

# Video-based tools to enhance nurses' geriatric knowledge

*a development and pilot study*

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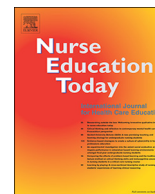


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## Video-based tools to enhance nurses' geriatric knowledge: A development and pilot study



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(English translated)

### ABSTRACT

**Background:** The need for health care professionals with geriatric knowledge is expected to increase due to aging of society. Educational tools that fit the specific learning styles of nurses and nursing students might be useful for this. Serioussoap.nl (available in Dutch and English) is an educational tool that integrates video-based gaming and storytelling, and it might be an effective way to improve the geriatric knowledge of nurses or nursing students.

**Objectives:** To investigate the effect of Serioussoap.nl on the geriatric knowledge of nurses and nursing students, and to evaluate its usability.

**Design:** We conducted a development and an explorative pilot study, using a pretest posttest quantitative design to investigate the effect of Serioussoap.nl on geriatric knowledge. A qualitative approach was used to evaluate its usability.

**Participants and setting:** Three vocational nursing schools ( $n = 119$  second/third year students), one baccalaureate nursing university ( $n = 77$  first year vocational nurses) and one home-care organization ( $n = 44$  vocational nurses) in the Netherlands participated in the quantitative study, and 94 vocational students participated in the qualitative study.

**Methods:** We measured the effect on geriatric knowledge with the Knowledge of Older People Questionnaire (KOP-Q, score 0–30). The qualitative study included observations of 94 participants while they played Serioussoap.nl, four semi-structured focus groups and eleven individual interviews.

**Results:** The study demonstrated a significant increase of geriatric knowledge of 7.8% (+2.3 score on the KOP-Q, 95% Confidence Interval (1.4–3.2,  $p < 0.001$ ). The qualitative data showed that Serioussoap.nl contributed to the reflective learning-style and enhanced meaningful learning.

**Conclusion:** Serioussoap.nl increased the students' geriatric knowledge and was perceived as a suitable and effective educational tool for vocational nursing students and nurses.

### 1. Introduction

The need for health care professionals with geriatric knowledge is expected to increase, due to aging of society and increasing healthcare needs (World Health Organization, 2016; Bähler et al., 2015). However, research has indicated that both nursing students and nurses demonstrate insufficient geriatric knowledge (Dikken et al., 2018; Deschodt et al., 2010; Hamers, 2011). In addition, the National Guidelines for Nurses' Re-Registration contains no obligatory post-graduate studies (CIBG, 2019). New evidence regarding up-to date geriatric care topics,

such as screening and self-management interventions can therefore be missed by experienced nurses. Dikken et al. (2018) confirmed this omission and showed that not only nursing students but also > 50% of the graduated nurses scored between “unsatisfactory” and “extremely poor” on geriatric knowledge.

Strijbos (2011), identified the failing Dutch geriatric educational system as a main cause for this deficiency. The author highlighted inadequate geriatric teaching materials and geriatric topics that are too integrated into other subjects to be effectively recognized. A study by Snoeren (2007) exposed the relationship between geriatric knowledge

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and learning styles. Conventional education is often presented through theoretical guidelines, and Snoeren illuminated its inadequacy, given geriatric nurses' preference for practical learning.

An alternative for conventional education is video-based educational tools that combine three main characteristics: a non-linear structure, a great number of symbol systems and interactivity (Schwan and Riempp, 2004). Several studies indicate that video-based tools add value for clinical reasoning for nurses. It provides an opportunity to practice decision-making skills in a realistic and safe environment where there is no risk of harm to patients. Kaczmarczyk et al., 2016; Johnsen et al., 2018a; Johnsen et al., 2018b; Habes et al., 2011). However, most of these studies are focused on the acute care setting rather than chronic elderly care. In addition, none explored the effect of the tools on nurses' knowledge.

The Amsterdam University Medical Center initiated the development of Serioussoap.nl in 2015. The developers aimed to integrate new evidence-based guidelines regarding geriatric care into an appealing interactive educational tool, and to investigate its effect on geriatric knowledge. This tool combined interactive videos, gamification, storytelling, and the participation of Dutch celebrities. An English translation of Serioussoap.nl can be found on [www.Serioussoap.nl/eng](http://www.Serioussoap.nl/eng) and it is freely available.

