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Research

Filipino nursing students' use of low-cost simulators during the COVID-19 pandemic: A summative content analysis of YouTube videos

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ABSTRACT

This study examined Filipino nursing students' use of household materials as low-cost simulators and how they aid in online return demonstrations. Summative content analysis guided this study. We collected uploaded YouTube videos (n = 14) depicting Filipino nursing students using low-cost simulators in their skills demonstration. We used Bengtsson's approach to content analysis to analyze the data. Four themes of low-cost simulators were identified: home and hardware, health and beauty, creative articles, and entertainment. The categories under home and hardware were tools, containers, furniture, and packaging. Health and beauty low-cost simulators were toiletries and medical supplies. Creative articles included fabrics, clothing accessories, and stationeries. Entertainment low-cost-simulators had toys and computer accessories. During the COVID-19 pandemic, our research uncovered home equipment employed as low-cost simulators to help nursing students' online simulation of skills demonstration. We recommend further investigation of whether students learned using low-cost simulators.

Introduction

Coronavirus disease (COVID-19) is a pandemic first reported in December 2019 in Wuhan, China. The COVID-19 pandemic negatively impacted society, and education was no exception. Educational institutions (e.g., universities, colleges, and schools) have remained closed for on-site or face-to-face learning and relied on online and distance learning to deliver classes (Berdida & Grande, 2022). Online learning allowed students in nursing schools to continue their academic and clinical courses. Online learning is an alternative educational platform using the internet and other essential technologies to create learning resources, deliver teaching, and manage a program (Adedoyin & Soykan, 2020). Nursing schools adapted their curricula to accommodate online classes to avoid a potential learning gap among students, employing approaches such as simulations to achieve learning outcomes (Berdida & Grande, 2022).

Earlier published research described a variety of materials and equipment to teach laboratory skills courses. Computers or virtual reality simulators can be used, as well as low-cost materials like PVC pipes, cardboard boxes, and handcrafted mannequins (Clariot et al., 2020; Muckler et al., 2017; Talley & Watts, 2020). Several studies focused on the high-tech simulators (Hippe et al., 2020; Soriero et al., 2020) utilized in universities where students took face-to-face classes before the epidemic. However, because the COVID-19 pandemic safety protocols prevented face-to-face classes, students could not use such simulators. Students worldwide had to resort to employing home items as simulators to exhibit their skills to continue conducting skills laboratory courses in an online environment (Angelina et al., 2021; Van Der Wege & Keil, 2021).

Nursing students communicate their experiences in the form of words (e.g., tweets), images (e.g., snaps), and even videos (e.g., TikTok, YouTube) on different platforms, owing to the popularity of social media as an outlet for expression. The materials used in return demonstrations, whether they are skill-specific materials or improvised makeshift substitutes for the original equipment, were uploaded by nursing students to social media. YouTube, a major social media platform, archives recorded videos of nursing students' return demonstrations (e.g., urinary catheterization, cord care, newborn bathing, perineal care). Interestingly, these videos depict students using home materials as low-cost simulators. Thus, empirical investigations of YouTube videos showing nursing students' use of home materials as low-cost simulators remain an understudied phenomenon in nursing education.

To our knowledge, no study examined nursing students' use of household materials as low-cost simulators on YouTube videos utilizing a content analysis approach. This study analyzed how nursing students used these low-cost simulators for online return demonstrations in skills laboratory courses. The uploaded videos on YouTube

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were the primary sources of data. Understandably, limited time was allotted to revise the nursing curriculum to online learning due to the rapid onset of the lockdown imposed by the pandemic (Agu et al., 2021). In contrast, the standard curriculum was prepared for years and constructively aligned with students' learning needs (Grande et al., 2021). More than ever, understanding various household materials as simulators is necessary to ascertain the viability of low-cost simulators in achieving learning outcomes of the nursing curriculum during the COVID-19 pandemic. Therefore, this study investigated Filipino nursing students' use of household materials as low-cost simulators and how these simulators aided with their online simulated return demonstrations as depicted in YouTube videos.

Background

Simulation imitates tasks, relationships, phenomena, or behaviors in real life (Aebersold, 2018). It is an approach for replacing a realistic experience and replicating significant aspects of the natural environment in a completely interactive manner (Albagawi et al., 2021). With modern technology, simulation in nursing education rapidly increased (Aebersold, 2018). A critical aspect of the nursing simulation is fidelity. Fidelity is typified by the realism and authenticity of the simulation experience (Lavoie et al., 2020). Hayden et al. (2014) suggested three levels of simulation fidelity: low, medium, and high. Low-fidelity simulations lack realism (e.g., case studies, role-playing, task trainers, or static mannequins). Medium-fidelity simulations employ full-body simulators that are more realistic than static mannequins (e.g., mannequins exhibit breath sounds, bowel sounds, and interacting with students). High-fidelity simulations use a standardized patient or a full-body simulator with mannequins to mimic the patient-care scenario.

Simulation-based learning refers to any educational activity that uses simulation tools to recreate case scenarios (Aebersold, 2018). It facilitates the acquisition of necessary skills through practice and serves as an alternative to actual patients. Furthermore, nursing students may make mistakes without endangering patients (Lavoie et al., 2020). Through simulations, student errors are reduced, and a safety culture is maintained (Jeffries et al., 2015). Various simulation tools have emerged and been developed to improve education and training in nursing. Nonetheless, the primary goal is to improve patient safety and care (INACSL Standards Committee et al., 2021).

Globally, numerous nursing schools use online education to comply with COVID-19 guidelines (Agu et al., 2021). Using simulations to attain learning outcomes, nursing schools have modified their curricula to suit online education (Grande et al., 2022). However, not every student has ready access to medical equipment. Consequently, some students resorted to low-priced simulators for their online simulated return demonstration. Low-cost simulators are inexpensive, environmentally friendly, and ready-to-use materials, such as home materials and equipment (Angelina et al., 2021; Van Der Wege & Keil, 2021).

