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Web-Enhanced Learning versus Traditional Education: Its Effect on Nursing Students' Satisfaction and Learning of Urinary Catheterization Skills

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Abstract
Background: Innovative teaching methods are essential in nursing education to improve students' competency and equip them for complex healthcare demands. Urinary catheterization (UC) is a common nursing procedure, but improper insertion can harm patients. Nursing students require adequate training prior to starting clinical practice. It is the responsibility of educators to develop effective teaching methods to boost students' skills, knowledge, and satisfaction. **Aim:** This study aimed to investigate the effect of web-enhanced learning versus traditional education on nursing students' satisfaction and learning of UC Skills. **Design:** A quasi-experimental study. **Settings:** This study was conducted at the Faculty of Nursing, Suez Canal University. **Participants:** First-year nursing students (N=175) were enrolled. **Methods:** For data collection, three tools were used: a students' knowledge questionnaire, a UC observational checklist, and a students' satisfaction questionnaire. **Results:** Students who acquired their education online carried out the procedure more skillfully compared to traditionally educated peers ($p = 0.003$). They also achieved higher cognitive exam scores ($p = 0.029$) and greater satisfaction ($p = 0.019$). **Conclusion:** The study focused on the importance of utilizing the platforms and technologies that are currently more available than before to educate students using innovative instructional methodologies (web-enhanced learning) for enhancing student understanding, skills, and satisfaction. **Recommendation:** The study recommends that nursing faculties adopt innovative teaching techniques, leveraging technology to maximize hands-on practice. Creating a comprehensive online record of curriculum procedures on the faculty's website would be beneficial for ongoing skill development.

Keywords: Nursing Students, Urinary catheterization, Traditional Education & Web-enhanced learning.

Introduction
New prospects for education have been made possible by information and communication technology (ICT), particularly in higher education. Significant improvements in educational practice are now possible due to the advancement in ICT knowledge, methodologies, and strategies. As ICT has advanced, E-Learning has emerged as the model for contemporary education **(Al-Rahmi et al., 2020; Faisal & Kisman, 2020).** Nursing curricula must be updated to equip students with the necessary skills to effectively use technology, ensuring they can deliver safe and high-quality care in a rapidly evolving healthcare setting **(Stone et al., 2020)**. Therefore, every educational institution must create, maintain, and enhance educational strategies **(HHDNP, 2020; Singh et al., 2022)**.

Clinical practice is a crucial element of nursing education, bridging the gap between theory and practical application, especially in the field of nursing **(Devi, Khandelwal, & Das, 2019).** Traditional teaching methods, like lectures, are widely used in universities to impart theoretical knowledge, develop skills, and shape attitudes within a face-to-face context **(HHDNP, 2020)**. Lectures, typically presented by experts, provide detailed instruction on specific subjects, and when enhanced with multimedia aids, efficiently convey organized information to large student groups, promoting meaningful learning and attitude formation **(Armstrong & Taylor, 2020; Kakharova, 2023; Khan et al., 2020; Xing-ju, et al., 2013).** Traditional approaches to support the development of clinical skills in nursing students have centred on demonstration in small-group, hands-on learning in clinical labs. However, as curricula evolve, student enrollment increases, and scheduling constraints in labs mount, it becomes imperative to explore alternative delivery methods to ensure students can effectively build confidence in their clinical skill development **(Chang & Lai, 2021).**

Contrarily, web-enhanced learning is the integration of web technology into educational activities to support the learning–teaching process and boost student learning in a particular subject. It incorporates both synchronous and asynchronous instruction options, including computer-assisted learning. Although the teacher and student are separated by

distance, synchronously conducted classes nevertheless take place in real-time, unlike asynchronous learning, which occurs in non-real-time **(Amiti, 2020; Jonassen & Yarbrough, 2021).**

Web-enhanced learning can benefit from effective multimedia use, including movies with visual representations of psychomotor abilities **(Saregar et al., 2019).** Given that students can learn in an environment that integrates cognitive, affective, and psychomotor learning domains. Where theory and skill training are carried out concurrently, nursing students are expected to hands on skills competently in labs before clinical application **(Jonassen & Yarbrough, 2021).**