The aim of this study was to investigate (1) the effect of Serioussoap.nl on the geriatric knowledge of nursing students and home-care nurses, and (2) the usability of Serioussoap.nl.

## 2. Methods

### 2.1. Design

We conducted an explorative pilot study, in which we combined a pretest posttest quantitative design, which was used to investigate the effect of Serioussoap.nl on geriatric knowledge, with a qualitative approach, which was used to evaluate its usability.

### 2.2. Participants and setting

For the quantitative study, we recruited students who were working in a nursing home at the time of the study or were aiming to do so, including second/third year vocational nursing students from three vocational nursing education centers in the Netherlands, (ROCs Midden Nederland, Flevoland and Amersfoort) and graduated vocational nurses who joined a first-year bachelor dual work/educational program (Hogeschool Utrecht). Moreover, graduated vocational nurses who worked in care for older persons (Zorggroep Almere) participated.

We included both nursing students and graduated vocational nurses, as we perceived similarities in the low levels of geriatric knowledge (Dikken et al., 2018). Furthermore, we expected them all to have experience in care for older persons, since the nursing students had completed an internship in a nursing home.

Respondents were eligible, if they had finished the obligatory education in geriatric care. Exclusion criteria were age < 18, and nurses with a baccalaureate's degree in nursing. Playing Serioussoap.nl and completing a survey (Kop-Q) demands cognitive concentration, which may deter participants from completing the survey twice or may create a carry-over effect as boredom and fatigue (Price, 2000). To avoid this carry-over effect and to enhance compliance, we assigned participants, after obtaining informed consent, into three different groups on a voluntary basis. The *paired group* completed the Kop-Q twice, once before (*T0 paired group*) and once after (*T1 paired group*) playing Serioussoap.nl. The *unpaired group* completed the Kop-Q once, either before playing (*T0 unpaired group*) or after playing (*T1 unpaired group*) (Fig. 1).

For the qualitative study, we used a convenience sample. We recruited second/ third year nursing students from the three vocational nursing schools whose students also participated in the quantitative

study. Nursing students were eligible, after they had taken geriatric classes on subjects covered by Serioussoap.nl.

### 2.3. Developmental process

Serioussoap.nl was developed in 2015. At first, we conducted a literature study and prioritized three subjects that had shown evidence based value for the geriatric nursing profession: comprehensive geriatric assessment (CGA) (NVKG, 2014), pain management (Vereno, 2011), and self-management (Dwarswaard et al., 2015). We formulated learning outcomes and critical scenarios, which were based on real life situations. An advisory board was formed comprising 9 nursing students, 5 vocational nurses, 2 experts on CGA, pain, and self-management, and 8 teachers. During a feedback session, the advisory board prioritized the learning outcomes and discussed the suitability of the critical scenarios. The students provided advice about the actors that should be approached for the film clips. We integrated a feedback loop into the storyline, in order to confront the users with the consequences of their choices. A film crew with two young, famous Dutch soap opera actors was engaged. In a second feedback session, the advisory board commented on the film clips and multiple-choice questions. Finally, we integrated the film clips and questions in an information technology tool, *Articulate* (version storyline 1 (New York, USA). We added a tutorial, PowerPoint presentations and a library as a reference for users.

### 2.4. Method of measurement

For the quantitative study, the survey collected participants' background characteristics on age, gender, educational background, and working experience in geriatric care. We added two questions to investigate their learning style and preferred education. The answer options to the first question (*'What is your preferred learning style?'*) were based on Kolb's (1984) theory: experimenting, doing, reflecting, and thinking. The validity of this question was guaranteed by the Kolb learning-style test that nursing students had completed in their first year of education. The second question (*'Would you like this type of education in the future?'*) was assessed with a 5-point Likert scale.

The effectiveness of Serioussoap.nl on geriatric knowledge was assessed with the Knowledge about Older Patients Questionnaire (KOP-Q). This 30-item instrument is a valid tool to investigate the geriatric knowledge of nurses and students (Scale-Content Validity Index = 0.91, Kappa = 0.70) (Dikken et al., 2016). According to Dikken, a KOP-Q score of 19 is normal for first-year baccalaureate students and a score of 23 is the reference for final-year baccalaureate students.