Using household equipment to create low-cost simulation tools utilized by the students, trainers, and facilitators in the performance of clinical skills in the current online distance learning environment has served its purpose (Van Der Wege & Keil, 2021). Fruits and vegetables (e.g., grapes, oranges, cucumber), meat, common household goods (e.g., corrugated plastic tubes, towels, toilet paper tubes), and educational supplies (e.g., foam, balloons, modeling clay) were cited as commonly available, low-cost simulators. Oranges and watermelons represented a vaginal intrapartum inspection (Shea & Rovera, 2015). Muckler et al. (2017) replicated a cricothyrotomy technique with a low simulated trachea using everyday household items such as inner cylindrical cardboard tubes of toilet paper, paper towel rolls, and small balloons. Talley and Watts (2020) investigated simulating a thoracentesis with paper towel holders, zip ties, basins, and unstuffed turkey. Similarly, a simulation of suprapubic catheter placement was conducted utilizing a lunchbox as the abdomen along with a party balloon, water-filled gloves, and gelatin (Gao et al., 2019; Nonde et al., 2020). However, medical students utilized these inexpensive simulators to practice their skills (Muckler et al., 2017; Nonde et al., 2020).

In teaching and learning online courses, low-cost simulators as models during clinical scenarios among nursing students proved practical and effective (Van Der Wege & Keil, 2021). There are few studies involving nursing students using low-cost simulators in online courses, particularly during the current COVID-19 pandemic. In nursing education, this is still an understudied area. Thus, this study investigated uploaded YouTube videos depicting Filipino nursing students using household equipment as low-cost simulators during their simulated online return demonstrations.

Theoretical Underpinning

This study is anchored on the National League for Nursing (NLN) Jeffries Simulation Theory (Jeffries & Rogers, 2012; Jeffries et al., 2015). There are six core elements in NLN Jeffries Simulation Theory: context, background, design, educational practices, simulation experience, and outcomes.

We highlighted nursing students using household equipment as low-cost simulators to aid their return demonstrations during online simulations. The technique of employing low-cost simulators is embedded in the simulation design element of NLN Jeffries Simulation Theory (Jeffries & Rogers, 2012; Jeffries et al., 2015). Simulation design includes specific learning objectives, desired fidelity, learner role assignments, simulation flow, and strategies for pre-briefing/debriefing (Cowperthwait, 2020). In utilizing low-cost simulators, learners must understand the desired fidelity of these simulators. Fidelity is defined as the degree of realism of a simulation and includes physical, conceptual, and psychological dimensions (INACSL Standards Committee et al., 2021).

There are three levels of fidelity: low, mid, and high (Lavoie et al., 2020). First, low fidelity simulation may include an intravenous (IV) arm or cardio-pulmonary resuscitation (CPR) manikins. The second type is mid-fidelity, which helps people learn new skills, such as full–body manikins with breath patterns, bowel sounds, and heartbeat tones. Finally, high–fidelity is the most realistic type and engaging. On the other hand, Beaubien and Baker (2004) identified three elements of simulation fidelity. The first element, equipment fidelity, refers to a simulator's appearance and feel. The second is environment fidelity. It involved the cues and other sensory information available to the learner in the simulator's environment. The third element is psychological fidelity, which refers to how much learners trust in simulation as a credible surrogate for an authentic task. Correspondingly, using household materials as low-cost simulators offer low-fidelity simulation experiences to learners. However, nursing students may experience the three elements of simulation fidelity, which our paper aimed to investigate.

Although high-fidelity simulations are highly realistic and have proven to enhance student's overall learning outcomes (Lavoie et al., 2020), low-cost simulations were reported to equally improve learners' knowledge and competence (Angelina et al., 2021). NLN Jeffries Simulation Theory encourages nurse educators to consider all simulation elements for learners to attain high-level outcomes (Jeffries & Rogers, 2012; Jeffries et al., 2015). The ultimate objective of the simulation is to enhance learners' knowledge, attitude, and skills toward quality and safe patient care.

Methods

Research Design

Summative content analysis (SCA) was used to analyze the YouTube videos showing Filipino nursing students using common

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household equipment as return demonstration low-cost simulators. SCA is a research design utilized in investigating phenomena of interest in an unobtrusive and non-interactive approach (Hsieh & Shannon, 2005). SCA refers to a combination of manifest and latent content analysis. The manifest content analysis highlights what the participants say in their own words, using their language, and describing the text's apparent elements. Conversely, the latent content analysis attempts to deduce the text's underlying meaning (Bengtsson, 2016). Because SCA requires counting and comparing keywords or material and evaluating the underlying context and meanings, this design was appropriate for the study's purpose (Bengtsson, 2016; Hsieh & Shannon, 2005).

Ethical Considerations

This study was exempt from an entire review board because its research design was unobtrusive. After submitting the necessary documentation, the researchers received ethical approval from the University of Santo Tomas College of Nursing Ethics Review Committee (reference number: USTCON ERC – 2021-SR32; approval date: September 21, 2021). To maintain anonymity, we withheld the content creator's personal information (e.g., name, gender, age, and location). Their social media account usernames were not revealed. This research was limited to low-cost simulators utilized and posted on YouTube. Therefore, no personal comments made by the creators in their videos or articles are included.

Data Gathering

Between March 15, 2020, and April 1, 2021, data was collected from uploaded videos on TikTok and YouTube. We used keywords (e.g., BSN, COVID-19 online simulation, COVID-19 simulation, Filipino nursing student, nursing, nursing school, nursing student, retdem during COVID-19, retdem, return demo, return demonstration, sims, simulations, skills demonstration, student nurse) to find related videos from social media posts. The search results were sorted according to their content by the researchers.