To ensure patient safety, allow nursing students to build self-confidence, and promote positive patient interactions, nursing education must precede clinical practice. Nursing faculty face the challenge of devising effective teaching methods to enhance student skills and knowledge. Adaptable, accessible learning aids that enable practice and review anywhere and anytime are essential **(Chuang et al., 2018).**

One of the core skills that disrupt patient safety is the UC skills, which is a critical procedure used in hospitals and long-term care facilities for acute care to monitor hemodynamic status, cure urine retention provide medicine, or irrigation. Up to 25% of adult hospitalized patients, according to the Centers for Disease Control and Prevention, require urethral catheterization **(Clarke et al., 2020).**

Urinary catheterization requires effective aseptic and adherence to insertion guidelines according to patient sex to prevent Catheter-Associated Urinary Tract Infection (CAUTI), urinary tract trauma and constrictions besides pain suffering **(Frödin et al., 2022).** CAUTI represents 70-80% of total urinary tract infections in healthcare settings, resulting in both patient morbidity and financial impact as a result of longer hospital stays and treatment of urinary tract infections **(Clarke et al., 2020).**

Many studies conducted in Egypt demonstrated a high prevalence of CAUTI with a great improvement in adherence to CAUTI prevention bundles and guidelines, resulting in a reduction of infection **(Abu Samra & Elsayed, 2022; Selim et al., 2018; Tan et al., 2019).** CAUTI preventive evidence-based practice is directly linked to the education and training they have received **(Kilgore, 2017).** UC is a fundamental nursing skill that can only be practised on real patients by putting the patient or trainees in an uncomfortable or upsetting scenario, even when done by a nurse or doctor **(Chang, 2022; Putri et al., 2023).**

The manipulation of sexual organs is frequently stigmatized and causes embarrassment and feelings of privacy infringement, limiting students' ability to learn new skills and knowledge **(Yoo et al., 2010)**. Thus, having the necessary knowledge and employing appropriate nursing procedures while providing patient care help to increase patient safety and boost students' confidence **(Herron et al., 2019; Vaismoradi et al., 2020).** Students with greater confidence in their abilities are more likely to understand the importance of these skills in nursing care and to be eager to put those skills to use **(Chen et al., 2020; Labrague et al., 2019)**

Satisfaction with education is crucial for higher education students **(Abuhassna et al., 2020).** Universities gauge their websites' efficacy using student satisfaction as a benchmark. Enhancing student satisfaction is essential for institutions aiming to bolster profitability by cultivating positive behavioural attitudes and intentions **(Yilmaz, 2017).** Student satisfaction refers to students' subjective evaluations of how effectively a particular learning environment supports academic performance **(Oducado & Estoque, 2021)**. Various factors influence learner satisfaction, including faculty, colleges, individual elements, interaction/ communication, course components, and the learning environment **(Abuhassna et al., 2020).** Strong student satisfaction may indicate that the instructional methods are effectively encouraging students' thinking and learning **(Harsasi & Sutawijaya, 2018).**

Significant of the study:

Incorporating technology into nursing curricula is believed to enhance efficiency and enrich student experiences by fostering active and interactive learning approaches **(Smart et al., 2020).** Online education programs (OEPs) are now a crucial tool for nursing programs, particularly with the rapid shift to platforms like Zoom and Microsoft Teams. This transition has resulted in a greater reliance on OEPs by both faculty and students, both inside and outside the classroom. It serves as a complementary approach to traditional learning methods, providing opportunities for interactive and engaging educational experiences **(Schuler et al., 2021).** As the nursing field embraces digital advancements, the use of web-enhanced learning is expected to play a vital role in facilitating learning and preparing future nurses for their professional roles. However, the lack of evidence makes this challenging. This study intends to shed light on the efficacy of web-enhanced learning in the context of nursing education, ultimately contributing to the ongoing progress and improvement of nursing education practices.

The present study aimed to investigate the effect of web-enhanced learning versus traditional education on nursing students' satisfaction and learning of UC

skills. Thus, the following hypotheses were developed:

H1: Using web-enhanced learning is more effective than using traditional education for teaching psychomotor abilities.

H2: Using web-enhanced learning is more effective than using traditional education for teaching cognitive abilities.

H3: Using web-enhanced learning leads to greater satisfaction than traditional education.

Methodology

Study design: A quasi-experimental study.