For the qualitative study, we generated a topic list based on the literature, and classified the concept of usability into the following topics: *attractiveness, perceptions, resemblance daily practice, technical user-friendliness, and value for geriatric knowledge*. The topic list was validated by two experts (VH, AB). This list was the basis for an observation scheme for participant observation, and for an interview guide for the focus group and individual interviews (Fig. 2). The observation scheme's purpose was to reduce observation bias and selective perceptions.

Next, with this observation scheme, three final-year baccalaureate nursing students, who completed an observation and interview training before starting, observed the students who were playing Serioussoap.nl in class. Interobserver reliability was assured by having paired observations of the student classes. In addition, they conducted focus group interviews, and interviewed some of the students and a lecturer separately, on a voluntary basis. The participants' observations were documented in writing, and the interviews were audiotaped and transcribed verbatim.

### 2.5. Sample size

Based on a total population of 17.800 nursing students who were

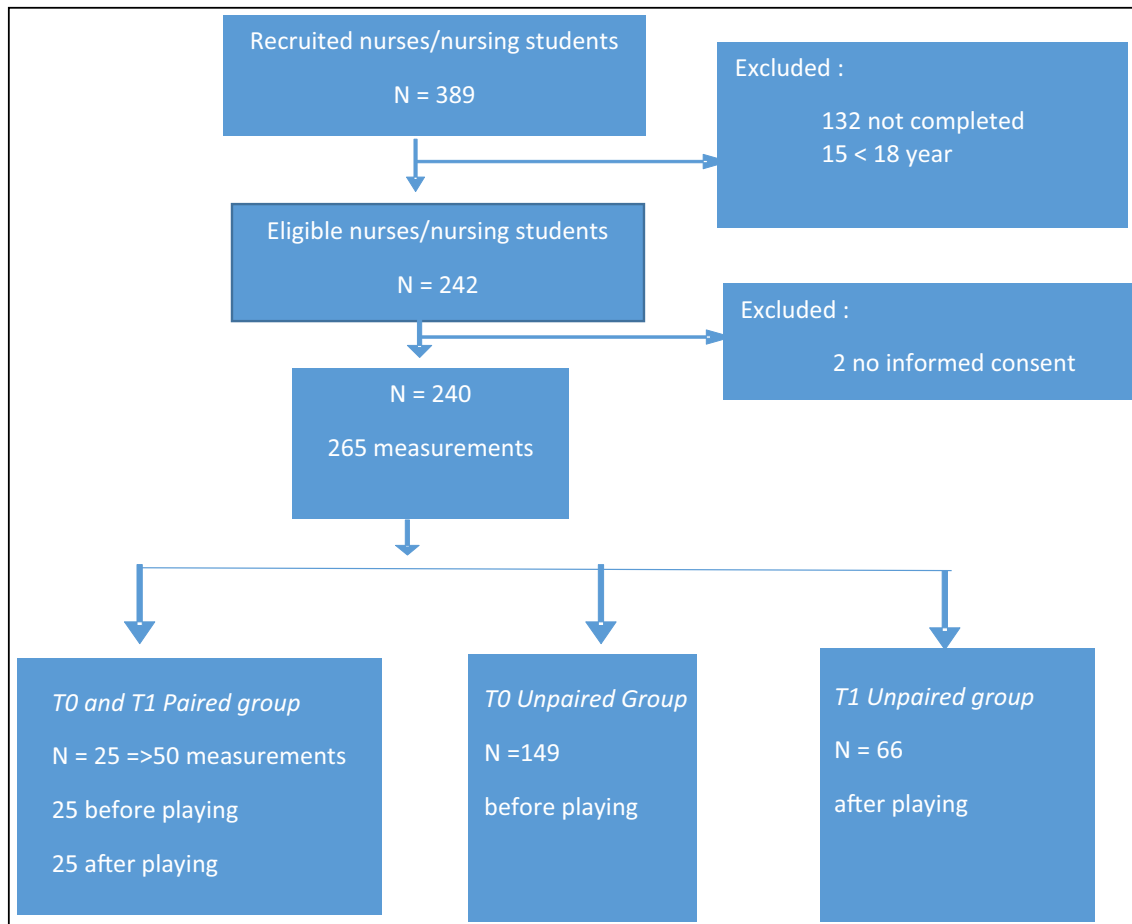


Fig. 1. Flow chart demonstrating the study population for the quantitative study.

