virtual patient characteristics and education program we developed had all these features, no significant difference was found in clinical decision-making skills in our study.

Conclusion

This study provided evidence of the effectiveness of virtual service and patient simulation in developing care plan preparation and clinical decision-making skills for student nurses. In general, the student nurses who participated in the implementation experienced virtual services and patient interventions as innovative, effective, and active learning methods. The findings indicate the importance of integrating virtual services and patient implementations into nursing education and making such implementations a continuous part of nursing education. In this way, it will be possible to improve patient safety and improve the quality of nursing care by increasing clinical competencies, especially care planning and clinical decision-making skills.

Ethics Committee Approval: The Marmara University Institute of Health Sciences Ethics Committee granted approval for this study (date: 18.01.2021, number: 02).

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