The study's inclusion criteria included videos created and uploaded in the Philippines by Filipino nursing students. They have legitimate social media accounts (crosschecked with other social media accounts [e.g., Facebook, Instagram, Twitter] that the same content creator is the owner and nursing students). The uploaded YouTube videos were in a public setting. Additionally, videos depicted a clear nursing skills demonstration, nursing students' English use, and employed low-cost household materials. A public social media account (e.g., Facebook, Instagram, Twitter) is accessible anytime by the general public without restrictions. While a private social media account (e.g., Facebook Messenger, WhatsApp, WeChat, Instagram's Direct Messages [DMs]) allows users to choose when to share data and with whom to communicate. Currently, public social media accounts have settings to convert them to private.

Exclusion criteria included displaying entertainment, poor video quality, no or unclear audio, obstructed view of skills demonstration, using medical equipment that was not widely available, and the content creator using the Filipino language. Finally, for data analysis, we exclusively used YouTube videos. We excluded TikTok videos in this study because they portrayed entertainment, skills demonstrations were obstructed, short-duration videos (most are less than one minute), and how they used the low-cost simulators was indiscernible.

Initially, 203 YouTube and TikTok videos were collected and tabulated using Google sheets. The researchers evaluated and analyzed the videos independently using the inclusion and exclusion criteria. During the first screening, 187 videos were excluded due to privacy concerns (the name of the videos and links were displayed; however, a privacy warning appears on the video when played), an obstructed view of the nursing skill, poor audio-video quality, entertainment depiction, not showing skills, repeated links, and the use of low-cost simulators. As a result, 16 videos were considered eligible. Due to privacy concerns, two videos were excluded from the second screening, leaving 14 videos for content analysis (Fig. 1).

Mode of Analysis

The collected data was analyzed using SCA. This mode of analysis emphasizes the underlying meaning of words or content (Bengtsson, 2016; Hsieh & Shannon, 2005). We used Bengtsson's (2016) four content analysis steps: decontextualization, recontextualization, categorization, and compilation.

The decontextualization stage entails recognizing meaning units in transcribed data (Bengtsson, 2016). We manually transcribed YouTube videos, including verbal and non-verbal cues. Although YouTube has a closed captioning that generates transcripts, there were significant inconsistencies. Also, most of the analyzed videos had no closed captioning. Thus, we decided to transcribe the selected videos manually. All researchers watched and validated the consistency of the transcription. Transcribing nonverbal cues involved detailing how a nursing student utilized a low-cost simulator (nonverbal cues were placed in brackets in the tables). These accompany participants' verbalizations. The data were reviewed to understand the meaning units and created the codes. Coding involved marking meaning units with context-related codes. The codes were used to generate the codebook, which comprises the concepts and categories required to arrange and analyze data. The recontextualization stage involves including the most critical content and removing the dross (unmarked or unrelated texts). A color-coding technique was utilized to find significant data rapidly. In this phase, we distanced from the data, reviewed the meaning unit and code list, reread the original transcript, and determined the most significant codes.

The categorization stage entailed discovering homogeneous codes by compressing related codes into large categories or themes (Bengtsson, 2016). From hundreds of codes, we discovered 12 themes and reduced them to four. Finally, the compilation stage of data analysis involved generating reasonable conclusions. Member-checking or participant validation improves the findings' validity (Bengtsson, 2016). This study analyzed YouTube videos without actual people; we used expert validators (i.e., research supervisors, nursing simulation professors, and content analysis experts) to enhance our findings' trustworthiness.

Intercoder reliability provides a realistic technique for establishing reliability in qualitative data analysis, specifically nominal data (O'Connnor & Joffe, 2020). Wimmer and Dominick (2006) proposed that the researchers code at least 10% of the data. Our study exceeded this requirement since each researcher coded all the YouTube videos (n = 14). We used "yes," and "no" decisions for each video to reach an intercoder agreement. If there were more than five "yes," the coded video was included. We excluded the video for further analysis if more than five "no" was obtained. However, the coded transcript will be reread and reviewed for videos with fewer than five "no" until we reach a consensus. The research supervisors acted as the arbitrator when there was a disagreement regarding a specific meaning unit, code, or theme. The researchers were adept at nursing simulation. They have local and international certifications and annual simulation training. Their research supervisor had a doctorate in curriculum and instruction with a specific focus on nursing simulation.

Trustworthiness

Before the data gathering procedure, the researchers continuously identify critical points using Elo et al. (2014) checklist to improve

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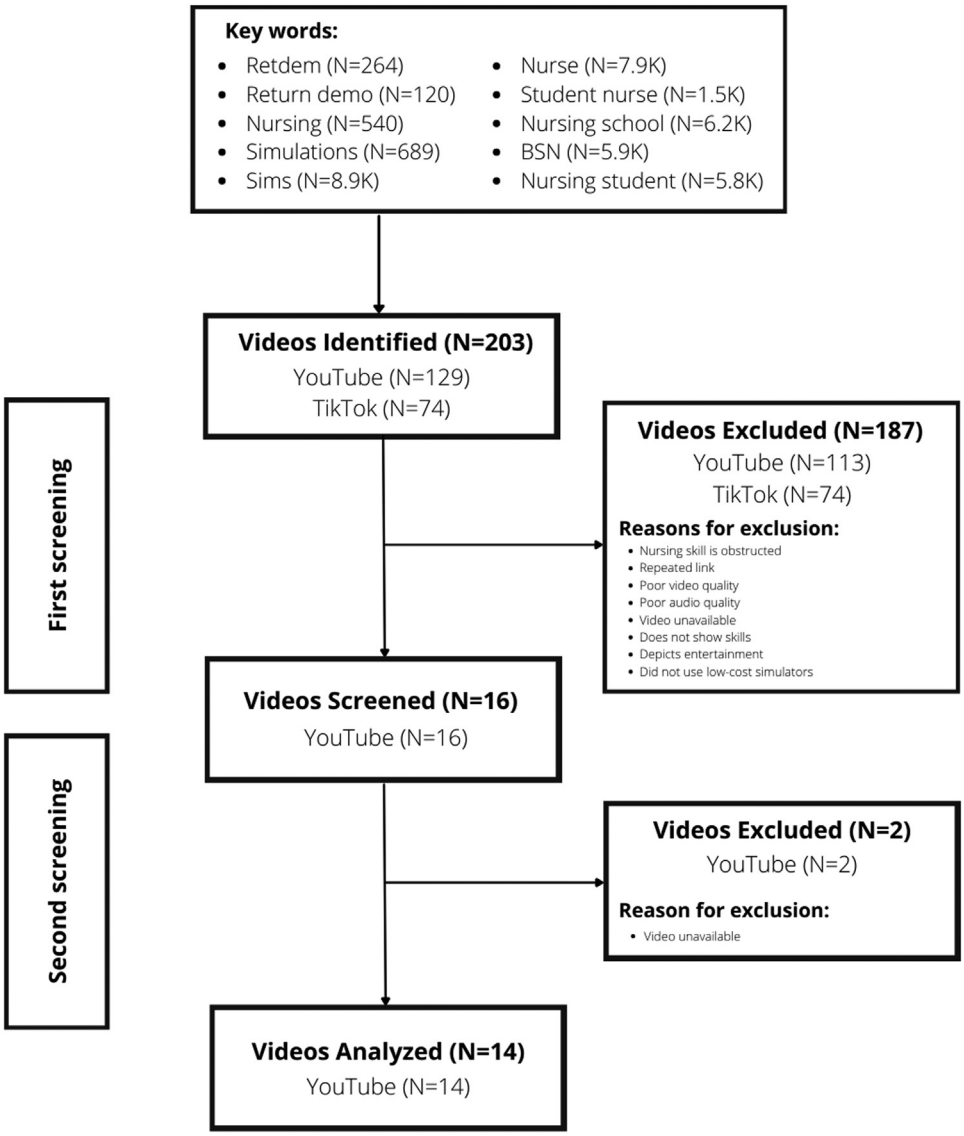