enrolled in all Dutch nursing schools in 2009–2010 (Lambregts and Grotendorst, 2012), with a margin error of 5% and a confidence level of 95%, we calculated a total sample size of 377 participants. As the included study population did not meet this sample size, we conducted a post-hoc power analysis, using the G\*power calculator 3.1.9.2. (Dusseldorf, Germany). For the unpaired group, this analysis showed sufficient power of 99% and for the unpaired group the power was 97%. For the qualitative study, the sample size was determined by data saturation.

2.6. Data analysis

We used descriptive statistics to summarize the data. To compare the baseline characteristics of the T0 and T1 groups, the Chi-square was used for the categorical variables, and the t-test for continuous

variables. We conducted a confounder analysis with Spearman's rho for the categorical variables, and Pearson's r for the continuous variables. To compare the Kop-Q results, the independent t-test for unpaired groups, and the t-test for paired groups, were used. In addition, the ANCOVA test was used to correct for confounders. Finally, Spearman rho was used to examine the relation between geriatric knowledge, learning style, and preference of education. Data were analyzed with IBM SPSS statistics 24.0 (SPSS Inc., Chicago, USA).

Qualitative data were analyzed by constant comparative methods. To guarantee validity, triangulation (participant observation, focus group, and individual interviews), audit trails and peer debriefing were used. The trained interviewers analyzed the results independently, which yielded two main themes regarding Serioussoap.nl's usability: value for geriatric knowledge and attractiveness. The concept of suitability to learning style evolved as a third theme during the course of the study.

Observation scheme for participant observation, while participants played Serioussoap.nl in school.	Interview guide for focus groups and individual interviews
Characteristics: Class level and date, Lecturer, Class size, First-time usage, Module, Introduction of Serioussoap	Characteristics: Class level and date
Attractiveness	Attractiveness
Geriatric knowledge	Geriatric knowledge
Perceptions	Resemblance to daily practice
Technical user-friendliness	Technical user-friendliness
Social factors (ambience, noise, time pressure)	Information Technology conditions at school
	Preference of education in future

Fig. 2. Topic list usability.

As we had integrated the concept of learning style as a baseline characteristic into the quantitative study, we decided to analyze the data for a second time with two researchers (VH, AB). For this analysis, we used QSR International's NVivo 12 qualitative data analysis software (NVivo, 2014). We categorized the transcribed data in four categories, which conformed to Kolb's four learning styles (1984): *doing, thinking, reflecting and experimenting*. Finally, each category was coded into positive and negative perception labels. Consensus was met by discussion.

### 3. Results

#### 3.1. Baseline characteristics

We approached 389 people for the quantitative study, of which 240 participants (62%) enrolled. Participants were excluded either because they were younger than 18 ( $n = 15$ , all nursing students), or because they had not completed the survey ( $n = 132$ , all vocational nurses). The *paired group* that completed the survey twice had 25 participants. The *unpaired group* had 215 participants, of which 149 participants completed the survey before playing Serioussoap.nl (*T0*), and the remaining 66 participants did so after playing (*T1*). The study population's baseline characteristics are shown in Table 1.

The baseline characteristics of the *T0* and *T1* group were comparable with regard to gender and working experience. The average age and educational background of the groups differed. The *T0* group included more younger participants ( $p < .01$ ), more second/third year vocational students and more graduated vocational nurses ( $p < .01$ ), whereas the *T1* group included more vocational nurses who were involved in a first year baccalaureate program.

Five groups with an average of 19 students (94 total) participated in the qualitative study and were observed. They were all second/third year nursing students, from three different vocational nursing schools. There were four focus groups with five students participating in each group. In addition, ten students and one lecturer were interviewed individually.