Setting: The study was conducted at the Faculty of Nursing, Suez Canal University.

Study Sample (Participants):

The sample size was confirmed using G*power version 3.1.9.6 **(Brysbaert, 2019; Faul et al., 2007)** using the formula $n = (Z\alpha)2 \times pq/d2$, with an effect size of 0.5, 90% power, and a significance level of 0.05. The required sample size was 86 participants for each group, with a 10% dropout rate considered. Participants were chosen using purposive sampling and divided into an experimental group (95 students learning UC techniques through web-enhanced learning) and a control group (95 students using traditional methods). However, only 175 participants, 86 in the experimental group and 89 in the control group, completed the study.

Inclusion Criteria:

Participants must be first-year nursing students enrolled in the 2022-2023 academic year, willing to attend the practical and theoretical parts of the procedure, then hands-on the procedure, and take part in assessments. They should not have prior catheterization training. Web-Based Learning Group participants need internet access, Microsoft Teams proficiency, and personal computers or mobile devices.

Study tools: Three tools were used for data collection, and they were formatted as follows:

Tool I. Students' knowledge questionnaire composed of two parts:

Part 1. Students' personal information:

It was used to compile information on each student's profile, including their age, sex, ability to pay for internet expenses, ability to use electronic learning platforms, and whether their internet connection was strong enough.

Part 2. Students' knowledge questionnaire about UC:

A self-administered English questionnaire was developed by the researchers based on previous studies **(Crisp et al., 2012; Lynn, 2018; Perry et al., 2013; Perry et al., 2017)** to evaluate the nursing student's understanding of UC; indications according to each UC type, principles of UC insertion, insertion preparation and securement care, and after removal care. It has 20 questions, including two true/false questions and 18 multiple-choice questions. Each right answer received one point, while incorrect answers got zero. The total score was 20 points, ranging from 0 to 20, with 0 representing the lowest and 20 representing the highest.

Tool II. UC observational checklist:

The UC observational checklist was adopted from **(Lynn, 2018; Perry et al., 2013; Perry et al., 2017)** to assess students' competency in UC techniques. The checklist contained 30 steps, and each step's performance was graded as follows: not done (0 degrees), done but not appropriately (1 degree), or appropriately done (2 degrees). The total score was 60, with 0 as the lowest and 60 as the highest.

Tool III. Students' satisfaction questionnaire:

This questionnaire was developed by the researchers based on previous studies **(Sharma et al., 2020; Topal, 2016)** to gauge the degrees of satisfaction with the chosen instructional approach in both groups. With 21 items were categorized into four dimensions: instructors' dimension (consisting of 7 items), evaluation dimension (consisting of 4 items), general skills and learning experiences dimension (consisting of 5 items), and course content and teaching process dimension (consisting of 5 items). Each item was scored on a Likert-type scale from 1 to 5, with 5 representing the strongest agreement and 1 the weakest. The total score was between 21 and 105, with 21 being the worst and 105 representing the greatest**.**

Tool reliability

Cronbach's alpha for the student satisfaction questionnaire was 0.92, which was regarded as a satisfactory level, whereas the UC observational checklist and knowledge were 0.80 and 0.75, respectively, which was regarded as a respectable level.

Tool validity

A panel of five bilingual experts were selected as a panel to evaluate the tools' face and content validity. The panel's feedback helped determine the necessary changes, which were then implemented to create the final and validated version of tools.

Pilot study

A pilot study assessed questionnaire reliability and time constraints, resulting in suggestions for necessary modifications. Moreover, 20 students (10% of the study population) were excluded. The knowledge and satisfaction questionnaire required 25 to 35 minutes for completion. The participants completed the procedure on 10 to 15 minutes.

Ethical considerations

The students were asked to thoroughly read the informed consent letter prior to study participation, which included the following information: they confirmed that their participation was anonymous with protection to confidentiality; an overview of the study's objectives; an assurance that answering the questions will not cause undue hardship; and their scores will not affect their semester or final grades. They had the option to withdraw study participation at any time. The Institution's Research Ethics Committee revised the research proposal with No. (154).

Data collection

From last October to mid-November 2022, a period of 4 weeks, data were gathered from students throughout the first term of their first academic year. The researchers gathered the students, explained the study's significance, and secured their consent to take part in data collection. The participants were then divided into two equal groups.