Fig. 1. Flowchart of the data collection process.

trustworthiness in qualitative content analysis. We constantly examined and analyzed the data to ensure its trustworthiness throughout the study until the final report of the findings.

We also employed bridling, horizontalization, and reflexivity to further enhance trustworthiness. Bridling is slowing down to improve understanding of the analyzed data (Dahlberg & Dahlberg, 2019). Bridling allowed the researchers to be careful, reflect on the analyzed data, and eventually reach a point of openness to new data. Horizontalization is to give equal value to each statement of the participants (Moustakas, 1994). We read and reread the transcripts in our study to place the same value on verbal and nonverbal data. Hence, we determined significant meaning units, codes, and themes. Reflexivity is acknowledging diverse roles in the research and critically reflecting on a researcher's position (Jootun & McGhee, 2006). We maintained reflexivity by establishing a hybrid position (Jootun & McGhee, 2006). We positioned ourselves in the middle of being an insider and outsider in the studied phenomenon. We used reflexive notes the entire study to write and reflect on our beliefs, experiences, biases, and presumptions. Since all researchers are nurses, experienced in simulation, and well-versed with YouTube, reflexivity promoted trustworthiness in this study.

Results

From the 14 videos examined, 34 everyday home items were identified as low-cost simulators (Table 1). Stuffed toys were the most popular low-cost simulator (71.43%), followed by clothespins (35.71%). Dolls, pillows, cloth, handkerchiefs, paper, and glass containers appeared thrice (21.43%). Wires, bottles, towels, and plastic containers were used twice in the videos (14.29%). Finally, sauce cups, basins, tables, shoebox lids, plastic bags, blankets, cardboard, zip envelopes, pens, ribbons, deodorant powders, roll-on Clindamycin, facial tissues, lip tint, tweezers, and oral suspension syringes were all used only once (7.14%). Additionally, Table 1 shows previous studies using the same materials to create low-cost simulators.

During the COVID-19 pandemic, our SCA of 14 YouTube videos demonstrating low-cost simulation materials developed by nursing students during online courses identified four themes: home and hardware, health and beauty, creative articles, and entertainment.

Home and Hardware

This low-cost simulator theme includes tools, containers, furniture, and packaging (Table 2). Nursing students used home tools in

Table 1
Distribution of low-cost simulators according to YouTube videos (n = 14) and previous studies using the same materials in creating low-cost simulators

Low-cost-simulator	Frequency	Percentage	Previous studies using the same household materials in creating low-cost simulators
Stuffed toy	10	71.43	Bishop and Stewart (2014), Phillips et al., (2012)
Clothespin	5	35.71	Liu et al. (2017)
Dolls, pillow, glass containers, cloth, handkerchief, paper	3	21.43	*Dolls*: Cox et al., 2021; Priode, 2020; *pillow*: Goldstein et al. (2018); Martins et al. (2012), Phillips et al., (2012); *glass containers*: Giraldo-Gutiérrez et al. (2018); *cloth/handkerchief*: Cohen et al. (2011); Knobel et al. (2018); Wanner et al. (2016); *paper*: Muckler et al. (2017); Talley and Watts (2020)
Wires, bottles, towels, plastic containers	2	14.29	*Wires*: Hoopes et al. (2020), Schneider 2017; *bottles*: Giraldo-Gutiérrez et al. (2018); *towels*: Knobel et al. (2018), Knobel et al. (2018), Targino et al. (2021), Wagner et al. (2009), Wanner et al. (2016),Cohen et al. (2011), Wanner et al. (2016), Handeland et al. (2021); *plastic containers*: Chao et al. (2013)
Balloons, mousepads,* pliers, straw strings,* Mighty Bond,* sauce cups,* basins, tables,* shoebox lids, plastic bags, blankets, cardboard, zip envelopes, pens, ribbons, deodorant powders,* roll on Clindamycin,* facial tissues,* lip tint,* tweezers, and oral suspension syringes*	1	7.14	*Balloons*: Nicka and Swanson-Biearman (2019), Wang et al. (2010); *pliers*: Bunting et al. (2015), Cruff (2021); *basins*: Talley and Watts (2020); *shoebox*: Li and George (2017); *plastic bags*: Belliveau et al. (2019), Shaikhrezai et al. (2015); *blankets*: da Silva et al. (2021); *cardboard*: Clariot et al. (2020), Muckler et al. (2017); *zip envelopes*: Talley and Watts (2020); *pens*: Aho et al. (2015), Almeida et al. (2021); *ribbons*: Cohen et al. (2011); *tweezers*: Drake and Adams (2015); Rojo et al. (2021).