#### 3.2. Quantitative results

##### 3.2.1. Geriatric knowledge

Playing Serioussoap.nl improved the *paired group's* geriatric knowledge by 4.6% (KOP-Q score + 1.4, Confidential Interval 95% 0.7–2.1,

**Table 1**  
Baseline characteristics of the quantitative study's participants.

Study population, N = 240 (265 measurements)		Paired group	Unpaired T0 group	Unpaired T1 group
N		25	149	66
Age (sd)	Years	24.1 (1.5)	25.8 (10.2)	31.8 (12.5)*
Gender (%)	Female	25 (100.0)	138 (92.6)	62 (93.9)
Educational background (%)	2nd/3rd yr Vocational degree student	25 (100.0)	76 (51.0)	18 (27.3) **
	Home-care nurse & vocational degree	0	34 (22.8)	10 (15.1)
	1st yr Bachelor student & vocational degree	0	39 (26.2)	38 (57.6)
Working experience (%)	With elderly	24 (96.0)	134 (89.9)	63 (95.5)
Preferred learning style (%)	Reflecting	13 (5.4)		
	Thinking	50 (20.8)		
	Experimenting	10 (4.2)		
	Doing	94 (39.2)		
	I don't know	43 (17.9)		
	Combination	30 (12.5)		
		<b>T0 = 174</b>	<b>T1 = 91<sup>c</sup></b>	
Would you like this type of education, in the future? (%)	Certainly, or preferably not	44 (25.3)	21 (23.1) **	
	Indifferent	78 (44.8)	18 (19.8)	
	Certainly, or preferably yes	52 (29.9)	52 (57.1)	

\*  $p < .01$ , t-test T0 - T1.

\*\*  $p < .01$  Chi-square test T0 - T1.

<sup>c</sup> T0; T1: paired and unpaired group.

**Table 2**  
Knowledge Older People Questionnaire score (0–30 score).

	Mean score (sd)	T0	T1	Score CI 95%
Paired group N = 25	20.0 (3.5)	19.2	20.6	+ 1.4 (0.7–2.1) = 4.6%*
Unpaired group N = 215 T0 = 149; T1 = 66	21.8 (3.6)	21.1	23.3	+ 2.3 (1.4–3.2) = 7.8%**

\*  $p = .002$ , t-test for paired groups.

\*\*  $p < .001$ , ANCOVA test for unpaired groups, adjusted for age and educational background.

$p = .002$ ). As for the *unpaired group*, the *T1* group improved by 7.8% more than the *T0* group (KOP-Q score + 2.3, CI 95% 1.4–3.2  $p < .001$ , Cohens  $d$  0.36), after correcting for age and educational background (Table 2). The subjects where the participants showed the most improvements were related to delirium (questions 3 and 8), and fall risk prevention (questions 10 and 29, KOP-Q (Dikken, 2017, pp. 66–67).

The question “would you like this type of education, in the future?” generated 27.2% more positive answers (*certainly or preferably yes*) in the *T1* group, compared to the *T0* group. A significant relationship was found between playing Serioussoap.nl and preference for this type of education ( $Rho$  0.26,  $p < .01$ ). No significant relationship was found between learning style and geriatric knowledge ( $p = .66$ ).

#### 3.3. Qualitative results

##### 3.3.1. Usability

The analysis of the qualitative results regarding Serioussoap.nl's usability, yielded three main themes: a) value for geriatric knowledge, b) attractiveness and c) suitability to learning style.

##### a) Value for geriatric knowledge

The qualitative data yielded mainly positive perceptions regarding the added value of Serioussoap.nl for geriatric knowledge. While playing Serioussoap.nl, nursing students discovered new nursing concepts like screening instruments, negative effects of pain medication, non-pharmacological treatment of pain, and motivational interviewing techniques. The most striking gain in geriatric knowledge came from