The UC skill was divided into theoretical and practical parts. The theoretical aspect was conveyed through lectures and included the definition, purpose, indication, contraindications, and side effects. In the practical part, the researchers show the students how to do the catheterization procedure step by step. They explain why each step is important and point out things to remember. After that, the students get to try it themselves, with the researchers guiding them and giving feedback on how they are doing.

During the first week, the control group attended a faculty pre-lab session. During this session, they learned the theoretical part of UC skills through a lecture accompanied by discussions and a question-and-answer session to ensure a better grasp of the concepts related to the procedure. Following this, the students were split into eight groups, each consisting of 11–12 students. The practical part of UC was explained to them, and after that, they hands-on the procedure in the faculty laboratory. In the second week, their performance was assessed using the UC observational checklist. They completed knowledge and satisfaction questionnaires using paper-based methods.

During the third week, the experimental group attended online lectures through the Microsoft Teams platform at a pre-determined time. The researchers provided the same instructional material used by the control group during this online session and also provided an opportunity for discussion and answer any questions from the participants. Additionally, the researchers used a synchronized teaching method through videos of the UC procedure carried out in the faculty laboratory to further elucidate the practical application of the skill. Afterwards, the students practised the procedure in small groups each consisting of 11–12 students in the faculty lab and received feedback.

During the fourth week, students' performance was evaluated using a UC observational checklist. After this assessment, the researchers requested the students to complete knowledge and satisfaction questionnaires distributed through a Microsoft Teams form. These questionnaires were then electronically reviewed and scored.

Statistical analysis

The study employed IBM SPSS Statistics (version 26) and Microsoft Excel for data analysis. Frequency and percentage descriptions were used to present the participant's profile. Means and standard deviations were used to describe the students' knowledge of UC, performance, and satisfaction. Non-normally distributed data, as determined by the Kolmogorov–Smirnov test, were compared between non-dependent groups using the Mann–Whitney U and chi-square tests according to the data type. The confidence interval used was 95%, and the significance level was set at 0.05.

Results

Table (1): Frequency distribution of personal characteristics of the study subject (N = 175).

Participants characteristics	Traditional Education N=89	Web-Enhanced Learning N=86	χ2	P value
Age Mean, (± SD)	18.73 (± 0.61)	18.75 (±0.59)	3729.5 [a]	.741
Sex Male Female	32 (36%) 57 (64%)	39 (45.3%) 47 (54.7%)	.228 [b]	.633
Can you afford the costs of using the internet? Yes No	82 (92.1%) 7 (7.9%)	81 (94.2%) 5 (5.8%)	.470[b]	.493
Do you have a reliable Internet connection? Yes No	69 (77.5%) 20 (22.5%)	62 (72.1%) 24 (27.9%)	2.158[b]	.142
Are you capable of using electronic learning platforms? Yes No	68 (76.4%) 21 (23.6%)	63 (73.3%) 23 (26.7%)	1.827 [b]	.176

[a] *Mann-Whitney U* [b] *Pearson's Chi-square test*

Table (2): Student knowledge about UC among the study groups (N = 175).

Knowledge Items	Traditional Education Correct answer		Web-Enhanced Learning Correct answer	
	N=89	%	N=87	%
Selection of proper catheter type according to indication				
• Indwelling urinary catheter	41	46	41	47.1
• *Intermediate catheter	33	37	26	29.8
• Condom catheter	43	48.3	49	56.3
• Supra pubic catheter	33	37	64	73.5
Principles of urinary catheter insertion				
• Strict aseptic technique	66	74.1	70	80.4
• Avoid injury through	48	53.9	60	68.9
o **Mechanical hematoma				
o *Proper catheter size	49	55	58	66.6
Insertion:				
• *Position according to sex	77	86.5	80	91.9
• *Disinfection technique of urinary meatus	40	44.9	47	54
• Urinary catheter lubrication	52	58.4	53	60.9
• *Advancement length of a urinary catheter according to sex	75	84.2	72	82.7
• Balloon securement recommended amount of liquid	46	51.6	56	64.3
After removal care	30	33.7	39	44.8

**2 questions* ***3 questions*

Table (3): Student satisfaction of the study groups (N = 175)