* To our knowledge, no previous study on this household item as a low-cost simulator.

their return demonstration of nursing skills, which they uploaded to YouTube. Long-nose pliers were used as forceps in the video demonstration of perineal care. On the other hand, clothespins were used five times to demonstrate the following skills: cord care (e.g., cord clamping and cutting), bathing the baby, and Essential Intrapartum Newborn Care (EINC). During the EINC video demonstration, wires and straw string were used twice as an umbilical cord, and Mighty Bond, a brand of superglue, was used as an eye ointment.

In their video-recorded return demonstrations, nursing students used containers as low-cost simulators. In two videos demonstrating EINC, plastic containers and glass jars were used with cotton ball canisters. Meanwhile, a nasogastric tube (NGT) insertion video shows a glass bowl used as a collection container. Small amber bottles were used as vials for BCG and hepatitis B vaccines. A plastic bottle serves as the rectum for administering an enema. The perineal care video showed a micellar bottle as an irrigating solution. Finally, sauce cups were used in cup-feeding an infant.

In most households, furniture supports human activities such as sleeping or seating. In a newborn assessment video, a nursing student used a basin as a weighing scale. Nursing students used pillows in a variety of ways. In fundal height measurement, pillows were used as an abdomen. In another video, a pillow dressed as a pregnant mother was used to demonstrate Leopold's maneuver. Finally, a video depicting enema administration used two pillows as buttocks. Meanwhile, a cloth-covered table was used as a bassinet to demonstrate cord care.

Shoes are protected by packaging such as shoebox lids, commonly made of cartons or corrugated cardboard. The students in the enema administration video used it as a bedpan or commode. On the other hand, a plastic bag was used as a urine bag to demonstrate a catheterization procedure.

Health and Beauty

Health and beauty theme includes toiletries and medical supplies (Table 3). In a cup-feeding demonstration, deodorant was used as a milk canister. Clindamycin gel was utilized as antibiotic eye ointments in EINC. In the perineal care video, facial tissues were used as a perineal pad. Tweezers were employed as catheterization forceps. Furthermore, lip tint was used as a Hepatitis B vial for EINC, despite its primary function and usage.

In their simulated return demonstrations, nursing students also used medical supplies. An oral suspension syringe was one of the medical supplies used. During EINC, the videos used an oral suspension syringe four times. This syringe demonstrated Vitamin K, BCG vaccine, Oxytocin, and Hepatitis B injections.

Creative Articles

Nursing students used a variety of fabrics, stationery, and clothing accessories in their YouTube simulated return demonstrations (Table 4). Blankets were a popular fabric for enema administration, bathing, and making beds. Clothes were also used for bathing the baby and as a bedpan and waterproof pad in perineal care. Handkerchiefs were employed in three different simulations, including the newborn assessment, EINC, and arm splinting. Finally, towels were used to simulate a placenta during EINC and a vagina during perineal care.

Students also made use of art supplies and stationery. During catheterization, papers were used as waterproof pads, a fenestrated drape, and a printed image of the vagina. Papers also served as sterile packaging for perineal care. Students used a regular pen to simulate NGT insertion, which required a penlight. During the cup feeding simulation, clipboards were utilized as a patient chart. Finally, ribbons were used as umbilical cords and cardboards as splints.

Entertainment

The entertainment theme included toys and computer accessories. These low-cost simulators were designed primarily for entertainment and recreation (Table 5). Nursing students used a variety of toys as low-cost simulators. During simulation, these toys portrayed mothers and newborns. Toys such as a baby doll, a balloon, and a monkey stuffed toy were used to simulate cord care (e.g., cord clamping and cutting), cup feeding, bathing the baby, and EINC. Nursing students used Dora™, Piglet™, and a Teddy Bear™ toys to simulate a mother during cup feeding, fundic height measurement, Leopold's maneuver, and EINC. During perineal care, a Minnie Mouse stuffed toy was used to simulate a female patient. Another YouTube video used a Teddy Bear as a patient to demonstrate NGT and enema skills.

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Table 2
Home and hardware low-cost simulators