## 68 REFERENCES REGARDING LEARNING STYLES, N = 95

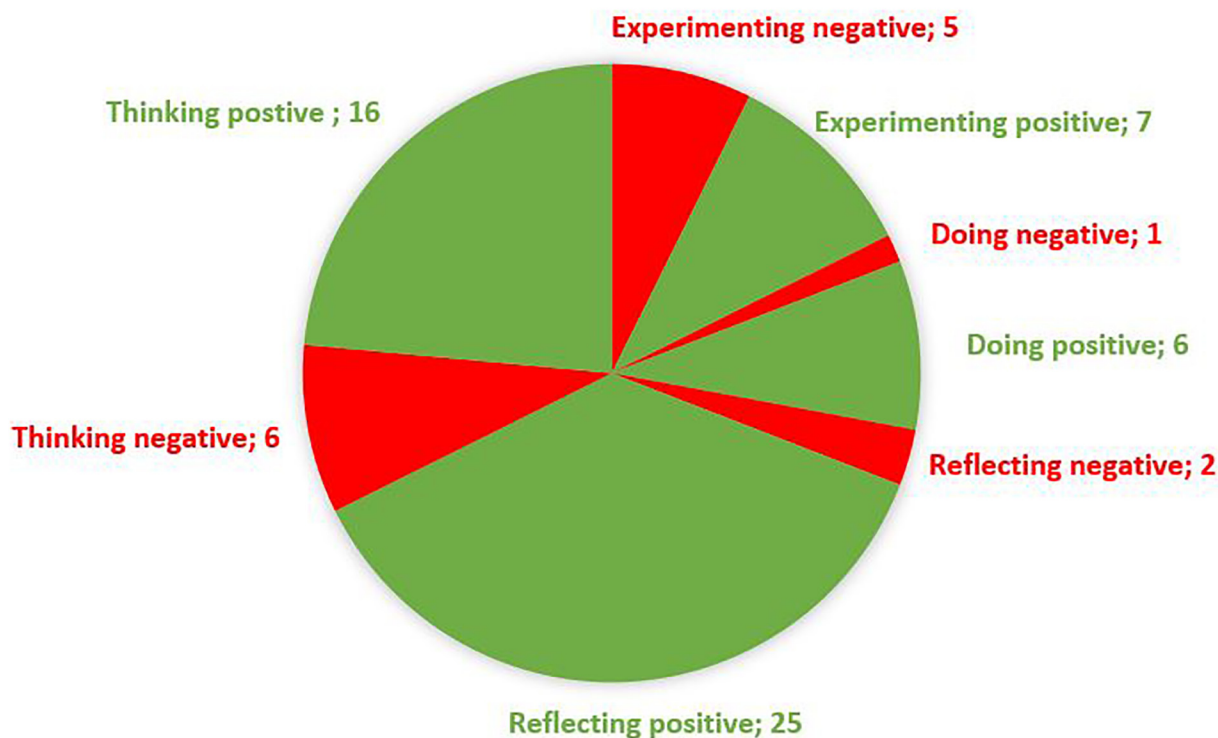


Fig. 3. Positive and negative references of the qualitative data.

the narrative portion of *Serioussoap.nl*. The story served as a feedback loop, which revealed the comprehensive meaning of the nurses' actions in the long term. The following quotations are taken verbatim from the participants' responses:

Of course, I know what the nurses' tasks are, but now you see them very clearly, like okay, when she arrives at that man's house for the wound care, she also had to take care of his mobility, so you see what she actually does to get him moving. And you see the consequences of the hospital care in the home care setting, and the way she motivates her patients, yes, I really learned a lot of that.  
(Student, female, third year)

I learned what self-management is ... it is much more than just for the patient, it is also about the family, so it is more about the whole connection.  
(Student, third year)

In addition, by receiving instant feedback on the questions and conclusions of each module, students were confronted with the consequences of their choices, which deepened their geriatric knowledge.

The last episode of the film confronts the student with the actual consequences of their own lack of knowledge ... I believe that moment is very important for their learning process, as they feel that they can really make a difference.  
(Lecturer, vocational nursing school)

### b) Attractiveness

*Serioussoap.nl* was mainly perceived to be attractive, due to the variation of interactive elements such as videos, questions, feedback, and the built-in library. During participant observation, it was observed that the tool evoked a variety of emotional reactions, like identification with the nurse, laughter, agreement, and disagreement from the students. *Serioussoap.nl*'s attractiveness was regularly confirmed by the

interviews:

It's creative ... normally we get information or we have to make an assignment, but this offers much more perspectives than our books or explanation of the lecturer...  
(Student, third year)

Especially the man was really funny, it makes it more interesting to watch ... and with well-known actors, the one of..., 'So you think you can Dance'.  
(Student, second year)

Students were enthusiastic about the realistic and humorous quality of acting by well-known actors, which made *Serioussoap.nl* informative and interesting to watch. Furthermore, they often recognized situations from their internships and working experiences.