Satisfaction dimensions	Traditional Education		Web-Enhanced Learning	
	Mean	SD	Mean	SD
Instructors' dimension	26.70	4.19	28.63	4.77
Evaluation dimension	14.85	3.02	15.95	3.11
General skills and learning experiences dimension	19.43	3.29	20.91	3.41
Course content and teaching process dimension	19.30	2.63	19.19	3.60

Table (4): Comparison of satisfaction, skills, and knowledge scores between the study groups (N = 175)

Variables		Score					Mean Whitney test		
Dependent variables	**Independent variables**	**N**	**Mean**	**SD**	**Min**	**Max**	**Mean rank**	**U**	**p**
Satisfaction	Web-Enhanced Learning (Experimental group)	86	84.70	13.07	57	105	97.15	3040	.019*
	Traditional Education (Control group)	89	80.30	11.61	41	105	79.16		
	Total	175							
Skills	Web-Enhanced Learning (Experimental group)	86	50.60	6.93	31	60	99.70	2820.5	.003*
	Traditional Education (Control group)	89	47.66	6.90	34	60	76.69		
	Total	175							
Knowledge	Web-Enhanced Learning (Experimental group)	86	13.12	0.39	5	19	96.49	3097	.029*
	Traditional Education (Control group)	89	11.94	0.38	4	18	79.80		
	Total	175							

**p<0.05*

Table (1): Shows the homogeneity of the groups, as there was no significant difference in characteristics between the control and experimental groups. The participants' mean age was 18.73 and 18.75 years in the control and experimental groups, respectively. The control (64%) and experimental (54.7%) groups showed female predominance. Both the control and experimental groups responded "yes" when asked if they could endure the expense of the internet (92.1% and 94.2%, respectively) if they had an internet connection available (77.5% and 72.1%, respectively) if they were capable of using electronic learning platforms (76.4% and 73.3%, respectively).

Table (2): Shows that the highest levels of students' knowledge scores among traditional and web-enhanced groups were about patient's proper insertion position according to patient sex 86.5%, 91.9%, and advancement length of the urinary catheter according to sex 84.2% and 82.7%, respectively. On the other side, the lowest students' knowledge scores among traditional and web-based groups were about the indication of insertion of intermediate catheter type 37%, 29.8% and after removal care 33.7%, 44.8%%, respectively. However, the student's score about the indication of insertion supra pubic catheter type was 37%; it was higher among the web-based group at 73.5%.

Table (3): Displays that the experimental group had a higher satisfaction level than the control group in all satisfaction dimensions except in the course content and teaching process.

Table (4): Shows that the experimental group had a higher satisfaction level, with a mean score of 84.70 than the control group, with a mean score of 80.30 (p = 0.019). Regarding students' performance, the experimental and control groups scored 50.60 and 47.66, respectively, showing a statistically significant difference (p = 0.003). For students' knowledge, the experimental and control groups scored 13.12 and 11.94, respectively, showing a statistically significant difference (p = 0.029).

Discussion

The fast advancement of ICT has caused an extraordinary transformation in universities worldwide to keep up with the enormous improvement in the nursing profession and its capabilities. Many studies have shown that the web-based learning method provides nurses with more efficient education than the conventional in-class setting **(Chuang et al., 2018; Jonassen & Yarbrough, 2021).** As instructors are periodically unavailable or preoccupied, students need to watch and practice skills numerous times at their own speed without interruptions **(Chuang et al., 2018).**

Concerning the 1st hypothesis stating that using web-enhanced learning is more effective than using traditional education for teaching psychomotor abilities

The current study's findings showed that the web-enhanced group performed better than the traditional group in urinary catheter practice scores. From the researchers' point of view, this may be attributed to students' ability to recall the practice done by the instructor and students in the faculty skill laboratory (both synchronized and asynchronized).

This was analogous to the findings of previous studies **(Chuang et al., 2018; Hansen et al., 2011; Jonassen & Yarbrough, 2021; Öztürk & Dinç, 2014)**. According to **(Barisone et al., 2019)**, who used a qualitative approach to examine the impact of

web-enhanced learning on undergraduate nursing students' acquisition of clinical skills, including UC, they explained that the student's abilities to review and memorize the skills at their own convenience improved their clinical skills' acquisition, especially after performing the procedures; thus, they learn from their own mistakes. This concurs with the findings of **Öztürk & Dinç (2014)**, who found a significant correlation between website visits and students' skill performance scores.