Verbal and non-verbal transcription	Condensed meaning unit	Code	Category	Theme
Assemble all the equipment. So we will just assume that this is the irrigating solution and assume that this is the forceps [grabs the longnose pliers then puts it down], the cherry balls, the waterproof pad, the bed pad or bedpan, and the sterile perineal pad. (V1)	Longnose pliers as forceps for perineal care	Pliers	Tools	Home and hardware
Clamp the cord two finger breaths from the infant's abdominal skin and base of the cord with the use of a cord clamp [takes a clothespin from the kidney basin and clamps the wire]. (V11)	Clothespin as umbilical cord clamp for cord clamping and cutting	Clothespin		
Then we're going to cut the cord with sterile surgical scissors [right-hand picks up scissors and cuts the black wire]. (V13)	Black cord as an umbilical cord for immediate newborn care	Wires		
We want to milk the cord and we're going to clamp the cord 5 cm above the base now [grabs the straw string and uses index finger and thumb to pinch the straw string away from the stuffed toy]. (V4)	Straw string as an umbilical cord for EINC	Straw string		
After successfully breastfeeding the baby, we will now apply eye ointment on the baby's eye [right hand grabs the Mighty Bond and lightly presses it on the stuffed toy's eye] (V4)	Mighty bond as an eye ointment for EINC	Mighty Bond™		
So after that, we are now going to disinfect again the cord by pouring or by using a cotton ball [uses forceps to get a cotton ball from the plastic container]. (V13)	Plastic container as cotton ball canister for immediate newborn care	Plastic containers	Containers	
So we're just gonna use that to spread the labia right there, and we're just gonna get the forceps then pick a cotton ball [picks up tweezers and gets a cotton ball from the glass jar]. (V9)	Glass jar as cotton ball canister for catheterization.	Glass container		
Okay, so gently [inserts the tip of enema inside the plastic bottle] and circular motion.. there you go. (V10)	Plastic bottle as rectum for enema administration	Plastic bottle		
Do not force the milk on the baby [places the medicine cup against the mouth of the stuffed toy], just let them sip on the milk. . . okay. (V3)	Sauce cup as medicine cup for cup feeding	Sauce cup		
Now we're going to weigh the baby, assuming that this is a baby scale [places the stuffed toy on the basin]. (V2)	Basin as weighing scale for newborn assessment	Basin	Furniture	
Okay, Mrs. Curry, I am going to do the Leopold's maneuver and this procedure will allow me to place my hands on your stomach to figure out the position of the baby [talking to a pillow in a dress]. (V12)	Pillow with a dress as a mother for Leopold's maneuver	Pillow		
The next thing to do is to gently lift the buttocks of our patient and to locate the rectal area [left hand is holding one of two pillows]. (V10)	Two pillows as buttocks for enema administration			
Place the baby on the bassinet and observe [balloon is placed on the table with white cloth]. (V8)	Table with a white cloth as a bassinet for cord care	Table		
We need our bedpan or commode [shows the camera a shoebox lid and puts it back down]. (V10)	Shoebox lid as bedpan/commode for enema administration	Shoebox lid	Packaging	
So, we're just going to tape that in the inner thigh and place the collection bag just below the hip at the bed frame, not the bed rails because bedrails tend to move [right hand grabs the plastic bag with a small hook]. (V9)	Plastic bag with a small hook as urine bag for catheterization	Plastic bag		

Statements inside square brackets indicate the non-verbal transcription; V = YouTube video where the low-cost simulator was used (e.g., V1 means YouTube video number 1).

Table 3
Health and beauty products low-cost simulators

Verbal and non-verbal transcription	Condensed meaning unit	Code	Category	Theme
So, we're going to check first the name of the baby on the canister - the milk canister, if it is correct - Alex Cruz, we're going to pour it into our sterile paper cup [tilts the deodorant powder towards the sauce cup]. (V3)	Deodorant powder as milk canister for cup feeding	Deodorant powder	Toiletries	Health and beauty products
Assemble all the equipment. So, we will just assume that this is the irrigating solution and assume that this is the forceps, the cherry balls, the waterproof pad, the bed pad or bedpan, and the sterile perineal pad [shows the camera two pieces of facial tissues inside a zip envelope]. (V1)	Facial tissue as a perineal pad for perineal care	Facial tissue		
Eye ointment, vitamin K, hepatitis B [left hand lightly touches the liptint], and BCG vaccine, cotton balls, and micropore tape. (V4)	Lip tint as Hepatitis B vial for EINC	Lip tint		
So, we're just gonna use that to spread the labia right there and we're just gonna get the forceps [picks up tweezers] then pick a cotton ball. (V9)	Tweezers as forceps for catheterization	Tweezers		
So now I'm going to start the immediate newborn care by Crede's prophylaxis [picks up Clindamycin roll on]. (V13)	Clindamycin as an eye ointment for immediate newborn care	Roll-on Clindamycin	Medical supplies	
So now we will inject our patient with the oxytocin, we are going to give it intramuscularly [holds an oral suspension syringe].	Oral suspension syringe as oxytocin syringe for EINC	Oral suspension syringe		

Statements inside square brackets indicate the non-verbal transcription; V = YouTube video where the low-cost simulator was used (e.g., V1 means YouTube video number 1).

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Table 4
Creative articles low-cost simulators

Verbal and non-verbal transcription	Condensed meaning unit	Code	Category	Theme
We may remove the top sheet of our patient [removes blanket underneath the new blanket on top of the stuffed you]. (V10)	Blanket as top sheet for enema administration	Blanket	Fabrics	Creative Articles
Next is unwrap - unwrap the baby and gently remove her diaper [removes the cloth on the baby doll's genitalia]. (V14)	Cloth as a diaper for bathing the baby	Cloth		
The equipment needed are a cardboard splint and a triangular cloth [shows handkerchief]. (V7)	Handkerchiefs as triangular cloth for arm splinting	Handkerchief		
So now we're going to inspect the mother's uhm... placenta after delivery [grabs the small brown towel]. (V4)	Small brown towel as placenta for EINC	Towel		
The fenestrated drape, exposing only the female genitalia [takes bond paper with a hole and sets it on top of the printed picture of female genitalia]. (V9)	Bond paper with a hole as a fenestrated drape for catheterization	Paper	Stationery	
The equipment needed is a cardboard splint [shows cut out and taped cardboard] and a triangular cloth. (V7)	Cardboard as a splint for arm splinting	Cardboard		
So, now we are going to document the procedure and the baby's tolerance and reaction into the baby's chart [holds the clipboard]. (V3)	Clipboard as patient's chart for cup feeding	Clipboard		
We can use a penlight [picks up penlight and shows it to the camera] to check if there's any obstruction inside the patient's nose. (V6)	Pen as penlight for NGT Insertion	Pen		
Observe the cord for pulsation [graphs the ribbon]. (V8)	Ribbon as an umbilical cord for cord care	Ribbon		

Statements inside square brackets indicate the non-verbal transcription; V = YouTube video where the low-cost simulator was used (e.g., V1 means YouTube video number 1).

Discussion

The purpose of this study was to examine nursing students' use of low-cost materials to aid their learning during the COVID-19 pandemic, as depicted in YouTube videos. The four themes identified in this SCA were home and hardware, health and beauty, creative articles, and entertainment. In the analyzed videos, nursing students used their creativity, resourcefulness, and innovation to perform various nursing skill demonstrations utilizing household materials.