It was really similar to daily practice, I recognized a lot of situations... It brings up an 'Ah-yes' feeling.  
(Student, third year)

Although the students perceived *Serioussoap.nl* as a welcome variation on traditional education, they valued the tutor's explanation of new subjects and the tutor's input to the discussion. The combination of video-based and tutor-based learning was perceived as optimal.

The length (approximately 15 min per module) was regarded as "precisely good". The most obvious negative remarks concerned moments where the students met obstacles to progression, such as vagueness in the digital manual, slow performance, and information technology errors. When errors occurred, it was unclear whether they were due to *Serioussoap.nl*'s software, the school's technology infrastructure, or glitches in the students' computers. Most errors were observed when the students were using tablets.

### c) Suitability to learning style

The data indicated that there were 68 references (remarks or observations) to the concept of *learning style*, of which 14 were negative and 54 were positive. Most of the positive references concerned the “*reflecting*” learning style (25 references) and “*thinking*” learning style (17 references) (Fig. 3).

Regarding the “*doing*” learning style, it was observed that students appreciated the interactive elements. They were quite alert and captivated while playing Serioussoap.nl. Despite a noisy environment, students remained concentrated on the game. The interactive elements supported the attention span of learners. This observation was confirmed by the following interviews excerpts:

Usually we are not very eeh ... she (the lecturer) was very surprised we were so quiet. This means we were really involved.  
(Student, second year)

I cannot concentrate very well on reading, but when I watch this I stay concentrated.. it gripes me ... it proves you can also learn from video and not only from books.  
(Student, second year)

Regarding the “*reflective*” learning style, students appreciated the challenging questions and instant feedback that supported discussion and reflection. During participant observation, it was observed that students were most focused on the behavior of the nurse, as they expressed several approving and disapproving remarks regarding the nurse's actions and communication skills. These remarks created reflective discussions among the students.

One episode is about an elderly man and what could go wrong ... there were a lot of things I had not flagged. It showed me to be more attentive to these things... and regarding the actions of the nurse, it makes me wonder: what would I do in this situation?  
(Student, third year)

You can learn from colleagues for sure, but it's also nice to learn from people who are actually engaged in exactly the same things you are and if you see such a real-life situation in one of those videos you can all share what you see and experienced...  
(Student, third year)

Regarding the “*thinking*” learning style, most students valued Serioussoap.nl's questions as clear and relevant. A few students found Serioussoap.nl's vocabulary to be difficult. However, most of them appreciated the explanation of new concepts by the built-in library and the provision of instant feedback.

I liked the explanation, so why is a response incorrect... I didn't know what nociceptive (pain, n.v.d.r.) was... because of the feedback I now know it, even though my answer was incorrect.  
(Student, third year)

Regarding the “*experimental*” learning style, it was observed that some students showed feelings of frustration when they had to independently explore how Serioussoap.nl worked. They disliked the moments of uncertainty that occurred while exploring, and preferred the tutor's explanations. None of the students consulted the manual independently. However, when they encountered uncertainties regarding the questions, students regularly explored the in-built library, to improve their intermediate scoring so as to move to the next level.

#### 4. Discussion

In this study, we found that playing Serioussoap.nl had a significant positive effect on geriatric knowledge. The quantitative data demonstrated a preference for “*doing*” as a learning style among the participants. Serioussoap.nl fits this learning style as it has several interactive elements. In addition, the qualitative data revealed that nursing students appreciated the elements that fit their “*reflecting*” and “*thinking*” learning styles, such as storytelling, the similarities with daily practice,

the feedback loop, and the built-in library. Further, they appreciated the use of humor, high quality of acting, and the participation of famous actors. Their recommendations for improvement concerned technical aspects and speed.