Contrarily, **Edeer et al. (2019)** discovered that there was no statistically significant difference between the web-based and conventional groups in terms of student clinical performance in preoperative and postoperative nursing care. This can be due to the different evaluation procedures and environments.

Concerning the 2nd hypothesis stating that using web-enhanced learning is more effective in teaching cognitive abilities

The current study demonstrated a significant difference in knowledge acquisition between the traditional and web-enhanced groups. According to the researchers' point of view, this may be due to the nursing students' access to the tutor's recordings, ability to review the material more than once and learn at their own pace, time flexibility, and comfortable learning environment that permits taking notes for significant points.

This was consistent with the findings of several studies reporting that students receiving web-enhanced learning supplements had greater knowledge scores than those in traditional classrooms **(Barisone et al., 2019; Kudubes & Bektas, 2020).**

However, this result contradicts the findings of previous reports **(Edeer et al., 2019; Öztürk & Dinç, 2014)** that found no significant difference in the degree of knowledge acquisition between web-based and traditional education. The above studies provided web-based education through recorded videos and did not allow students to ask, communicate, and interact. Therefore, students felt alone and behind since there was not enough effective interaction between them and the instructor through questions and answers **Park et al. (2020).** This accounts for the significant discrepancy. During our investigation, this finding was taken into account; hence, synchronized and asynchronous communication was present during classes.

Concerning the 3rd hypothesis stating that using web-enhanced learning leads to greater satisfaction than traditional education

While the experimental group demonstrated higher levels of satisfaction compared to the control group, it is noteworthy that both groups expressed considerable satisfaction with the teaching and learning approach employed. From the researchers' standpoint, both the control and experimental groups' satisfaction holds significant importance as students' satisfaction is considered a benchmark for college accreditation, which stimulates the nursing college to create favourable and conducive learning environments for all students.

From the researcher's perspective, the experimental group exhibits greater satisfaction. This could be attributed to the widespread accessibility of the internet and mobile applications, which facilitate access to online learning platforms. Additionally, students have honed their technical proficiency, especially in the aftermath of global challenges. This trend suggests a growing prevalence of web-enhanced learning.

These results align with those of **Faize & Nawaz (2020)**, who reported that students had higher satisfaction with online learning compared to offline learning. Also **Oducado & Estoque (2021)** found that over half of undergraduate nursing students were satisfied with synchronized and asynchronized online learning. Additionally, **Sharma et al. (2020)** noted that more than half of students expressed satisfaction with online learning. In the study conducted by **Widiasih et al. (2022),** it was found that a web-based simulation significantly enhanced nursing students' knowledge of nursing skills, their satisfaction, and their self-confidence in performing IV catheterization for patients when compared to the students in the control group.

In contrast to **Dutta et al. (2021)**, who found that first-year students were dissatisfied with online learning, it was also concluded that online learning is essential in current times but may not be an effective alternative for medical and nursing education. The study suggests that a combination of face-to-face classes, practical sessions, and online learning can be a viable approach.

Conclusions

Our web-enhanced method improved the acquisition of a desired outcome in the form of student academic performance, knowledge achievement, and satisfaction, especially when coupled with synchronized and asynchronized web-enhanced learning that enhances student memory and maintains student interaction with teachers. The students receiving web-enhanced learning at UC had more knowledge and psychomotor capabilities than those receiving traditional education. Due to their familiarity with technology and skill in using online learning platforms, the experimental group expressed higher levels of satisfaction than the control group.

Limitations

The current study cannot be generalized because it was conducted on one nursing skill (urinary catheterization) and first-year undergraduate students only. However, the results of the current study showed a promising effect of web-enhanced learning on training undergraduate students' UC skills.

Recommendation:

The study recommends that nursing faculties adopt innovative teaching and learning techniques that leverage technology's full potential. This approach can maximize students' hands-on laboratory practice time. As the number of nursing students continues to rise, creating a comprehensive online record of curriculum procedures on the faculty's website would be beneficial for ongoing skill development. Faculty should regularly assess student satisfaction and work to improve the motivating learning environment. Further research in this direction is essential to enhance nursing education and the overall student learning experience.

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