Our study revealed that home and hardware products (e.g., tools, containers, furniture, packaging) were common low-cost simulators used by nursing students in online return demonstrations. Tools (e.g., pliers, clothespins, wires, straw string) are instruments or simple equipment that can be held in one's hands and used to perform specific tasks. Similarly, these household tools have been documented in several studies as essential in creating low-cost simulators for medical students (Bunting et al., 2015; Cruff, 2021; Hoopes et al., 2020; Schneider 2017). Pliers were reported as substitute forceps for manipulating surgical skills for a novel peritonsillar abscess simulator (Bunting et al., 2015) and a low-fidelity simulator for laparoscopic simulation at home (Cruff, 2015).

Our findings reported that nursing students used wires and straw strings as an umbilical cord and clothespins as an umbilical cord clamp for their return demonstrations. Hoopes et al. (2020) discovered that garden wires and zip ties effectively build vaginal, laparoscopic, and abdominal hysterectomy simulators. Schneider (2017) used bendable wires to make a hand-built tube thoracotomy simulation box, whereas clothespins were also used as aneurysm clips in a cerebral aneurysm simulator (Liu et al., 2017).

The analyzed YouTube videos showed that nursing students used various containers (e.g., plastic and glass bottles, sauce cups, basins) in their simulations. Our findings showed that nursing students used a plastic bottle as a rectum to simulate the skill of enema administration. On the other hand, a micellar bottle was used as an irrigating solution for performing perineal care. Furthermore, nursing students used glass and plastic containers as cotton ball canisters for EINC and immediate newborn care, amber and perfume bottles as vaccine vials, and glass bowls as collection containers for NGT insertion. These findings parallel the study of Chao et al. (2013). They used plastic containers to create low-cost and reusable phantom models to simulate vein anatomy. Glass containers and bottles were also used to build a simulation model for practicing dantrolene reconstitution

Table 5
Entertainment low-cost simulators

Verbal and non-verbal transcription	Condensed meaning unit	Code	Category	Theme
So good morning, Miss Smith. So, for today, we will do perineal care [facing the stuffed toy (patient) as she talks]. (V4)	Minnie mouse™ as a patient for perineal care	Stuffed toy	Toys	Entertainment
Before we start any procedure, we as a student nurse, should introduce ourselves to the patient [hand gesturing; looks down to the stuffed toy (Teddy bear; mother) and baby doll (baby)] and explain to her about the procedure and encourage her for cooperation [hand gesturing]. (V14)	Teddy bear™ as a mother for bathing the baby			
Place the baby on the bassinet and observe [places balloon (baby) on a table with white cloth (bassinet)]. (V8)	Balloon as a baby for cord care	Balloon		
Clean your baby's face from less contaminated area to the most contaminated area [wipes the baby doll's (baby) face with both hands with one cotton ball each at hand]. (V14)	Baby doll as a baby for bathing the baby	Baby doll		
The materials that we need for enema procedure are the following. We need our bath blanket. We need our rubber pad or the bed protector [shows mouse pad to camera]. (V10)	Mousepad as rubber pad/bed protector for enema administration	Mouse pad	Computer accessory	

Statements inside square brackets indicate the non-verbal transcription; V = YouTube video where the low-cost simulator was used (e.g., V1 means YouTube video number 1).

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(Giraldo-Gutiérrez et al., 2018). Plastic bottles were used in making homemade models for practicing interventional skills such as pediatric central venous access and tracheostomy care (Sagalowsky et al., 2016) and a manikin for practicing chest compressions for cardiopulmonary resuscitation (National Health Care Provider Solutions, 2021). Additionally, nursing students in our study used a basin to replicate a weighing scale for demonstrating newborn assessment. In contrast, medical students used basins as part of the thoracentesis simulation setup (Talley & Watts, 2020).

Across all analyzed videos, nursing students utilized pillows as patients (e.g., fundal height measurement, Leopold's maneuver, enema administration, nurse-patient interaction). In practicing chest compressions (Goldstein et al., 2018) and intramuscular injection techniques (Martins et al., 2012), pillows are effective simulators. They concluded that using a pillow can be comparable to practicing on a high-resource manikin. Students utilized shoebox lids as bedpan or bedside commodes in their nursing return demonstration of enema administration. Li and George (2017) reported that shoeboxes were used in creating low-cost simulators for laparoscopic home trainers and alternative pelvis. Nursing students used plastic bags as urine bags to demonstrate a catheterization procedure. In comparison, medical students used plastic bags (e.g., press and seal sandwich bags, storage bags) were used for the aortic root replacement simulator (Shaikhrezai et al., 2015) and pericardiocentesis model (Belliveau et al., 2019).

Health and beauty low-cost simulators involved toiletries and medical supplies. Our study found that most household toiletries and medical supplies were used by nursing students in medication administration skills demonstrations. Campbell and Daley (2018) stated that medication administration skills could be done with any available household materials during simulation scenarios. Utilizing household materials enhance psychomotor skill and competency to administer medications safely. Nursing students employed tweezers as a substitute for forceps in urinary catheterization. Plastic tweezers were used in collecting glass and paint chips in forensic nursing science (Drake & Adams, 2015) and minor surgery suturing simulations (Rojo et al., 2021).

Moreover, a lip tint is used as a makeshift Hepatitis B vial for EINC, contrary to its primary function as a cosmetic product. In recent years, moulage became standard equipment in nursing skills simulation. Moulage is a collection of techniques incorporating wax, latex, makeup, and artificial fluids to simulate injury, disease, aging, and other physical changes (Smith-Stoner, 2011). Similarly, significant moulage components were also found among beauty products. Using moulage in simulations enhances fidelity and realism in healthcare education (Stokes-Parish et al., 2020). Even though the studies mentioned makeup products for their actual function, nursing students in the analyzed videos did not. The thought of using makeup products in simulations is not unprecedented.

Nursing students used a medical supply like the oral suspension syringe in their simulated return demonstrations in the videos. It was used as a syringe for Vitamin K, BCG vaccine, Oxytocin, and a Hepatitis B vaccine administration during EINC. Choi et al. (2020) found that using medical equipment or supplies may be costly. However, current times provided greater accessibility, considering them part of low-cost simulations. Moreover, using actual equipment with the same function allows the students to gain experience working with these devices. It provides realism and enhances relevance for the learner (Albagawi et al., 2021).