The 7.3% (2.2 KOP-Q score) gain in geriatric knowledge that occurred after Serioussoap.nl was played is more effective than conventional education, in which a general increase of 1.3 KOP-Q score/year is observed (Dikken et al., 2016). This suggests that participants gained almost two years of geriatric education by playing Serioussoap.nl. An explanation for this positive effect might be that interactive video may support learning through the process of experiencing failure in a safe environment (Maltese et al., 2018). In this respect, Serioussoap.nl's integrated feedback loop might accelerate the learning process, which was the participants' opinion. Furthermore, the study by Geri et al. (2017) shows that interactive videos may increase the attention span of students, which we observed as well.

A second explanation for Serioussoap.nl's contribution to learning can be found in the study by Snoeren and Bekker van Doorn (2007). Snoeren points at the tendency of geriatric nurses to avoid the “*thinking*” and “*reflection*” learning style, in favour of the “*doing*” learning style. She explains that this avoidance severely negates the learning process and recommends that educators of geriatric nurses support the “*thinking*” and “*reflection*” learning styles. Our study confirmed “*doing*” as the most preferred learning style. However, our results showed no significant relationship between this learning style and geriatric knowledge. The qualitative data demonstrated an appreciation for elements that stimulate less preferred learning styles, such as “*reflecting*” and “*thinking*”. The elements of Serioussoap.nl that enhanced *reflecting* and *thinking* were storytelling, the feedback loop, recognizable critical scenarios, and the built-in library. Hence, instead of avoiding less-preferred learning styles, nursing students were enabled to face them, which seemed to strengthen their learning process.

A final explanation derives from the High-Impact Learning that Lasts (HILL) theory (Douchy and Segers, 2018). This theory describes seven elements that enhance learning, and Serioussoap.nl incorporates nearly all of these. The story-telling part of the video enhances *feelings of urgency* (1); the freely accessible platform facilitates *learning agency* (2) and a combination of *formal and informal learning* (4). The integration of video, pop-up questions and library stimulate *interactivity* (5). Furthermore, the integration can be considered as *hybrid learning* (6) and serves *assessment-as-learning* (7). In this respect, Serioussoap.nl can be perceived as a high-impact learning tool.

##### 4.1. Strengths and limitations

Some methodological limitations need to be mentioned. The design of this study is inductive and explorative as we did not randomize groups, nor did we use blinding for any group. Therefore, we cannot derive strong conclusions from our findings. Moreover, although paired group measurements are perceived as a strong design feature due to the absence of selection bias (Price, 2000), the size of the *paired group* in this study was small, possibly because the participants could choose whether or not to join the group. The smaller effect in increased knowledge from the *paired group* (4.6%), compared with the *unpaired group* (7.3%), may have been caused by a carry-over effect as boredom and fatigue.

A second limitation concerns the *unpaired groups*, as these groups differed in age and educational background, which may have caused selection bias. However, after correction for this bias by the ANCOVA test, the positive effect on geriatric knowledge stayed significant.

Further, the interviews and observations were performed by final-year bachelor nursing students, which may have influenced the quality of this study. They were trained and guided by a qualitative expert in order to enhance their research skills.

There are also strong aspects to mention. The reliability of the quantitative data, was guaranteed by the similar results in the

measurements of the *unpaired* and *paired groups*. The reliability of the qualitative data was reinforced by paired observation, the use of a topic list, observation schema, and data analysis by three independent researchers. In addition, the validity of the qualitative study was guaranteed by triangulation, audit trail, and verbatim transcription of the audiotapes.

Despite the limitations, our study provides a good foundation for further studies and implementation of Serioussoap.nl in educational nursing curricula and the geriatric nursing field.

## 5. Conclusion

To summarize, the results of this study supports the perspective that Serioussoap.nl can serve as an effective educational tool to enhance geriatric knowledge. The usability of serioussoap.nl is perceived as mainly positive, due to the variety of attractive learning elements, which both fits the preferred learning style (*doing*) and facilitates the less-preferred learning styles (*reflecting* and *thinking*) of nurses and nursing students. In this respect, Serioussoap.nl may offer a meaningful learning environment. Serioussoap.nl is translated in English and it is free, so educators and geriatric nurses can use it for their educational goals.

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## Ethical consideration

The Dutch Ethical Board for Medical Education (NVMO) approved the study (NVRB number 594). All participants provided informed consent.

## Declaration of competing interest

There is no conflict of interest.

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