Fabrics, clothing accessories, and art materials were identified as low-cost simulators under creative articles. Our findings showed that student nurses used towels to simulate a placenta and vagina in the EINC and perineal care simulations. Results also showed that student nurses used handkerchiefs as diapers, dry linen, and triangular cloth in various simulations. These findings were corroborated by Knobel et al. (2018) and Wanner et al. (2016). They used towels and other fabrics such as T-shirts to build their low-cost CPR simulator (Wanner et al., 2016). Cotton clothes were employed to simulate the internal anal sphincter, creating a low-cost simulator for teaching surgical techniques to repair obstetric anal sphincter injuries (Knobel et al., 2018). Furthermore, the cloth was used as a diaper, bedpan, and waterproof pad in the videos analyzed. A study by Cohen et al. (2011) depicts cloth such as a pair of pants and cotton fabrics to create a high-fidelity, low-tech birth simulator. Thus, fabrics are versatile items easily sourced and readily found in student nurses' households.

Nursing students displayed stationeries (e.g., paper, cardboard, clipboard, pens, ribbons) as their low-cost simulators. Corollary, Muckler (2017) reported using various stationeries such as pencil grippers, tape, balloons, and cardboard tubes to create low-cost simulators. Students used these versatile materials in demonstrating skills like bathing a baby, cord care, and NGT insertion. A clipboard was used as a patient's chart. Although documenting in a chart is one of the hallmarks of nursing practice, only one video used a clipboard this way. It gives the audience an idea that they will require a patient's chart for a simulation. When an actual patient chart is unavailable, a clipboard is a suitable replacement that is more readily available.

Among the videos reviewed, students used cardboard as a splint in simulating arm splinting. Cardboard, Styrofoam, and pencils were part of creating low-cost simulation models for tracheal intubation (Clariot et al., 2020) and cricothyroidotomy skills (Aho et al., 2015; Almeida et al., 2021). During a cord care simulation, one video depicted a nursing student using a ribbon as an umbilical cord. Cohen et al. (2011) also used ribbons, a pair of pants, and a cotton cloth to make their low-tech birth simulator.

Toys and computer accessories were found as low-cost simulators in this study. Most of the toys used were stuffed toys (e.g., Dora™, Piglet™, Teddy Bear™, Minnie Mouse™) in different forms that served as simulators for performing other nursing skills such as perineal care, EINC, and fundic height measurements. Most of the videos analyzed revealed that nursing students primarily employed stuffed toys to conduct nursing skills that required patient simulators. Bishop and Stewart (2014) used stuffed toys during a pediatric clinical case simulation, whereas Philips et al. (2012) identified these toys as household hazards in a simulated environmental hazards scenario.

Alongside stuffed toys, balloons (Nicka & Swanson-Biearman, 2019; Wang et al., 2010) and dolls were also used as patient simulators. Correspondingly, Targino et al. (2021) used a customized, low-cost infant doll as a simulator for infant cardiopulmonary resuscitation for nursing students for their basic life support course. Also, nursing students use baby dolls to practice maternal and infant care skills (Wagner et al., 2009). Handeland et al. (2021) explored the effectiveness of low-fidelity manikins such as dolls. They concluded that the efficacy of the manikin depended on the student nurse's ability to perceive the manikin as a patient and their role as the nurse. Both high-fidelity and low-fidelity simulation equipment can accomplish desired learning outcomes, depending on how students interact with their materials (Bland et al., 2014). These low-cost simulators increase the sense of realism, and nursing students can experience performing basic clinical skills (Angelina et al., 2021).

Limitations

While our study presented promising findings, we identified several limitations. First, the analyzed video provided data limited to what the nursing students showed. This approach does not allow researchers to probe deeper into the studied phenomenon, thus necessitating the traditional face-to-face interview with participants. Second, the YouTube videos analyzed were specific to Filipino nursing students. The results may be similar or not to those of other

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international nursing students. Third, our study only focused on low-cost household materials used in simulated nursing demonstrations. We did not analyze if nursing students used these materials correctly, if they became competent with the procedures, or if they acquired unintended learning. Fourth, the study's inclusion criteria restricted the analysis of other low-quality videos. These excluded videos might contain information-rich data that will enhance the rigor and validity of the results. Finally, we conducted the data collection within a time frame. Thus, our findings did not represent YouTube videos uploaded before the COVID-19 pandemic and after the data collection period.

Recommendations

Future researchers could conduct similar studies using nursing students' uploaded videos to other social media platforms (e.g., TikTok, Instagram, and Twitter) to confirm whether the materials used in their low-cost simulators are similar. More research is needed to determine whether nursing students acquired the desired skills, knowledge, and attitude when using low-cost simulators. Furthermore, unintended learning brought about by using low-cost simulators could be of research interest. To cross-culturally compare their low-cost simulators, we recommend including videos of nursing students from outside the Philippines.

Conclusion

Our findings show that household materials can be used as low-cost simulators to support nursing students' learning during the COVID-19 pandemic. This study highlighted nursing students' creativity and resourcefulness in creating low-cost simulators despite quarantine restrictions and online learning. In our SCA of nursing students' YouTube videos, four themes of low-cost simulators were identified: home and hardware, health and beauty, creative articles, and entertainment. These materials include tools, containers, kitchen materials, packaging, toiletries, medical supplies, art materials, fabrics, clothing accessories, toys, and computer accessories. Nursing students could use these common household materials other than their intended purposes. Using readily available materials as low-cost simulators may increase the effectiveness of skills training and allow nursing students who do not have access to expensive simulators to practice clinical procedures safely.

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Ethics Approval Number

University of Santo Tomas College of Nursing Ethics Review Committee (Reference number: USTCON ERC – 2021-SR32; approved: September 21, 2021).

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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